Phonology **22** (2005) 1–36. © 2005 Cambridge University Press
doi:10.1017/S0952675705000424 Printed in the United Kingdom

*Mid vowel fronting in Ukrainian**

Jerzy Rubach
University of Iowa and University of Warsaw

This article investigates the process of *o*-fronting in Ukrainian and claims that it should be analysed as an effect of PAL-*e*, a constraint mandating that the consonant and the vowel agree in backness. The operation of PAL-*e* is opaque, due to the interaction with a depalatalisation process applying before [ɛ]. The analysis establishes four points of theoretical interest. First, from a typological perspective, PAL-*e* parallels PAL-*i*, postulated by Rubach (2000a) for Russian, which strengthens the contention that PAL constraints should be stated as agreement constraints that bring under the same denominator the palatalisation of consonants and the fronting of vowels. Second, the opacity of *o*-fronting cannot be analysed by appealing to MAX[F] constraints. Third, sympathy theory cannot handle the data either. Fourth, Optimality Theory must be modified to admit derivational levels.

Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1995) decouples structural change from structural description in the statement of phonological generalisations. Thus, if XY is not a well-formed output representation, Optimality Theory (henceforth OT) posits a markedness constraint that makes XY illicit. Since this constraint (*XY) refers to the output and says nothing about the input, the illicit structure XY may occur in the input representation, due, for example, to morpheme concatenation: X+Y. If *XY is ranked sufficiently high, the prediction is that XY must be modified in the optimal output; however, the *XY constraint does not itself specify what structural change needs to be made. The selection of the optimal output is a matter of how *XY interacts with other constraints in the grammar. The decoupling of structural change from structural description opens the possibility of stating generalisations in novel ways. One area where this new way of thinking has had an effect is palatalisation.

* I would like to thank the three reviewers, an associate editor and the editors of *Phonology* for their discussion and criticism, which have led to considerable improvement of both the content and the presentation of my analysis. I am also very grateful to my Ukrainian consultants: Oleg Alexeyev, Viktoria Alexeyev, Valentyna Arkhelynk, Michal Bilynsky, Maria Demchuk, Olha Drozdiak, Natalia Habor, Oleksandra Harmatij, Olha Harmatij, Iryna Havrykh, Olha Horbova, Vanda Ilyeva, Evheniya Kozlovska, Borys Potiatynyk, Uliana Potiatynyk, Kataryna Rashkvich, Vira Sheptak, Olha Verbovecka and Olha Vivchar. However, let me add that the responsibility for this article is solely mine.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

In his study of Russian, Rubach (2000a) posits the following palatalisation constraint.

(1) PAL-*i*
A consonant and a following high vowel must agree in backness.

PAL-*i* is violated by the faithful mapping of two inputs: /C'+ɨ/,[1] because the consonant is palatalised (i.e. [−back]) and the vowel is back, and /C+i/, because the consonant is velarised (i.e. [+back]) and the vowel is front.[2] Since PAL-*i* is a high-ranked constraint in Russian, it compels two surface effects, given such inputs:

(2) a. *Vowel Fronting*
/C'+ɨ/ → [C'i]
b. *Consonant Palatalisation*
/C+i/ → [C'i]

The effects in (2) are derived through the interaction of three constraints: undominated PAL-*i*, which compels the changes, and the two faithfulness constraints stated in (3), with IDENT[−back] being ranked above IDENT [+back].

(3) a. IDENT[−back]
[−back] on an input segment (a consonant or a vowel) must be preserved as [−back] on that segment in the output.
b. IDENT[+back]
[+back] on an input segment (a consonant or a vowel) must be preserved as [+back] on that segment in the output.

The interaction of PAL-*i* and these two IDENT constraints is illustrated below: I first address Vowel Fronting, and then Consonant Palatalisation.

The violation of PAL-*i* in the input /C'+ɨ/ (traditionally the structural description) is eliminated in the output by fronting /ɨ/ to [i] (traditionally the structural change), as in *los*+*i*,[3] the nominative plural of *los*' /lɔs'/, where the underlying /lɔs'+ɨ/ surfaces as [lɔs'i].[4]

[1] I use double slashes for underlying representation, single slashes for intermediate stages and square brackets for surface representations.

[2] Russian consonants are either palatalised or velarised, i.e. there are no neutral or 'plain' consonants. Palatalised consonants are called 'soft' and velarised consonants 'hard' in the Slavic tradition. I will adopt this convention in the discussion of the data.

[3] The transliteration convention for Slavic is to write *si*, rather than *s'i*, for [s'i], because palatalisation is recoverable from the use of *i*. For convenience, I will transcribe all the instances where palatalisation is not obvious from the transliterated spelling.

[4] The occurrence of [i] in the plural is limited distributionally to soft stems. Elsewhere, we see [ɨ], for instance, *nos*+*y* [nɔsɨ] 'noses'. Since [ɨ] does not cause palatalisation, the standard analysis is that the plural [ɨ] derives from an underlying /ɨ/, i.e. the underlying representation and the surface representation are identical in *nos*+*y* and the like. The surface variant [i] occurring after soft stems is then analysed

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

(4)

‖C'+ɨ‖	PAL-*i*	IDENT[−bk]	IDENT[+bk]
☞ a. C'i			*
b. C'ɨ	*!		
c. Cɨ		*!	

Russian consonants are either palatalised, i.e. [−back], or velarised, i.e. [+back].[5] Consequently, when morpheme concatenation produces ‖C+i‖, the faithful output violates PAL-*i* because the consonant is [+back] and the vowel is [−back]. The violation of PAL-*i* is eliminated in the optimal output by palatalising the consonant: ‖C+i‖→[C'+i], as in *nos+ik*, the diminutive of *nos* 'nose', where the underlying representation ‖nɔs+ik‖ surfaces as [nɔs'ik] in the output form.

(5)

‖C+i‖	PAL-*i*	IDENT[−bk]	IDENT[+bk]
☞ a. C'i			*
b. Ci	*!		
c. Cɨ		*!	

The evaluations in (4) and (5) show that two different but nevertheless related processes (Rubach 2000a), Fronting in (4) and Palatalisation in (5), conspire to eliminate the violation of PAL-*i*: the inputs ‖C'+ɨ‖ and ‖C+i‖ are both realised as [C'+i], in which the consonant and the vowel agree in backness, thereby satisfying PAL-*i*. OT makes perfect sense of such conspiracies, precisely because it decouples structural description from structural change.

Rubach (2000a) does not discuss palatalisation caused by mid vowels. A question which arises is whether PAL-*i* should be paralleled by PAL-*e*.

(6) PAL-*e*

A consonant and a following mid vowel must agree in backness.

If PAL-*e* is a valid generalisation, then, by analogy to PAL-*i*, we would expect it to capture the conspiracy of ‖C'ɔ‖ changing into [C'ɛ] and ‖Cɛ‖ changing into [C'ɛ], with the optimal output satisfying PAL-*e* by bringing the consonant and the mid vowel into agreement in backness.[6] This expectation is borne out in Ukrainian, although the actual picture is more complex than that shown for Russian in (4) and (5).

This article has two goals. First, I test the prediction made by PAL-*e* that it can compel Fronting, ‖ɔ‖→[ɛ] after palatalised consonants, and Palatalisation, ‖C‖→[C'] before [ɛ]. If this is true, then Ukrainian exhibits a conspiracy that parallels that found in Russian for PAL-*i*. Second,

as an instance of fronting after an underlyingly palatalised consonant of the soft stem: *ɨ*→*i*/ C' __ ; see Rubach (2000a) for further discussion of this analysis.

[5] Palatalised and velarised consonants are also [+high].

[6] As noted by Chen (1973), palatalisation before [ɛ] implies palatalisation before [i]. This observation is built into OT by assuming the universal ranking PAL-*i* ≫ PAL-*e*.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

I present an instance of opacity that is particularly complex because it exhibits both a NOT SURFACE-TRUE generalisation and a NOT SURFACE-APPARENT generalisation instantiated by the same constraint: PAL-*e*. I flesh out these goals in some detail below.

With regard to the first goal, testing the conspiracy effect of PAL-*e*, notice that this constraint is satisfied by outputs that have either a soft (i.e. palatalised) consonant followed by [ɛ] or a hard (i.e. velarised) consonant followed by [ɔ]: i.e. [C'ɛ] and [Cɔ] respectively.[7] Therefore, PAL-*e* is vacuous with respect to the faithful mappings of the inputs ∥C'+ɛ∥ and ∥C+ɔ∥, where front and back vowel suffixes have been added to stems ending in soft and hard consonants respectively. Given that PAL-*e* is ranked sufficiently high, the other configurations, i.e. ∥C+ɛ∥ and ∥C'+ɔ∥, are not permitted to map faithfully, because [Cɛ] and [C'ɔ] violate PAL-*e*. The prediction then is that the grammar should resolve the absence of agreement in [back] between consonants and vowels in the following four ways:

(7) a. C+ɛ → C'ɛ palatalisation of the consonant from hard to soft
b. C'+ɔ → C'ɛ fronting of the vowel from back to front
c. C+ɛ → Cɔ retraction of the vowel from front to back
d. C'+ɔ → Cɔ depalatalisation of the consonant from soft to hard

The resolutions of the input conflicts between a hard/soft consonant and a front/back vowel mandated by PAL-*e* violate the faithfulness constraints IDENT[+back] and IDENT[−back] in (3), so the typology in (7) is derived by the ranking of these constraints *vis-à-vis* each other. PAL-*e* acts as a driver for the resolution of conflicts and is therefore ranked highest. Recall from the statement in (3) that the violations of IDENT[−back] and IDENT[+back] may occur either in the vowel or in the consonant, because both vowels and consonants can be either [−back] (front vowels and palatalised consonants) or [+back] (back vowels and velarised consonants).

(8) a. IDENT[−back] ≫ IDENT[+back]

i. *Palatalisation*

∥C+ɛ∥	PAL-*e*	IDENT[−bk]	IDENT[+bk]
☞ a. C'ɛ			*
b. Cɛ	*!		
c. Cɔ		*!	

ii. *Fronting*

∥C'+ɔ∥	PAL-*e*	IDENT[−bk]	IDENT[+bk]
☞ a. C'ɛ			*
b. C'ɔ	*!		
c. Cɔ		*!	

[7] As I explain in the following section, Ukrainian consonants are either palatalised or velarised, as in Russian.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

b. IDENT[+back] ≫ IDENT[−back]

i. *Retraction*

/C+ɛ/	PAL-*e*	IDENT[+bk]	IDENT[−bk]
a. C'ɛ		*!	
b. Cɛ	*!		
☞ c. Cɔ			*

ii. *Depalatalisation*

/C'+ɔ/	PAL-*e*	IDENT[+bk]	IDENT[−bk]
a. C'ɛ		*!	
b. C'ɔ	*!		
☞ c. Cɔ			*

Ukrainian exhibits the pattern in (8a): Palatalisation and Fronting, which means that IDENT[−back] dominates IDENT[+back]. The co-occurrence of these processes to the exclusion of those in (8b) shows that IDENT constraints must be individuated according to feature value. That is, IDENT[back] is insufficient, and must be spelled out further as IDENT[−back] and IDENT[+back].

The patterns in (8a), Palatalisation and Fronting, are obscured by the fact that Ukrainian has a process of Depalatalisation before [ɛ], which brings us to the second goal of this article: the discussion of phonological opacity.

Developing the ideas of Kiparsky (1971, 1973), McCarthy (1999) observes that opacity occurs in two basic forms: NON-SURFACE-TRUENESS and NON-SURFACE-APPARENTNESS. McCarthy explains that a generalisation is not surface-true if there are output representations that violate this generalisation. The operation of PAL-*e* in Ukrainian illustrates this case of opacity, because Velar Palatalisation (see §2), which is expected to produce changes such as /k+ɛ/→[ʧ'ɛ], where the [ʧ'] is soft, is actually instantiated as /k+ɛ/→[ʧɛ], where the [ʧ] is hard, so that [ʧɛ] violates PAL-*e*, as in *kozač*+*e* [ʧɛ], the vocative singular form of *kozak* 'Cossack'. Similarly, we see a violation of PAL-*e* in *brat*+*e* [tɛ], the vocative singular form of *brat* 'brother'.[8] The non-surface-trueness of PAL-*e* is caused by *e*-depalatalisation, a process which removes [−back] on consonants before [ɛ], so PAL-*e* is opaque.

The second form of opacity, according to McCarthy (1999), occurs when the reasons for the operation of a given process are not visible in the surface representation. This case of opacity, dubbed non-surface-apparentness, is

[8] The non-surface-trueness for /k+ɛ/→[ʧɛ] holds in the Halle–Sagey model of feature geometry (Sagey 1986, Halle 1992). In the Clements–Hume model (Clements & Hume 1995), PAL-*e* is satisfied by [ʧɛ] by the fact that both [ʧ] and [ɛ] have the feature [coronal], although [ʧ] has it under the C-Place node whereas [ɛ] has it under the V-Place node. See note 19.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

also illustrated by PAL-*e*. The process in question is Fronting (8a.ii), which, like Palatalisation (8a.i), conspires to satisfy PAL-*e*. We see it in forms such as the instrumental singular of *los'*, where the suffix *-om* is appended to the soft stem: ‖lɔs'+ɔm‖. Given Fronting as a strategy to satisfy PAL-*e* (here ‖ɔ‖→[ɛ] after a soft consonant), we expect the surface representation to be [lɔs'ɛm], but this is not what we find. Instead, the attested output is [lɔsɛm]. The fronting of ‖ɔ‖ to [ɛ] is not surface-apparent, because its trigger, soft ‖s'‖, has been depalatalised by *e*-depalatalisation.

In sum, the operation of PAL-*e* in Ukrainian, specifically the conspiracy that it induces (Palatalisation and Fronting), is both non-surface-true and non-surface-apparent. It thus combines the types of opacity that normally occur in unrelated processes.[9] For example, McCarthy (1999) discusses Arabic Raising as an instance of a non-surface-true process and Tiberian Hebrew Epenthesis as an example of a non-surface-apparent process. The operation of PAL-*e* in Ukrainian is an instance of an opaque conspiracy, a case that has not been discussed in the literature before. A further question, one which I will address below, is how such opaque conspiracies should be analysed in OT: can they be handled by sympathy theory (McCarthy 1999, 2003) or do they constitute evidence for derivational OT (Kiparsky 1997, 2000, Rubach 1997, 2000a, b, 2002 and others)?

In addition to the discussion of theoretical issues, this article addresses empirical issues in the grammar of Ukrainian. Ukrainian has been little studied from the perspective of generative phonology. Specifically, Vowel Fronting and Consonant Palatalisation before [ɛ] have not been explored in the generative literature to date.[10] The data are drawn from my fieldwork and from Ukrainian grammars, including Medushevskyj & Zyatovska (1963), Zhovtobryukh & Kulyk (1965), Bilodid (1969a, b), Buryachok *et al.* (1973), Zilyns'kyj (1979), Gryshchenko (1986), Rusanovskyj *et al.* (1986), Chukina *et al.* (1998) and Ponomareva (2001).[11]

This article is organised as follows. §1 considers consonant–mid vowel configurations with respect to which PAL-*e* is vacuous: ‖C+ɔ‖ and ‖C'+ɛ‖. Their discussion creates an opportunity to introduce some descriptive background facts of Ukrainian and to discover an *e*-depalatalisation process that turns soft consonants into hard consonants before [ɛ]. §2 looks at the hard consonant–front vowel configuration, ‖C+ɛ‖, and argues that, as opposed to *e*-depalatalisation, Palatalisation is active in Ukrainian. §3 addresses the soft consonant–back vowel configuration, ‖C'+ɔ‖, and shows that Vowel Fronting, turning ‖ɔ‖ into [ɛ], is an opaque process. It is argued that the correct analysis is one that assumes the existence of two

[9] But see Newton (1972), Kaisse (1977) and Idsardi (1998).

[10] The generative literature on this subject is limited to one work: Foster (1966). Foster briefly mentions Palatalisation before [ɛ], but not Vowel Fronting. His analysis is set in the framework of early generative phonology, preceding the seminal *Sound Pattern of English* (Chomsky & Halle 1968).

[11] I have conducted fieldwork over a period of several years primarily with speakers from Western Ukraine, in particular with speakers from Lviv and from Mykulynci, a town in the vicinity of Ternopil (see the acknowledgements above).

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

derivational levels in the grammar of Ukrainian. §4 is a summary of the most important results.

1 Vacuous configurations

The configurations that do not activate PAL-*e*, ‖C+ɔ‖ and ‖C'+ɛ‖, occur in Ukrainian because, like Russian, Ukrainian exhibits an opposition between velarised [+back] and palatalised [−back] consonants. These consonants are called 'hard' and 'soft' respectively. Since all consonants are either hard or soft, there are no neutral consonants. The opposition hard *vs.* soft is contrastive, with soft consonants appearing in contexts that do not warrant Palatalisation, i.e. before a back vowel, a word boundary or a consonant.

(9) a. *hard*

*s*ad	[s]	'garden'
ma*s*ka	[s]	'mask'
čа*s*	[s]	'time'
*z*ad	[z]	'bottom'
*t*ahan	[t]	'tripod'
*d*ar	[d]	'gift'
*c*ap	[ts]	'he-goat'
*dz*vonyty	[dz]	'ring'
*nan*os	[n]	'sediment'
*r*ad	[r]	'satisfied'
*l*uk	[l]	'bow'

b. *soft*

*s'*ahty	[s']	'reach'
bilorus*'*kyj	[s']	'Belarus (ADJ)'
lo*s'*	[s']	'moose'
*z'*at'	[z']	'son-in-law'
*t'*ahar	[t']	'burden'
*d'*a*d'*a	[d']	'uncle'
*c'*a*c'*a	[ts']	'toy'
*dz'*avkaty	[dz']	'bark'
*n'*a*n'*ka	[n']	'nanny'
*r'*ad	[r']	'row'
*l'*ut	[l']	'anger'

The 'paired', velarised–palatalised, oppositions in the class of coronals are paralleled in the class of labials: [p]–[p'], [b]–[b'], [f]–[f'], [ʋ]–[ʋ'] and [m]–[m'], e.g. *riz'b'ar* [b'] 'sculptor' *vs. baran* [b] 'ram' and *sv'ato* 'holiday' *vs. svat* 'father-in-law'.[12] Postalveolars, [ʃ ʒ ʧ ʤ], as well as velars, [k x], are not paired at the underlying level, in the sense that they do not show an opposition between [−back] and [+back]. In addition, Ukrainian has a voiced laryngeal [ɦ], transliterated as *h*, but, as I show in §2, it derives from an underlying voiced velar fricative ‖ɣ‖.

The vocalic system of Ukrainian parallels those of Polish and Russian. Relevant for our purposes is the class of mid vowels, which includes [ɛ] and [ɔ], as in *de* [dɛ] 'where' and *do* [dɔ] 'before'.[13]

[12] In Western Ukraine, but not in Eastern Ukraine, soft labials are decomposed phonetically into sequences of labials followed by *j* (Bilodid 1969a, Zilyns'kyj 1979). Note that [ʋ] is a labiodental or bilabial approximant, depending on the dialect.

[13] The other vowels are [i ɨ u a], which are transliterated as *i, y, u, a* respectively. The glide [j] is written *j*.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

Given these facts, we expect that the concatenation of a hard consonant followed by [ɔ] should occur not only inside morphemes but also across morpheme boundaries. This is indeed the case, as the following examples show.

(10) vod+a 'water'
korov+a 'cow'
brat+om 'brother (MASC INSTR SG)'
sov+a 'owl'
bab+oju 'old woman (FEM INSTR SG)'
jazyk+ov+yj 'linguistic'

The other concatenation for which PAL-*e* is vacuous, a soft consonant followed by [ɛ], does not occur in surface representations (except after geminates; see (17) below). Instead, what we find is [Cɛ] both inside morphemes (11a) and across morpheme boundaries (11b).

(11) a. *te*pl+yj [tɛ] 'warm' *sere*d [sɛrɛ] 'among'
*ne*lad [nɛ] 'disorder' *ledve* [lɛ, vɛ] 'hardly'

b. bra*t* [t] 'brother (NOM SG)' bra*t*+*e* [tɛ] (VOC SG)
bra*t*+*e*c' [tɛ] 'dear brother'
bra*t*+*e*n'k+o [tɛ] (DIM)

The absence of palatalisation in [Cɛ] contrasts with its presence in [C'i]. The occurrence of a soft consonant before *i* is exceptionless. That is, the contrast between soft and hard consonants, otherwise robust in Ukrainian, is neutralised in favour of [C'] before [i]. This neutralisation occurs both inside morphemes (12a) and across morpheme boundaries (12b).

(12) a. *di*d [d'i] 'old man' *bi*da [b'i] 'poverty'
*vi*k [v'i] 'century' *ni*by [n'i] 'as if'
*li*s [l'i] 'forest'

b.

fem nom sg		*dat sg*		
vo*d*+a	[d]	vo*d*+*i*	[d'i]	'water'
ry*b*+a	[b]	ry*b*+*i*	[b'i]	'fish'
voro*n*+a	[n]	voro*n*+*i*	[n'i]	'crow'
ško*l*+a	[l]	ško*l*+*i*	[l'i]	'school'
koro*v*+a	[v]	koro*v*+*i*	[v'i]	'cow'

Furthermore, the same morpheme may exhibit both palatalisation before [i] and the absence of palatalisation before [ɛ].

(13)

masc nom sg		*gen pl*		*voc sg*		
ly*s*	[s]	ly*s*+*iv*	[s'i]	ly*s*+*e*	[sɛ]	'fox'
zavo*d*	[d]	zavo*d*+*iv*	[d'i]	zavo*d*+*e*	[dɛ]	'factory'
ba*l*	[l]	ba*l*+*iv*	[l'i]	ba*l*+*e*	[lɛ]	'dance'

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

These data seem to indicate that Ukrainian simply does not have Palatalisation before [ɛ],[14] which would mean that PAL-*e* is inactive as a driver for Palatalisation. I argue in §2 that this is not true.

The question of whether there is Palatalisation before [ɛ] is complicated by the fact that Ukrainian has an independently motivated dissimilation process, shown in (14).

(14)

nom sg	*dat pl*		*gen pl*		
prysta*n'*	prysta*n'*+am	[n']	prysta*n*+ej	[n]	'harbour'
mi*d'*	mi*d'*+am	[d']	mi*d*+ej	[d]	'copper'
hr'a*z'*	hr'a*z'*+am	[z']	hr'a*z*+ej	[z]	'mud'
nom sg	*dat pl*		*dim*		
tes*t'*	tes*t'*+am	[t']	tes*t*+en'k+o	[t]	'father-in-law'
do*l'*+a	do*l'*+am	[l']	do*l*+en'k+a	[l]	'fate'
matu*n'*+a	matu*n'*+am	[n']	matu*n*+ečk+a	[n]	'mother'

The soft consonants in (14) come from the underlying representation, because they occur in contexts that do not warrant palatalisation: word-finally and before back vowels. The occurrence of hard consonants before [ɛ] must therefore be an effect of dissimilation.

(15) *e*-DEPALATALISATION (*e*-DEPAL)
Consonants must be hard before [ɛ].

From the formal point of view, in order to have an effect, *e*-DEPAL must dominate IDENT[−back], the constraint given in (3a). Furthermore, *e*-DEPAL conflicts with PAL-*e*, which mandates an agreement in backness between a consonant and a mid vowel. Since the surface facts demand that *e*-DEPAL win in this conflict, *e*-DEPAL must outrank PAL-*e*. In (16) we look at the evaluation of *prystan+ej* 'harbour (GEN PL)', restricting our attention to the relevant portion of the word.

(16)

‖n'+ɛj‖	*e*-DEPAL	PAL-*e*	IDENT[−bk]
☞ a. nɛj		*	*
b. n'ɛj	*!		

e-DEPAL is surface-true, except for geminates, which retain softness before [ɛ].[15]

[14] Indeed, such a claim has been made in the literature; see Bilodid (1969a), de Bray (1980), Rusanovskyj *et al*. (1986) and others.

[15] Geminates come from two sources: in some words geminates are underlying and in others they are derived. The instances where geminates are derived are collective or abstract nouns that are created through a morphological process adding the suffix *j*. The *j* is found on the surface in stems that end in [r], because [r] cannot geminate, for instance *nevirja* 'faithlessness', whose structure is *nevir+j+a*. Other stems lose the *j* and geminate the consonant (see Bilodid 1969a, Bethin 1998). The geminates that do not come from the underlying representation are derived at level 1, where Palatalisation is active (see below). *e*-depalatalisation is a level 2 process, so all geminates, regardless of whether they are underlying or derived, are present as

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

(17)	l'l'+u	'I pour'	*l'l'*+*e*š	[l'l'ɛ]	'you pour'
	žyt't'+a	'life'	ž*y*t*'t'*+*e*v+yj	[t't'ɛ]	(ADJ)
	vzut't'+a	'shoes'	vzu*t't'*+*e*v+yj	[t't'ɛ]	(ADJ)
	movlen'n'+a	'speech'	movle*n'n'*+*e*v+yj	[n'n'ɛ]	'linguistic'

The generalisation in (17) is captured by an IDENT constraint.

(18) IDENT-GEM[−back]
[−back] on an input geminate must be preserved as [−back] on that geminate in the output.

IDENT-GEM[−back] must outrank *e*-DEPAL, as documented for *l'l'*+*eš* 'you pour' in (19).

(19)

‖l'l'+ɛʃ‖	IDENT-GEM[−bk]	*e*-DEPAL	PAL-*e*	IDENT[−bk]
☞ a. l'l'ɛʃ		*		
b. llɛʃ	*!		*	*

Given that, with the exception of geminates, consonants are hard before [ɛ], we face the following question. Is it true, as claimed in the literature (see note 14), that PAL-*e* is inactive in Ukrainian, or is it instead the case that PAL-*e* is active, but its effects are erased by *e*-DEPAL?

The discussion in the sections §§2 and 3 shows that PAL-*e* is active in Ukrainian. There are two sources of evidence for this contention, and in fact the two relevant phenomena parallel the two responses to PAL-*i* described for Russian in (4) and (5). First, velars are realised as postalveolars before [ɛ], a palatalisation effect caused by PAL-*e*. Second, ‖ɔ‖ is realised as [ɛ] after an underlyingly palatalised consonant. In §3, this is shown to be analogous to the fronting phenomenon observed for high vowels in Russian, although the Ukrainian case is more complex, because underlying soft consonants generally surface as hard consonants, satisfying *e*-DEPAL.

2 Consonant–front vowel configuration: palatalisation

This section deals with the consonant–front vowel configuration: ‖C+ɛ‖. The goal is to establish that PAL-*e* is active in Ukrainian in its function as a driver for palatalisation.

The difficulty with discovering the effects of Palatalisation is that Ukrainian has *e*-DEPAL, which removes [−back] on consonants that occur before [ɛ]. Consequently, for inputs such as *brat*+*e* ‖brat+ɛ‖, the vocative singular of *brat* ‖brat‖, there is no way to tell whether Palatalisation attempts to apply but is blocked by *e*-DEPAL (*e*-DEPAL ≫ PAL-*e* ≫ IDENT[+back]) or whether it is simply inactive because markedness is dominated by faithfulness (IDENT[+back] ≫ PAL-*e*, where *e*-DEPAL plays

inputs to level 2. Therefore the IDENT-GEM[−back] constraint protecting geminates against *e*-DEPAL works exactly as desired, and we obtain the correct surface forms.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

no role in blocking Palatalisation). Suppose, however, that as a result of Palatalisation some consonants were to change their place of articulation. Then, the prediction is that these consonants should retain a trace of Palatalisation by keeping the newly acquired place of articulation. This prediction is a consequence of the fact that *e*-DEPAL merely mandates that the consonant be hard before [ɛ], but says nothing about the place of articulation. Fortunately, Ukrainian offers evidence to test this prediction. The case in point is the palatalisation of velars.

Velars change into non-anterior stridents in exactly the contexts where words such as *brat+e* fail to provide evidence for Palatalisation.

(20) a.

nom sg	*voc sg*		
koza*k*	koza*č+e*	[ʧɛ]	'Cossack'
dru*h*	dru*ž+e*	[ʒɛ]	'friend'
l'a*x*	l'a*š+e*	[ʃɛ]	'Pole'

b.

nom sg	*dim*		
ri*k*+a	ri*č+e*n'k+a	[ʧɛ]	'river'
plu*h*	plu*ž+e*n'k+o	[ʒɛ]	'plough'
sva*x*+a	sva*š+e*n'k+a	[ʃɛ]	'matchmaker'
had'u*k*+a	had'u*č+e*n'+a	[ʧɛ]	'viper'
inf	*past part*		
pe*k*+ty	pe*č+e*n+yj	[ʧɛ]	'bake'
stry*h*+ty	stry*ž+e*n+yj	[ʒɛ]	'shear'

The alternations between [k] and [ʧ] and between [x] and [ʃ] are clear, and follow from the pattern attested elsewhere in the Slavic languages (for example, in Polish; see Rubach 1984), but a comment is in order about the status of *h*.

Phonetically, *h* in words such as *had* 'reptile', *hnom* 'dwarf' and *noh+a* 'leg' is a voiced laryngeal [ɦ]. Therefore [ɦ] is assumed to be a phoneme in descriptive grammars of Ukrainian (for example, Bilodid 1969a, Shevelov 1979, Rusanovskyj *et al.* 1986 and others). The inspection of contexts indicates that [ɦ] is limited to onsets. My fieldwork shows that [ɦ] is replaced by a velar fricative [ɣ] when it occurs in the coda. Thus, *druh+a* 'friend (GEN SG)' has [ɦ], while *druh* (NOM SG) has [ɣ]. In a similar vein, dialects that permit devoicing show an alternation between [ɦ] and [x], as in *nihot'* [ɦ] 'nail' ~ *niht'+a* [x] (GEN SG) and *leh+en'k+o* [ɦ] 'very lightly' ~ *leh+k+o* [x] 'lightly'. These observations, coupled with the fact that we find [ʒ] for *h* in the contexts in which [k x] alternate with [ʧ ʃ], lead to the conclusion that Ukrainian has an underlying ‖ɣ‖ that is realised as [ɦ] in the onset and as a velar fricative in the coda. In sum, the class of alternations in (20) is typical for Velar Palatalisation, which is a classic process of Slavic (see Rubach 1984). Schematically:

(21) *Velar Palatalisation*

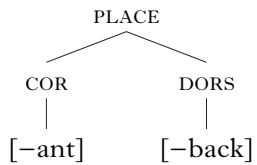
k ɣ x → ʧ ʒ ʃ before front vowels

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

Velar Palatalisation is sensitive to the derived environment condition (Kiparsky 1973), in the sense that it operates across morpheme boundaries but not inside morphemes (roots),[16] where velars may be followed by [ɛ], e.g. *hokej* 'hockey', *ahent* 'agent' and *xeruvyn* 'cherubin'.[17]

Now the question is how Velar Palatalisation can be analysed in OT. I assume here the Halle–Sagey model of feature geometry (Sagey 1986, Halle 1992). In this model, front vowels are [−back], and the feature [back] is a dependent of the DORSAL node. Palatalisation is a secondary articulation effect, so it is represented as an additional DORSAL [−back] specification appearing under the PLACE node alongside the primary articulation. That is, palatalised consonants are complex segments. The relevant fragment of the feature tree for a palatalised postalveolar is shown in (22).

(22)



The operation of Velar Palatalisation must therefore pass through a stage at which a postalveolar such as [ʧ] is soft, i.e. [−back], because the feature that spreads from the palatalising context, here ∥ɛ∥, is [−back]. The problem is that ∥k+ɛ∥ in Ukrainian surfaces as [ʧɛ], rather than as [ʧ'ɛ], where [ʧ'] is [−back]. The reason why the [ʧ] in [ʧɛ] is hard is clear: Ukrainian has *e*-DEPAL, so palatalised consonants before [ɛ] must lose their [−back] specification. In effect then, the mapping of ∥k+ɛ∥ to [ʧɛ] violates PAL-*e*, because [ʧ] is hard before a front vowel and hence [ʧ] and [ɛ] disagree in backness. We face a paradox: PAL-*e* triggers the change from a velar to a postalveolar, and yet it is violated in surface representation (an effect of *e*-DEPAL). This paradox is easily solved if we assume a derivational version of OT (Kiparsky 1997, 2000, Rubach 1997, 2000a, b

[16] A reviewer asks whether Velar Palatalisation could not be recast in terms of allomorphy. In this analysis, all the outputs of Velar Palatalisation are listed as allomorphs in the lexicon. For instance, the surface allomorph [kɔzaʧ] of *kozač+e*, the vocative singular of *kozak*, is listed in the underlying representation as ∥kɔzaʧ∥, alongside the allomorph ∥kɔzak∥. (The latter is what would normally be assumed to be the only underlying representation of the morpheme meaning 'Cossack'.) Now, to derive the vocative singular *kozač+e*, all that we need to do is to select the allomorph ∥kɔzaʧ∥ (rather than ∥kɔzak∥) when a word-formation rule has added ∥ɛ∥ to create the vocative singular form.

This analysis is untenable empirically. The alternation between velars and postalveolars is productive in the sense that it occurs with new words (for instance, names) and with nonce forms. Thus, a nonce word such as *marak* would have the diminutive *marač+en'k+o*, even though the allomorph ∥maraʧ∥ is not listed in the lexicon, because *marak* is not a word of Ukrainian.

[17] See Łubowicz (2002) for a discussion of derived environments in OT.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

and others).[18] At level 1, ‖k+ɛ‖ has /ʧ'ɛ/ as its optimal output, where the soft /ʧ'/ is [−back], so PAL-*e* is satisfied. *e*-DEPAL is not active at this level, because it is bottom-ranked. At level 2, where the optimal output from level 1, /ʧ'ɛ/, is the input, PAL-*e* and *e*-DEPAL change places. With *e*-DEPAL ranked above PAL-*e*, the optimal output has a hard consonant: i.e. /ʧ'ɛ/ →[ʧɛ], which is the correct surface form for Ukrainian.[19] The details of the analysis are as follows.[20]

The most natural way in which the inputs ‖k+ɛ ɣ+ɛ x+ɛ‖ can satisfy PAL-*e* is a change from a velar to a palatalised velar: ‖k+ɛ ɣ+ɛ x+ɛ‖→/k'+ɛ ɣ'+ɛ x'+ɛ/, because then the consonant and the vowel agree in backness, but this is not what happens. To prevent this, we need a constraint that prohibits palatalised velars (Zubritskaya 1995).

(23) *SOFTDORSAL

Don't be a [−back] dorsal.

With /kɛ ɣɛ xɛ/ and /k'ɛ ɣ'ɛ x'ɛ/ being outlawed by PAL-*e* and *SOFT DORSAL respectively, velars are forced to change their place of articulation. The natural change is from DORSAL to CORONAL rather than to LABIAL since, universally, *LAB≫*COR (Prince & Smolensky 1993). However, the matter is far from settled. The default coronals are [+anterior] because, universally, *[−ant]≫*[+ant], so how can we obtain [ʧ ʒ ʃ], which are [−anterior], from ‖k ɣ x‖?

The first point to note is that the optimal outputs at level 1 are soft /ʧ'ɛ ʒ'ɛ ʃ'ɛ/, as demanded by PAL-*e*. The hardness of consonants before [ɛ] is a function of *e*-DEPAL that becomes active only at level 2, as already mentioned. Given that we need to obtain /ʧ'ɛ ʒ'ɛ ʃ'ɛ/ from ‖kɛ ɣɛ xɛ‖, there are two changes that are necessary in addition to the spreading of

[18] Positing derivational levels in the sense of domains is as old as OT itself and goes back to McCarthy & Prince (1993), who permit a level distinction at the interface between the stem and the prefix–stem morphology. Essential for the model adopted here is a different property: constraints may be reranked between levels. This option is not allowed by McCarthy & Prince (1993).

[19] A reviewer points out that a derivational step in the analysis of Velar Palatalisation can be avoided if we assume the Clements–Hume model of feature geometry (Clements & Hume 1995); see note 8. In this model, front vowels are characterised as carrying the feature [coronal] under the V-place node. Since, obviously, the postalveolar outputs of Velar Palatalisation are coronal (where [coronal] is under the C-place node), PAL-*e* is satisfied by candidates such as [ʧɛ].

This analysis might be correct for the Velar Palatalisation data discussed here, because the Ukrainian pattern is not sufficiently complex. The facts of Polish in Rubach (2003a) are more complex, and do not yield to an analysis within the Clements–Hume model of feature geometry.

Ultimately, the question of which theory of feature geometry, the Halle–Sagey model or the Clements–Hume model, is supported by Slavic palatalisations can be answered only when a complete typology of the relevant processes has been established. Achieving this goal would require a large-scale research agenda, involving much more work than has been done so far. See also the criticism of the Clements–Hume model in Flemming (1995) and Halle *et al.* (2000).

[20] The analysis shown below is supported independently by Velar Palatalisation in Polish, which exhibits a much greater complexity than Velar Palatalisation in Ukrainian. See Rubach (2003b).

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

[−back]. We must make sure, first, that the place of articulation is [−anterior] and, second, that the outputs acquire the feature [+strident].[21] Thus, the input /k/ changes into a non-anterior affricate /ʧ'/. The task of discovering the relevant constraints is aided by typological facts that characterise the Slavic languages.

Palatalisation in Slovak produces non-anterior segments (Rubach 1993).

(24) *Slovak palatalisation* ([t̠' d̠' ɲ ʎ] *are prepalatal consonants*)

nom sg		*loc sg*		
bra*t*	[t]	bra*t*+e	[t̠']	'brother'
hra*d*	[t]	hra*d*+e	[d̠']	'castle'
pa*n*	[n]	pa*n*+e	[ɲ]	'sir'
soko*l*	[l]	soko*l*+e	[ʎ]	'falcon'

The Slovak facts suggest that there is a segment-inventory constraint that prohibits palatalised anterior coronals.

(25) Posteriority (Posterior)
Don't be a palatalised anterior coronal.

Like any other constraint, Posterior is violable. For example, Palatalisation in Russian produces palatalised dentals, i.e. place of articulation does not change under palatalisation.

(26) *Russian palatalisation*

nom sg		*loc sg*		
bra*t*	[t]	bra*t*+e	[t']	'brother'
goro*d*	[t]	goro*d*+e	[d']	'town'
zvo*n*	[n]	zvo*n*+e	[n']	'bell'
za*l*	[l]	za*l*+e	[l']	'room'

The retention of the dental place of articulation under palatalisation is the effect of Ident[+ant].

(27) Ident[+ant]
[+anterior] on the input segment must be preserved as [+anterior] on that segment in the output.

With the ranking Ident[+ant] ≫ Posterior, Palatalisation in Russian does not induce changes in the place of articulation. In contrast, Slovak does display such changes, so the ranking in Slovak must be Posterior ≫ Ident[+ant].

Returning to Ukrainian /k+ɛ/ → /ʧ'+ɛ/ at level 1, we note that Posterior by itself is insufficient to derive an affricate from a stop. All

[21] I assume with Rubach (1994) that affricates are strident stops, a view that goes back to Jakobson *et al*. (1951).

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

that POSTERIOR can guarantee is that ‖k‖ will turn into a non-anterior stop. We need to make sure that the stop becomes [+strident]. Enlightening in this respect is the observation that in Vilnius Polish, a dialect of Polish spoken in Lithuania, stops become affricates under palatalisation (Turska 1983).

(28) *Vilnius Polish*

kompo*t*	[t]	'fruit salad (NOM SG)'	kompo*ci*+*e*	[ts'ɛ]	(LOC SG)
			kompo*c*+*i*k	[ts'i]	(DIM)
sa*d*	[t]	'orchard (NOM SG)'	sa*dzi*+*e*	[dz'ɛ]	(LOC SG)
			sa*dz*+*i*k	[dz'i]	(DIM)

The relevant constraint, which I call STRIDENCY, prohibits non-strident palatalised coronals.[22]

(29) STRIDENCY (STRID)
Don't be a palatalised non-strident coronal.[23]

The combined effect of POSTERIOR and STRID is that ‖k+ɛ‖ must change into /ʧ'ɛ/ in Ukrainian. Such a change is a violation of *COR, because the input dorsal ‖k‖ is replaced by a coronal in the output.

(30) *COR
Don't be a coronal.

Needless to say, *COR is dominated by IDENT[COR], mandating the preservation of the coronal place of articulation in the output. The point is that *COR should not have the effect of eliminating coronals that come from the underlying representation.

The evaluation of ‖k+ɛ‖ changing into /ʧ'ɛ/ is now as shown in (31). Note that (31e) is a palatalised dental stop, as in Russian, while (31g) is a prepalatal stop, as in Slovak. For compactness, I omit the irrelevant constraints such as IDENT[−back] and IDENT[COR], because they play no role in the evaluation that has a dorsal in the input.

[22] A reviewer suggests that the relevant parameter for STRID is [−anterior]. Even though this might be true for some languages, it is inappropriate for the Slavic languages, because, as shown by Vilnius Polish, dentals, which are [+anterior], need to be within the purview of STRID.

[23] Sonorants do not become strident, a fact that is regulated by a separate constraint.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

(31) *Level 1:* ‖k+ɛ‖ → /ʧ'ɛ/

‖k+ɛ‖	PAL-*e*	IDENT[−bk]	*SOFTDORS	POSTERIOR	STRID	*COR	*e*-DEPAL
☞ a. ʧ'ɛ						*	*
b. kə		*!					
c. kɛ	*!						
d. k'ɛ			*!				*
e. t'ɛ				*!	*	*	*
f. ʧɛ	*!					*	
g. t̪'ɛ					*!	*	*
h. ʧə		*!				*	

As noted earlier, PAL-*e* and *e*-DEPAL change places at level 2. The evaluation proceeds as in (32), where inactive constraints have been omitted. I assume that the IDENT constraints (not shown here) do not permit the change of the input affricate into any other segment.

(32) *Level 2:* /ʧ'ɛ/ → [ʧɛ]

/ʧ'ɛ/	*e*-DEPAL	IDENT[−bk]	PAL-*e*
☞ a. ʧɛ		*	*
b. ʧ'ɛ	*!		
c. ʧə		**!	

Since, as just shown, PAL-*e* is active in its palatalisation function, the question is what happens when non-velar stems occur before [ɛ], as in *brat+e*, the vocative singular of *brat*. The analysis predicts that *brat+e* undergoes Palatalisation at level 1, because PAL-*e* is ranked above *e*-DEPAL at this level. However, the evaluation at level 2, where PAL-*e* and *e*-DEPAL are reranked, reverses the effect of Palatalisation derived at level 1, so the attested surface form is [bratɛ], with a hard [t].[24] We know that such a reversal can take place because, as documented in §1, stems that have underlying palatalised consonants lose their palatalisation before [ɛ]. For example, *dyn'+a* [dɨn'a], underlying ‖dɨn'+a‖ 'melon (FEM NOM SG)', appears as *dyn+ej* [dɨnɛj] in the genitive plural.

(33) a. *Level 1:* ‖brat+ɛ‖ → /brat'ɛ/

‖brat+ɛ‖	PAL-*e*	IDENT[−bk]	IDENT[+bk]	*e*-DEPAL
☞ a. brat'ɛ			*	*
b. bratɛ	*!			
c. bratə		*!		

[24] Given the level distinction, the depalatalisation in *prystan+ej*, given earlier in (16), takes place at level 2. Nothing happens at level 1, because *e*-DEPAL is inactive at this level.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

b. *Level 2:* /brat'ɛ/ → [bratɛ]

/brat'ɛ/	*e*-DEPAL	IDENT[−bk]	IDENT[+bk]	PAL-*e*
☞ a. bratɛ		*		*
b. brat'ɛ	*!			
c. bratə		**!		

This analysis shows a Duke-of-York derivational effect (Pullum 1976): Palatalisation occurs at level 1 but its result is undone by *e*-DEPAL at level 2.[25]

The analysis for velars in (31) and (32) has no adverse effects on the palatalisation of dentals in (33). Notice that for dentals it is crucial that POSTERIOR does not force them to become non-anteriors at level 1, because they would then not be able to return to the dental place of articulation at level 2 shown in (33b). There is no problem, however. Dentals are [+anterior] in the input representation, so IDENT[+ant] ≫ POSTERIOR thwarts the shift to non-anteriors. In contrast, velars are defined by the DORSAL node and are not within the purview of [+anterior], which is under the CORONAL node. Consequently, IDENT[+ant] plays no role with velar inputs, and hence POSTERIOR takes its toll.

Attention should be drawn to the fact that three independent constraints are sensitive to the [−back] feature at the intermediate level of Velar Palatalisation: PAL-*e*, POSTERIOR and STRID. The latter two are segment-inventory constraints that are active at level 1, but not at level 2, where morpheme-internal palatalisation gives [k' ɣ' x'].

To conclude, contrary to appearances, PAL-*e* is active in Ukrainian, but its operation is masked in part by *e*-DEPAL. The tangible effects of PAL-*e* are found with the palatalisation of velars, because velars change their place of articulation to non-anterior coronals. *e*-DEPAL removes the [−back] feature on the outputs of Velar Palatalisation from level 1, but it cannot reverse the fact that velars have changed into non-anterior stridents.

A point of interest is that levels 1 and 2 are both word-internal, because *e*-DEPAL does not apply across word boundaries, for example, *cil' eksperymenta* 'the aim of the experiment' surfaces with [l'#ɛ] rather than with [l#ɛ]. Even though this is not required by the data, nothing stands in the way of regarding level 1 as the stem level (root + suffixes) and level 2 as the word level (stem + prefixes), as in Kiparsky (2000).

3 Soft consonant–back vowel configuration: *o*-fronting

The goal of this section is to show that PAL-*e* in its *o*-fronting function is active, but that the process is opaque. §3.1 reviews the relevant data. §3.2 attempts to analyse these data by assuming that ∥C'+ɔ∥ → [Cɛ] is due to

[25] See Rubach (2003a) for further exemplification of Duke-of-York derivational effects.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

transparent feature movement, so no phonological opacity is involved: the [−back] of the consonant is transferred to the vowel. However, this analysis turns out to be untenable. On the one hand, it complicates OT as a theory and, on the other hand, it is unable to account for the full range of attested facts. The failure of the feature-movement account leads to the conclusion that *o*-fronting is an opaque process. §3.3 addresses the issue of opacity and argues that *o*-fronting should be analysed derivationally by appealing to the two levels established independently in the analysis of Velar Palatalisation. §3.4 demonstrates that an alternative analysis in terms of sympathy theory fails, thereby strengthening the conclusion from §3.3 that the opacity of *o*-fronting provides evidence for derivational levels in OT.

3.1 Review of the data

Underlying soft consonants cause the fronting of /ɔ/ to [ɛ] in a host of disparate suffixes, exemplified in (34). The evidence for the consonant being soft in the underlying representation derives from the fact that it occurs in contexts that do not warrant Palatalisation: at the end of the word or before a back vowel. The soft consonant triggers *o*-fronting, but then depalatalises, an effect of *e*-DEPAL.

(34) a. *masc instr sg* -om

ly*s*	[s]	ly*s*+om	[s]	'fox'
ba*l*	[l]	ba*l*+om	[l]	'grade'
lo*s'*	[s']	lo*s*+em	[s]	'moose'
pryjate*l'*	[l']	pryjate*l*+em	[l]	'friend'

b. *masc dat sg* -ovi

ly*s*	[s]	ly*s*+ovi	[s]
ba*l*	[l]	ba*l*+ovi	[l]
lo*s'*	[s']	lo*s*+evi	[s]
pryjate*l'*	[l']	pryjate*l*+evi	[l]

c. *neut nom sg* -o and *neut voc sg* -o

ko*l*+o	[l]	'wheel'
pe*r*+o	[r]	'feather'
po*l*+e	[l]	'field'
mo*r*+e	[r]	'sea'

(*kol*+*o* and *per*+*o* are hard stems – cf. the genitive singulars *kol*+*a* [l] and *per*+*a* [r] – whereas *pol*+*e* and *mor*+*e* are soft stems – cf. the genitive singulars *pol'*+*a* [l'] and *mor'*+*a* [r'].)

d. *neut instr sg* -om

ko*l*+om	[l]
pe*r*+om	[r]
po*l*+em	[l]
mo*r*+em	[r]

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

e. *fem instr sg* -oju

sti*n*+a	[n]	sti*n*+oju	[n]	'wall'
ska*l*+a	[l]	ska*l*+oju	[l]	'rock'
dy*n'*+a	[n']	dy*n*+eju	[n]	'melon'
do*l'*+a	[l']	do*l*+eju	[l]	'fate'

f. *fem voc sg* -o[26]

sti*n*+o	[n]
ska*l*+o	[l]
dy*n*+e	[n]
do*l*+e	[l]

g. *adjectivising* -ov[27]

sto*l*	[l]	sto*l*+ov+yj	[l]	'table'
pa*n*	[n]	pa*n*+ov+yj	[n]	'master'
ščave*l'*	[l']	ščav*l*+ev+yj	[l]	'sorrel'
vyš*n'*+a	[n']	vyš*n*+ev+yj	[n]	'sour cherry'

h. *linking morpheme* -o

ma*l*+o+vir	[l]	'person who doubts'
vo*d*+o+nos	[d]	'person carrying water'
zem*l*+e+vlasnyk	[l]	'landowner'
hr'a*z*+e+likuval'nyj	[z]	'treatable with mud'

(*mal*+*y* 'little' and *vod*+*a* 'water' are hard stems, whereas *zeml'*+*a* 'land' and *hr'az'* 'mud' are soft stems.)

i. *example showing multiple suffixes*

sta*l'*	[l']	'steel (FEM NOM SG)'	sta*l*+ej	[l]	(GEN PL)
			sta*l*+e	[l]	(VOC SG)
			sta*l*+ev+yj	[l]	(ADJ)
			sta*l*+e+var	[l]	'foundry oven'

The observation is that these examples show a coincidence of two processes: *o*-fronting (/ɔ/ → [ɛ] after a soft consonant – an effect of PAL-*e*) and *e*-DEPAL (/C'/ → [C] before [ɛ]).

o-fronting has exceptions, as shown by the fact that [ɔ] rather than [ɛ] appears after a soft consonant in (35).[28]

[26] The fact that the vocative singular for neuter and feminine nouns both have /ɔ/ does not mean that they are the same suffix. Slavic languages, including Ukrainian, exhibit a great deal of syncretism. For example, the feminine nominative, accusative and genitive singulars, the neuter genitive singular and the neuter nominative, accusative and vocative plurals are all represented as *a* in Ukrainian.

[27] A reviewer points out that dictionaries list *žyt't'*+*ov*+*yj*, which violates *o*-fronting, as an alternative form for *žyt't'*+*ev*+*yj* 'life (ADJ)'.

[28] Thanks to a reviewer for drawing my attention to this fact. The reviewer asks further why the noun *školar* 'schoolboy' triggers *o*-fronting in, for example, *školar*+*em* (MASC INSTR SG)' – see (34a) – but appears with the hard [r] in the genitive singular *školar*+*a*, as opposed to *kobzar*+*em* 'singer of tales (MASC INSTR SG)', which behaves as expected, and appears with a soft [r'] in the genitive singular *kobzar'*+*a*. The answer is that *školar* belongs to the so-called 'mixed declension', which includes a handful of nouns that exhibit stem suppletion. Some cases of the paradigm are

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

(35)

adv	-o	syl'*n*'+*o*	[n'ɔ]	'strongly'
masc gen sg	-oho	syl'*n*'+*o*ho	[n'ɔ]	'strong'
masc dat sg	-omu	syl'*n*'+*o*mu	[n'ɔ]	
fem gen sg	-oji	syl'*n*'+*o*ji	[n'ɔ]	
fem instr sg	-oju	syl'*n*'+*o*ju	[n'ɔ]	

Similarly, inside roots we find both [Cɔ] and [C'ɔ].

(36)

*lo*b	[lɔ]	'forehead'	*l'o*x	[l'ɔ]	'dungeon'
*do*roh+a	[dɔ]	'road'	*d'o*hot'	[d'ɔ]	'tar'
*so*m	[sɔ]	'catfish'	*s'o*mh+a	[s'ɔ]	'salmon'

3.2 Transparent analysis

The facts of *o*-fronting and *e*-DEPAL make PAL-*e* both not surface-apparent and not surface-true (recall the discussion in the introductory section). The input representation /lɔs'+ɔm/ for *los+em* 'moose (INSTR SG)' has [lɔsɛm] as its output, which raises two questions. First, why does the /ɔ/ front to [ɛ] if the trigger of the process, the soft /s'/ in the input, surfaces as a hard consonant in [lɔsɛm]? Thus, PAL-*e* in its function of turning /C'+ɔ/ into [C'ɛ] is not surface-apparent. Second, [lɔsɛm] violates PAL-*e*, because [s] and [ɛ] do not agree in backness, so PAL-*e* is not surface-true. Since non-surface-apparentness and non-surface-trueness are McCarthy's (1999) criteria for diagnosing opacity, PAL-*e* appears to be an opaque process. It is therefore not surprising that our system of constraints is not able to yield the correct result for *los+em*, as shown in (37).[29] Recall that *e*-DEPAL must outrank PAL-*e* and IDENT[−back], otherwise Depalatalisation could never take place in the optimal output. PAL-*e* drives Palatalisation and *o*-fronting, so it is ranked above IDENT[+back], which militates against these changes. IDENT[+back] in turn is outranked by IDENT[−back], because Ukrainian chooses Fronting and Palatalisation rather than Retraction and Depalatalisation as strategies to satisfy PAL-*e*. (*e*-DEPAL is an independent constraint.)

(37)

/lɔs'+ɔm/	*e*-DEPAL	PAL-*e*	IDENT[−bk]	IDENT[+bk]
☞ a. lɔsɛm		*!	*	*
b. lɔs'ɛm	*!			*
c. lɔs'ɔm		*!		
🖒 d. lɔsɔm			*	

based on the hard stem (for instance, the genitive singular) and some on the soft stem (for instance, the instrumental singular and the nominative plural, which surface as [ɛm] and [i] respectively).

[29] The candidate [lɔs'+ɔ̈m], with the front rounded vowel [ɔ̈], is not considered, because [ɔ̈] does not exist in Ukrainian. This means that the segment-inventory constraint *[ɔ̈] is undominated and, consequently, [lɔs'+ɔ̈m] can never be optimal.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

The desired winner, candidate (37a), has lost to the undesired output, candidate (37d). Notice that there is no way of repairing the analysis by the manipulation of ranking between the constraints, because the desired output [lɔsɛm] has a superset of the violations of the undesired winner [lɔsɔm] (37d).

A reviewer points out that the mapping of /C'ɔ/ to [Cɛ], as in /lɔs'+ɔm/→[lɔsɛm], need not be regarded as opaque. It can be seen as an effect of moving [−back] from the consonant to the vowel, which is a transparent rather than an opaque operation. Below I present the feature-movement analysis and pursue its consequences for OT as a theoretical framework and for the grammar of Ukrainian. I show that feature movement requires a significant extension of the OT machinery, whose sole *raison d'être* is to avoid opacity. I also point out that feature movement has undesirable empirical consequences for the grammar of Ukrainian.

A feature-movement analysis of *o*-fronting is founded on the assumption that the OT framework can be extended to include MAX[F], a new class of constraints.[30] Specifically, the mapping from /C'ɔ/ to [Cɛ] is an effect of the high-ranked MAX[−back]. Informally:

(38) MAX[−back]
[−back] of the input string must be preserved in the output string.

From the perspective of this analysis, the difference between IDENT[F] and MAX[F] is that the former specifies the locus in the output where F must occur, while the latter does not. IDENT[F] achieves this end through correspondence: F must be found in the output segment that corresponds to the input segment which hosts F. MAX[F] is not restricted in this way, so F can move and occur anywhere in the output string (see below). It appears that this is exactly what happens in Ukrainian: the [−back] of the consonant moves to the vowel, causing it to front, /C'ɔ/→[Cɛ]. This analysis is troubled in several essential ways.

An evaluation of *losem*, /lɔs'+ɔm/→[lɔsɛm], shows that the conjoined effort of PAL-*e* and MAX[−back] does not yield the correct result.

(39)

/lɔs'+ɔm/	*e*-DEPAL	MAX[−bk]	PAL-*e*	IDENT[−bk]	IDENT[+bk]
☞ a. lɔsɛm			*	*!	*
b. lɔs'ɛm	*!				*
☞ c. lɔs'ɔm			*		
d. lɔsɔm		*!		*	

There is no ranking of constraints in (39) that can deliver the correct result, because [lɔsɛm], the desired output, has a superset of violations of [lɔs'ɔm], the undesired winner. To salvage the analysis, we need to find a

[30] The possibility that correspondence relations could be extended to features was originally raised by McCarthy & Prince (1995). This extension is exemplified by Lombardi (1998), Walker (1999) and Zhang (2000). See Rubach (2000b) for discussion.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

way of excluding [lɔs'ɔm] as the winner. A reviewer suggests that the solution is to introduce a new constraint that bans the configuration of a soft consonant followed by a mid back vowel, which is what we see in [lɔs'+ɔm], but crucially not in [lɔs'ɛm]. The putative constraint is stated in (40).

(40) *C'o

A palatalised consonant cannot be followed by a mid back vowel.

We need one further stipulation: *C'o must be ranked above PAL-*e*, so that [lɔs'ɔm], the unwanted winner, can be eliminated. The analysis now works, as shown in (41).

(41)

‖lɔs'+ɔm‖	*C'o	*e*-DEPAL	MAX[−bk]	PAL-*e*	IDENT[−bk]	IDENT[+bk]
☞ a. lɔsɛm				*	*	*
b. lɔs'ɛm		*!				*
c. lɔs'ɔm	*!			*		
d. lɔsɔm			*!		*	

The success comes at a cost: in addition to some ranking stipulations, we need to postulate *C'o as a new constraint. This is a problem, because *C'o, a markedness constraint, duplicates PAL-*e*.[31]

Duplication is not the only problem faced by the transparent analysis. Additional theoretical machinery is necessary to ensure that feature movement works correctly. This point is illustrated by two examples: *los+evi* 'moose (DAT SG)' and *radost+ej* 'joy (GEN PL)'.

On a general level, a version of OT that recognises MAX[F] constraints treats features as entities rather than as properties of segments. That is, a correspondence relation between input and output is defined for each feature. For instance, MAX[−back] requires that the [−back] feature of the input have an output correspondent. In order to determine whether such constraints are satisfied in an output candidate, features must be indexed. This theory is more complex than standard OT, because the indexing of features does not obviate the need for the indexing of segments (see below).

Let us consider *losevi*, the dative singular of *los'*, where the input ‖lɔs'+ɔvi‖ must be mapped to [lɔsɛv'i], the attested output form, which exhibits three changes: first, ‖s'‖ has depalatalised to [s], second, ‖ɔ‖ has fronted to [ɛ] and third, ‖v‖ has palatalised to [v']. The last change is an

[31] It appears that this cost might be lessened by assuming that PAL-*e* does not exist as a constraint. Rather, we have *C'o, which bans a string with a soft consonant followed by a mid back vowel, and *Ce, which bans the reverse configuration: a hard consonant followed by a front vowel. The advantage of this view is illusory, because a significant generalisation has been missed: putative *C'o and *Ce lose sight of the fact that they both conspire to avoid a string of a consonant and a mid vowel that disagrees in backness, a generalisation that PAL-*e* is designed to capture. Also, the parallel with the Russian analysis in (4) and (5) breaks down, leading to a system of constraints that is not coherent.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

effect of PAL-*i*, the constraint stated in (1), which is active not only in Russian but also in Ukrainian (see (12) in §1). The situation here is different from that found in ∥los'+ɔm∥→[losɛm] in (41), because the underlying representation ∥lɔs'+ɔʊi∥ contains two instances of [−back]: one on the consonant ∥s'∥ and the other on the vowel ∥i∥.

MAX[−back] is satisfied not only by [lɔsɛʊ'i], the attested surface form, but also by some other candidates that need to be excluded. For example, the [−back] from ∥s'∥ can dock onto [l], yielding the incorrect output *[l'ɔsɔʊ'i]. Such a candidate is a viable output in Ukrainian, which has words such as *l'ox* [l'ɔx] 'dungeon', mentioned in (36).

In order to exclude *[l'ɔsɔʊ'i], we need to complicate the grammar by adding a root-faithfulness constraint prohibiting the addition of [−back] on consonants in the root morpheme. But appealing to root faithfulness is insufficient to eliminate the candidate *[lɔsɔʊ'i]. There, in one analysis, the [−back] from ∥s'∥ has travelled to [ʊ'], and [ʊ'] is part of the suffix, so root faithfulness cannot block this transfer.

A different analysis of ∥lɔs'+ɔʊi∥→*[lɔsɔʊ'i] is possible. The palatalisation of ∥ʊ∥ can come from spreading, which means that [ʊ'] and [i] would share the same [−back] feature. If the occurrences of [−back] are indexed, then this candidate is excluded by MAX[−back], because the [−back] from the ∥s'∥ has no correspondent in the surface representation.

Yet another scenario for the incorrect output *[lɔsɔʊ'i] is possible: the [−back] from ∥s'∥ can dock on the [i], which would then contain two occurrences of [−back]. To exclude this possibility, we would need to postulate a new constraint, which we might call OVERKILL[−back], that would ban more than one occurrence of [−back] on a segment.

The list of negative consequences of admitting MAX[−back] as a constraint is not yet complete. Consider *rad+ost+ej* [radɔstɛj] 'joy (GEN PL)', derived by the addition of the genitive singular suffix ∥ej∥ (cf. the examples in (14)). The underlying representation has ∥t'∥, not ∥t∥, because [t'] is found before back vowels, as in the dative plural *rad+ost'+am* [t'a]. The surface representation of the genitive plural form [radɔstɛj], where the *t* is hard, is an effect of *e*-DEPAL. But, given the input ∥rad+ɔst'+ɛj∥, what precludes the incorrect output *[radɛstɛj]? In this output, [−back] from ∥t'∥ has surfaced on the vowel, causing it to front from ∥ɔ∥ to [ɛ], exactly as in the feature-movement analysis of ∥lɔs'+ɔm∥→[lɔsɛm] in (41). Root faithfulness has no jurisdiction over the movement of [−back] from ∥t'∥ to ∥ɔ∥, yielding [ɛ] in *[radɛstɛj]. The reason is that the mapping of ∥ɔ∥ to [ɛ] occurs in the suffix and not in the root.

In order to block the movement of [−back] in [radɔstɛj], from ∥rad+ɔst'+ɛj∥, but to permit it in [lɔsɛʊ'i], from ∥lɔs'+ɔʊi∥, we need to stipulate that [−back] can move only and exclusively to the neighbouring segment. This stipulation is particularly disturbing, because it is then an accident that MAX[−back], a constraint that, unlike IDENT[−back], is not bound to a specific locus, has a purely local effect, the kind of effect that simulates derivation. Further, the neighbouring segment restriction, a new type of constraint, shows that feature indexing does not simplify the

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

theory by making superfluous the indexing of segments, because, in order to be effective, this constraint must know which segment a given occurrence of [−back] has been relocated to.

As if these complications in the grammar were not enough, we need to restrict the movement of [−back] further, by penalising its occurrence on the *s* in the candidate *[rados'tɛj]. Notice that *s* fulfils the locality restriction, since it is a neighbour of ‖t'‖ in the input representaion ‖rad+ɔst'+ɛj‖. Since *s* is in the suffix and hence outside the jurisdiction of root faithfulness, it becomes necessary to stipulate yet another restriction on feature movement, that the [−back] from the consonant must dock on the vowel, as in the *o*-fronting cases, and not on another consonant. This stipulation, as well as the above-mentioned OVERKILL[−back] and the neighbouring segment restriction, are liabilities of the feature-movement analysis.

The credibility of the feature-movement analysis is undermined further by the fact that MAX[−back] is insufficient to handle all the data. The examples in (42), involving geminates, show that ‖ɔ‖ fronts to [ɛ] without concomitant loss of palatalisation on the consonant. Evidently, *o*-fronting in (42) is due to spreading and not to feature movement.

(42) a. *adjectivising* -ov (cf. (34g))
stol+ov+yj 'table (ADJ)'
žyt't'+ev+yj 'life (ADJ)'
b. *linking morpheme* -o (cf. (34h))
prav+o+pys 'correct orthography'
žyt't'+e+pys 'curriculum vitae'

These data show that the transparent analysis of *o*-fronting based on MAX[−back] leads to an asymmetry: in *los+em* (41) the fronting is caused by feature movement, while in *žyt't'+ev+yj* it is caused by feature spreading.

MAX[−back] as a constraint also has empirical problems. On the one hand, it predicts the wrong output forms in a fragment of Ukrainian phonology that has nothing to do with *o*-fronting. On the other, it is insufficient to provide a complete and adequate account for the attested facts of the *o*-fronting pattern.

The wrong predictions made by MAX[−back] come to light when we look at the process of *j*-deletion, which Ukrainian shares with other Slavic languages: the glide *j* is deleted before consonants.

(43) a. myj+u ‖mɨj+u‖ 'I wash'
myj+eš ‖mɨj+ɛʃ‖ 'you wash'
b. my+ty ‖mɨj+tɨ‖ → [mɨtɨ] 'to wash'

According to MAX[−back], the deletion of ‖j‖ in *my+ty* should leave a trace in the output representation. Specifically, either the ‖ɨ‖ of the root

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

/mɨj/ should front to [i] or the /t/ of the suffix should palatalise to [t'], but neither of these changes is attested.[32]

Finally, the feature-movement analysis does not account for the full range of the *o*-fronting facts. Recall (see (35)–(36) in §3.1) that /ɔ/ does not front after a soft consonant in roots (36) and in some suffixes (35). Thus, we have [ɔ] rather than [ɛ] in, for example, *l'ox* 'dungeon' and *syl'n'+omu* 'strong (MASC DAT SG)'. MAX[−back] predicts *[lɛx] and *[sɨl'nɛmu], with [−back] transferred from the consonant to the vowel on the pattern of /lɔs'+ɔm/→[lɔsɛm], but these are incorrect surface forms.[33]

I conclude that the transparent analysis of *o*-fronting, based on MAX[−back], is incorrect. It is flawed from both theoretical and empirical perspectives. On the one hand, it complicates OT by enriching the theory to include MAX[F], a new family of constraints, and by introducing a number of stipulations. On the other hand, it complicates the grammar of Ukrainian by activating a host of otherwise inactive constraints and by producing an asymmetry in the treatment of *o*-fronting (42). Furthermore, in the fragments of the grammar that deal with *j*-deletion and with the surface violations of *o*-fronting, MAX[−back] yields an analysis that is empirically incorrect.

3.3 Derivational analysis

The observation that emerges from the previous section, as well as from §3.1, is that *o*-fronting is challenged by a large number of counter-examples in the surface representation. The counterexamples can be accommodated and explained if we assume that *o*-fronting is no longer an active process of Ukrainian. Rather, it operated productively at some point in the history of Ukrainian, leaving behind allomorphs that are now present in the underlying representation. In this view, each of the derivational or inflectional morphemes in (34) has two allomorphs, one with /ɔ/ and the other with /ɛ/; for example, the masculine instrumental singular ending is represented as both /ɔm/ and /ɛm/. The former occurs in the surface representation of words such as *lys+om*, whereas the latter is found in words such as *los+em*. Given that /ɛm/ exists in the underlying representation, it appears that deriving *los+em* is a simple concatenation of morphemes, where *o*-fronting (PAL-*e*) has no role to play. I show below that this contention is false and that *o*-fronting is active in Ukrainian, albeit it works under a different guise: it accounts for the distribution of the allomorphs.

Counter to expectation, the allomorphy approach to *o*-fronting does not eliminate opacity, because the distribution of the allomorphs is hampered

[32] The former change, /ɨ/→[i], can be blocked by root faithfulness, but the latter cannot. Activating root faithfulness would be yet another complication of the grammar.

[33] The absence of *[lɛx] could be explained by postulating a root-faithfulness constraint, but this constraint would have nothing to say about *syl'n'+omu*, because the violation of *o*-fronting is in the suffix and not in the root.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

by the operation of *e*-DEPAL. The interplay between PAL-*e*, which is sensitive to the presence of a palatalised consonant, and *e*-DEPAL, which depalatalises consonants, is analysed by derivational OT, whose assumption is that the grammar of Ukrainian contains two levels of derivation, exactly the same levels that were postulated for the analysis of Velar Palatalisation in §2.

Words in (35) and (36) such as *syl'n'+omu* challenge *o*-fronting, because the attested surface form contains [ɔ] after a soft consonant: [n'+ɔmu] in the relevant part of the word. Evidently, *o*-fronting is no longer an active process, so PAL-*e*, which subsumes *o*-fronting, must be disempowered. It appears that to obtain this effect, we need to rank IDENT[−back] and IDENT[+back] above PAL-*e*. Then, the desired output [n'ɔmu] from ‖n'+ɔmu‖ of *syl'n'+omu* will win from the undesired output *[nɔmu], with a depalatalised consonant, and from the undesired output *[nɛmu], with a fronted vowel. The candidates *[nɔmu] and *[nɛmu] are excluded because they violate IDENT[−back] for the consonant and IDENT[+back] for the vowel. The desired winner, [n'ɔmu], violates PAL-*e*, but this is irrelevant if PAL-*e* is ranked below IDENT[−back] and IDENT[+back].

The problem with this analysis is that the ranking IDENT[−back] ≫ IDENT[+back] ≫ PAL-*e* blocks Velar Palatalisation, ‖k+ɛ‖ → /ʧ'ɛ/, at level 1, which is incorrect (see §2). Evidently, what we need is a way to remove the *o*-fronting function of PAL-*e*, but not its palatalisation function. This goal can be achieved if we individuate our IDENT constraints, such that IDENT-C refers to consonants and IDENT-V to vowels, yielding four constraints: IDENT-C[−back], IDENT-C[+back], IDENT-V[−back] and IDENT-V[+back].[34] Since the distinction between IDENT-V[−back] and IDENT-V[+back] plays no role in palatalisation, these constraints will be treated together, and represented as IDENT-V[back]. The ranking IDENT-V[back] ≫ PAL-*e* makes it clear that vowels stay unchanged in palatalisation. Crucial for the analysis is the ranking PAL-*e* ≫ IDENT-C[+back], because then only consonants are able to palatalise. The ranking IDENT-C[−back] ≫ PAL-*e*, which has no effect on palatalisation, can now block depalatalisation, giving the faithful mapping as optimal, hence ‖C'ɔ‖ → [C'ɔ] instead of ‖C'ɔ‖ → [Cɔ].

The evaluation of *syl'n'+omu* is as follows. I assume that the evaluation is strictly parallel, because [n'ɔmu] from ‖n'+ɔmu‖ does not constitute an argument for distinguishing derivational levels. Notice that *e*-DEPAL must

[34] Individuating IDENT constraints with regard to consonants and vowels can hardly be regarded as controversial. First, it parallels the same subdivision in MAX and DEP: MAX-C, MAX-V, DEP-C and DEP-V. Second, much more specific individuating than that referring to vowels and consonants is in fact necessary. This can be illustrated by Retraction in Polish. The input /Ci/ retracts the vowel to [Cɨ], but the process is limited to hard coronals as triggers, and does not operate after labials and velars. For instance, ‖ti‖ surfaces as [tɨ] in *optymalny* 'optimal', but ‖pi‖ and ‖ki‖ appear as [p'i] and [k'i] in *pilot* 'pilot' and *kilometr* 'kilometre' respectively, with palatalisation of the consonant rather than retraction of the vowel. The constraint that derives this pattern is IDENT-COR[+back]. See Rubach (1984, 2003b).

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

be ranked above IDENT-C[−back] and PAL-*e*, or else consonants would never be able to depalatalise (see (18) in §1).

(44)

/n'+ɔmu/	IDENT-V[bk]	*e*-DEPAL	IDENT-C[−bk]	PAL-*e*	IDENT-C[+bk]
☞ a. n'ɔmu				*	
b. n'ɛmu	*!	*			
c. nɔmu			*!		

Since, as documented in (44), PAL-*e* cannot induce the change from /ɔ/ to [ɛ], the question is how we account for instances showing allomorphy in the surface representations in (34), such as *lys+om*, where the instrumental singular ending appears as [ɔm], *vs*. *los+em*, where the same ending appears as [ɛm]. The analysis here is to list the allomorphs in the underlying representation. Thus, the instrumental singular morpheme has both /ɔm/ and /ɛm/ in the underlying representation. The task of the grammar is to distribute these allomorphs correctly in the output representation.[35] This job is illustrated by the evaluation of *lys+om*, the instrumental singular of *lys* /lɨs/.

(45)

/lɨs+{ɔm, ɛm}/	IDENT-V[bk]	*e*-DEPAL	IDENT-C[−bk]	PAL-*e*	IDENT-C[+bk]
☞ a. lɨsɔm					
b. lɨsɛm				*!	

Evaluation of inputs containing allomorphs requires explanation. Previous studies of allomorphy in OT, notably Kager (1996), Mascaró (1996) and Rubach & Booij (2001), have clarified the mechanics of such evaluation. Output candidates can arbitrarily take one allomorph or the other, and faithfulness is assessed between the output form and the corresponding allomorph in the input that a given candidate has selected (with the other allomorph being ignored). Each of the candidates in (45) has selected from the input representation a different allomorph, in the sense that (45a) has taken the allomorph /ɔm/, while (45b) has chosen the allomorph /ɛm/. In this scenario, none of the candidates incurs faithfulness violations, because surface [ɔm] in (45a) and surface [ɛm] in (45b) are in a correspondence relation with the inputs /ɔm/ and /ɛm/ respectively, so the output representations are identical (fully faithful) to the input representations.

[35] The listing of all the stems in two allomorphic forms is not an option, because the relevant list could not be finite. New words, names or nonce forms select the allomorph of the suffix in exactly the same way as the words that already exist in the lexicon of Ukrainian, for example, *model*' [mɔdɛl'] 'model (FEM NOM SG)'–*model+e* [mɔdɛlɛ] (VOC SG), *paralel*' 'parallel (FEM NOM SG)'–*paralel+e* [paralɛlɛ] (VOC SG) and *Bretan*' [brɛtan'] 'Brittany (FEM NOM SG)'–*Bretan+e* [brɛtan+ɛ] (VOC SG). Recall that the feminine vocative singular has two allomorphs: one, just illustrated, is [ɛ], and the other [ɔ], as in *ruk+o* 'hand (VOC SG)'. See the data in (34f) in §3.1.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

The list of candidates in (45) could be extended by assuming the candidates [lʲisɔm] and [lʲisɛm], from the input representations /lʲis+ɛm/ and /lʲis+ɔm/ respectively. In this scenario, [lʲisɔm] based on /lʲis+ɛm/ violates IDENT-V[back], because the input /ɛ/ has [ɔ] as its output correspondent. IDENT-V[back] is also violated in the candidate [lʲisɛm] based on /lʲis+ɔm/, because the input /ɛ/ has [ɔ] as its output correspondent. Technically, such candidates should be evaluated, because they can be submitted by GEN, but such evaluation can never be fruitful, because the unfaithful [lʲisɔm], based on /lʲis+ɛm/, can never fare better than the faithful [lʲisɔm], based on /lʲis+ɔm/. Similarly, the unfaithful [lʲisɛm], based on /lʲis+ɔm/, can never beat the faithful [lʲisɛm], based on /lʲis+ɛm/. Consequently, the scenario just outlined will not be considered in the remainder of this article.

Returning to tableau (45), let us observe that PAL-*e* plays a role in the evaluation. The ranking of IDENT-V[back] and IDENT-C[−back] above PAL-*e* means that the *o*-fronting function of PAL-*e* no longer actively induces the change from /ɔ/ to [ɛ], but PAL-*e* remains active in selecting the winner in (45). Specifically, the role of PAL-*e* is to evaluate the selection of the allomorph, making sure that the correct allomorph is chosen. A point of theoretical interest here is the observation that allomorph selection is carried out by a markedness constraint and not by a syllable-structure constraint, as was the case in the studies of allomorphy by Kager (1996), Mascaró (1996) and Rubach & Booij (2001).

We turn now to the analysis of *los+em*. The situation here is different from that found for *lys+om*, because the root morpheme has a soft consonant in the underlying representation: *los'* /lɔsʲ/, surface [lɔs']. The surface form in the instrumental singular is [lɔsɛm], where the underlying /sʲ/ has depalatalised to [s], an effect of *e*-DEPAL. Yet *los+em* has selected the [ɛm] allomorph, as if the root-final consonant were soft. For /ɛm/ to be selected, PAL-*e* must have treated the root-final consonant as soft, because only then is the choice of /ɛm/ possible: the soft consonant and the [ɛ] agree in backness. Evidently, these complications are due to the interaction between PAL-*e* and *e*-DEPAL, a dilemma that we analyse below.

A strictly parallel evaluation of *los+em* gives the wrong result.

(46)

/lɔsʲ+{ɔm, ɛm}/	IDENT-V[bk]	*e*-DEPAL	IDENT-C[−bk]	PAL-*e*	IDENT-C[+bk]
☞ a. lɔsɛm			*!	*	
b. lɔsʲɛm		*!			
☞ c. lɔsʲɔm				*	
d. lɔsɔm			*!		

Candidates (46a) and (46d) violate IDENT-C[−back], because /sʲ/ has lost palatalisation and there is no allomorph in the input representation that would have an /s/. In contrast, the occurrence of [ɛ] or [ɔ] in the inflectional ending in candidates (46a, b) and (46c, d) respectively does not

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

incur a violation of IDENT-V[back], because both ‖ɛ‖ and ‖ɔ‖ exist in the input representation. Specifically, candidates (a) and (b) are based on the input ‖ɛm‖, whereas candidates (c) and (d) have taken ‖ɔm‖ as their input. The result in (46) is incorrect, and there is no ranking of constraints that would deliver the desired winner [lɔsɛm], because [lɔssɛm] has a superset of violations of the undesired winner *[lɔs'ɔm].

The dilemma posed by (46) is easily solved in derivational OT. Recall from §2 that, for reasons entirely independent of *o*-fronting, the grammar of Ukrainian must recognise two derivational levels. These levels are motivated by the analysis of Velar Palatalisation. At level 1, PAL-*e* is ranked high while *e*-DEPAL is bottom-ranked. At level 2, *e*-DEPAL and PAL-*e* switch places and depalatalisation ensues.[36] Transferred into the analysis of *o*-fronting, this scenario yields exactly the desired result.

(47) a. *Level 1:* ‖los'+{ɔm / ɛm}‖ → /lɔs'ɛm/

‖lɔs'+{ɔm / ɛm}‖	IDENT-V [bk]	IDENT-C [−bk]	PAL-*e*	IDENT-C [+bk]	*e*-DEPAL
a. lɔsɛm		*!	*		
☞ b. lɔs'ɛm					*
c. lɔs'ɔm			*!		
d. lɔsɔm		*!			

b. *Level 2:* /los'ɛm/ → [lɔsɛm]

/lɔs'ɛm/	IDENT-V [bk]	*e*-DEPAL	IDENT-C [−bk]	IDENT-C [+bk]	PAL-*e*
☞ a. lɔsɛm			*		*
b. lɔs'ɛm		*!			
c. lɔs'ɔm	*!				*
d. lɔsɔm	*!		*		

Notice that level 2, unlike level 1, does not have /ɔm/ as an allomorph in the input, which is a consequence of the fact that /lɔs'ɛm/, containing the allomorph /ɛm/, was the winner at level 1.

The analysis of *los+em* in (47) has no adverse effects on the analysis of *syl'n'+omu* introduced in (44) under the assumption of parallel evaluation. Recasting the analysis in derivational terms does not affect the outcome of evaluation, because the dative singular morpheme *omu* of *syl'n'+omu* differs from the instrumental singular morpheme *om*/*em* of *lys+om* and *los+em* in that it has a unique representation: the input is ‖ɔmu‖ and, crucially, the allomorph *‖ɛmu‖ does not exist, because *[ɛmu] is not attested in any surface form of any word in Ukrainian. The evaluation of

[36] PAL-*e* is not active at level 2, since all palatalisation has taken place at level 1. In contrast, *e*-DEPAL is active at level 2, so it must be ranked above IDENT-C[−back].

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

syl'n'+omu proceeds as in (48), where we look only at the relevant fragment of the word.

(48) a. *Level 1:* /n'+ɔmu/ → /n'ɔmu/

/n'+ɔmu/	IDENT-V[bk]	IDENT-C[−bk]	PAL-*e*	IDENT-C[+bk]	*e*-DEPAL
☞ a. n'ɔmu			*		
b. nɔmu		*!			
c. n'ɛmu	*!				*
d. nɛmu	*!	*	*		

b. *Level 2:* /n'ɔmu/ → [n'ɔmu]

/n'ɔmu/	IDENT-V[bk]	*e*-DEPAL	IDENT-C[−bk]	IDENT-C[+bk]	PAL-*e*
☞ a. n'ɔmu					*
b. nɔmu			*!		
c. n'ɛmu	*!	*			
d. nɛmu	*!		*		*

Since, as already mentioned, the input representation of the inflectional ending is the unique /ɔmu/, candidates (48c, d) violate IDENT-V[back] at both levels, because the input /ɔ/ has an output [ɛ] as its correspondent.

To conclude, the fact that PAL-*e* has lost its *o*-fronting function is beneficial to the grammar of Ukrainian. First, the morphemes that defy *o*-fronting in (35) and (36) in §3.1 are accounted for, for instance *syl'n'+omu* has the faithful [n'ɔmu] in the optimal output in (48). Similarly, *l'ox* /l'ɔx/, cited in (36), has [l'ɔx] as the optimal output, because it is recognised that [C'ɔ], no matter whether it occurs root-internally or at morpheme boundaries, is a legitimate collocation in modern Ukrainian. Consequently, words such as *l'ox* and *syl'n'+omu* are not exceptional in any way. This is a change of perspective, as [C'ɔ] is no longer under pressure from PAL-*e* to 'regularise' by fronting the vowel to [ɛ]. Therefore, a prediction is made that Ukrainian will not develop new forms in which the earlier [C'ɔ] is replaced by [C'ɛ] (or rather [Cɛ], due to *e*-DEPAL). This prediction seems to be correct, because words such as *l'ox* and *syl'n'+omu* have been stable in Ukrainian phonology for a long time.

3.4 Sympathy-theoretic analysis

The goal of this section is to investigate whether the derivational analysis from the preceding section can be recast in terms of sympathy theory, whose role in OT is to handle phonological opacity (McCarthy 1999, 2003). I show that a sympathy-theoretic reanalysis fails to deliver the correct result, which strengthens the contention in §3.3 that OT must admit derivational levels.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

Recall that the fully parallel evaluation of *los+em* in (46) fails because it selects the wrong output [lɔs'ɔm], rather than the desired [lɔsɛm]. For convenience, this evaluation is repeated in (49), which serves as a worksheet, but IDENT[round] has been added in order to increase the pool of constraints from which a sympathy-theoretic selector can be chosen.[37]

(49)

/lɔs'+{ɔm, ɛm}/	IDENT-V [bk]	*e*-DEPAL	IDENT-C [−bk]	PAL-*e*	IDENT-C [+bk]	IDENT [rd]
☞ a. lɔsɛm			*!	*		
b. lɔs'ɛm		*!				
☞ c. lɔs'ɔm				*		
d. lɔsɔm			*!			

McCarthy (1999, 2003) assumes that the constraint selecting the sympathetic base, called a selector and marked ✯, must be recruited from among the faithfulness constraints, so it must be one of the following four constraints: IDENT-V[back], IDENT-C[−back], IDENT-C[+back] or IDENT ([round]). By definition, the sympathetic base, marked ❀, cannot violate the selector. This principle is important, because it excludes some candidates as contenders for the status of the sympathetic base.

The worksheet in (49) shows that IDENT-C[+back], IDENT-V[back] and IDENT[round] are not violated by any candidate. IDENT-C[+back] is in fact mute in this evaluation, because the input has /s'/, a soft consonant. IDENT-V[back] and IDENT[round] evaluate the faithfulness of vowels, but the vowels are mapped faithfully in all the candidates since the input has two allomorphs: /ɔm/ and /ɛm/. The candidates that have [ɔm] are based on the input /ɔm/, while the candidates that contain [ɛm] are based on the input /ɛm/, so the mapping is fully faithful in each case.

Appointing IDENT-C[+back], IDENT-V[back] or IDENT[round] as the selector is fruitless, because we do not reap any benefit from the principle that candidates violating the selector cannot be considered for the status of the sympathetic base. We must look to IDENT-C[−back], which is violated in (49). However, the results of this are not good.

IDENT-C[−back] as the selector leads to the choice of [lɔs'ɔm] as the sympathetic base, as shown in tableau (50) below. The reasoning is as follows. Candidates (50a) and (50d) violate the selector, so they are *hors du combat* from the point of view of the search for the sympathetic base. Of the remaining candidates, [lɔs'ɔm] (50c) fares better than [lɔs'ɛm] (50b) on constraint violation, so it becomes the sympathetic base ❀[lɔs'ɔm]. The sympathy constraint ❀SYM requires that the candidate must accumulate the faithfulness violations of the sympathetic base, i.e. it should have the same violations as the sympathetic base and, possibly, some additional

[37] This constraint is stated as follows: the value for [round] on the input segment must be preserved on that segment in the output.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

violations. (These are penalised by ❀Sym.) Since ❀[lɔs'ɔm] is the faithful output, it incurs no violations of the faithfulness constraints. Therefore, from the perspective of ❀[lɔs'ɔm], all candidates in (50) are cumulative. Candidates (50a) and (50d) violate one faithfulness constraint, so they receive one violation mark for ❀Sym. Candidate (50b) does not offend ❀Sym, because it does not violate any faithfulness constraints. The sympathetic base ❀[lɔs'ɔm] by definition passes on ❀Sym.

(50)

/lɔs'+{ɔm / ɛm}/	❀Sym	Ident-V [bk]	*e*-Depal	✶Ident-C [−bk]	Pal-*e*	Ident-C [+bk]	Ident [rd]
☜ a. lɔsɛm	*			*!	*		
b. lɔs'ɛm			*!				
☜❀ c. lɔs'ɔm					*		
d. lɔsɔm	*			*!			

The result is incorrect, and there is no ranking of constraints in (50) that can favour the desired winner [lɔsɛm], because [lɔsɛm] has a superset of violations of the undesired winner [lɔs'ɔm]. I conclude that sympathy theory fails.[38]

Finally, the question is whether a sympathy-theoretic analysis could be salvaged if we abandon McCarthy's assumption that selectors must be chosen from among faithfulness constraints, as suggested by Itô & Mester (1997). This line of reasoning is not successful, however.

The worksheet in (49) contains two markedness constraints: *e*-Depal and Pal-*e*. Appointing *e*-Depal as the selector excludes [lɔs'ɛm] (49b) as a possible candidate for the status of the sympathetic base, because [lɔs'ɛm] violates *e*-Depal, and the sympathetic base by definition cannot violate the selector. Of the remaining candidates, [lɔs'ɔm] (49c) fares best on constraint violations and becomes the sympathetic base, but, as we have just seen in (50), the choice of ❀[lɔs'ɔm] is incorrect.

Appointing Pal-*e* as the selector excludes [lɔsɛm] (49a) and [lɔs'ɔm] (49c) as contenders for the status of the sympathetic base, because they violate Pal-*e*. Of the remaining candidates, [lɔsɔm] (49d) fares better than [lɔs'ɛm] (49b), and becomes the sympathetic base. There is no point in pursuing the details of this evaluation, because [lɔsɛm] (49a), the desired winner, has a superset of violations of the undesired winner ❀[lɔsɔm] (49d). Since ❀[lɔsɔm] by definition passes on ❀Sym, no ranking of constraints can give [lɔsɛm] as the winner. I conclude that turning to markedness constraints as selectors cannot salvage the sympathy-theoretic reanalysis.

[38] Appointing Ident-C[+back], Ident-V[back] or Ident[round] as the selector would repeat the wrong result in (50). Since none of these constraints is violated by any candidate, the choice of the sympathetic base is made by the other constraints in (49), which suggest ❀[lɔs'ɔm] (49c) as the sympathetic base, because [lɔs'ɔm] fares best on constraint violations. With [lɔs'ɔm] as the sympathetic base, the evaluation is the one in (50), the wrong result.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

The intriguing question is why sympathy theory fails in all of the scenarios that we have considered.[39] The answer is that the underlying representation in (49) contains allomorphs and, consequently, the violations of faithfulness in the output candidates are diminished. Sympathy theory is not well equipped to handle such situations, because it thrives on faithfulness and hence loses its sting when faithfulness violations are not robust. The failure of sympathy theory in dealing with the opacity of *o*-fronting reaffirms the conclusion from §3.3 that OT must admit derivational levels, and that the principle of strict parallelism cannot be maintained.

4 Conclusion

The analysis of the fragment of Ukrainian phonology which involves Velar Palatalisation and *o*-fronting supports the OT idea that structural description and structural change should be decoupled in stating phonological generalisations. Viewed from the perspective of PAL-*e*, which requires agreement in backness between the consonant and the vowel, the decoupling of structural description and structural change leads to a conspiracy. With the inputs ‖C'ɔ‖ and ‖Cɛ‖, PAL-*e* acting as a driver for phonological changes is satisfied in four ways:

(51) ‖C'ɔ‖ →[C'ɛ] Fronting
‖C'ɔ‖ →[Cɔ] Depalatalisation
‖Cɛ‖ →[C'ɛ] Palatalisation
‖Cɛ‖ →[Cɔ] Retraction

Of these four strategies, two are attested in Ukrainian: Fronting and Palatalisation. This fact makes Ukrainian parallel to Russian, where the same processes occurs with high vowels, an effect of PAL-*i* transforming ‖C'ɨ‖ into [C'i] and ‖Ci‖ into [C'i].

Ukrainian Fronting is complicated by an independently motivated depalatalisation process applying before [ɛ]. *e*-DEPAL obscures the effects of Palatalisation, ‖Cɛ‖→/C'ɛ/, and Fronting, ‖C'ɔ‖→/C'ɛ/, because the attested surface output is [Cɛ] for both of these cases. It would therefore appear that Palatalisation is simply inactive in Ukrainian. This contention is false, however. The evidence for Palatalisation comes from velars, because they change their place of articulation to coronals before [ɛ]: ‖kɛ‖→[ʧɛ]. This change cannot be reversed by *e*-DEPAL, because all that *e*-DEPAL does is to remove the feature [back] on the consonant before [ɛ].

[39] Reviving the rejected *C'o constraint from §3.2 is of no avail. When ranked above *e*-DEPAL, *C'o can tip the balance in favour of [lɔs'ɛm] (49b) as the sympathetic base, because [lɔs'ɔm] (49c) violates *C'o, but this change does not help the evaluation. The result is that [lɔsɔm] (49d) is the winner, which is incorrect. The evaluation cannot be repaired by judicious ranking of the constraints, because [lɔsɔm] (49d), the undesired winner, has a subset of violations of [lɔsɛm] (49a), the desired winner.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

The operation of *e*-DEPAL leads to opacity. Specifically, PAL-*e* in its function as Fronting is not surface-apparent, because the output [Cɛ] from the input ‖C'ɔ‖ does not disclose the reason for Fronting: why should ‖ɔ‖ front to [ɛ] if the output has a hard consonant? PAL-*e* is also not surface-true, because *e*-DEPAL, overriding PAL-*e*, selects as optimal the outputs that violate PAL-*e*, for example, *brat*+*e* [tɛ], the vocative singular of *brat*.

An attempt to deny the existence of opacity by invoking feature movement, ‖C'ɔ‖→[Cɛ] due to the transfer of [−back], fails on both essential counts: theoretical and empirical. On the one hand, the feature-movement analysis would require an extension of the OT framework and a host of stipulations for which there is no independent evidence. On the other hand, even if such stipulations are made, the analysis becomes complex for two reasons. First, the constraints that are otherwise inactive in Ukrainian have to be activated, and second, an asymmetry occurs in the treatment of ‖ɔ‖→[ɛ]. This asymmetry consists in the fact that in some cases Fronting would come from the putative feature movement and in other cases from spreading, and there is solid evidence from geminates for the latter contention.

The empirical failure of feature movement is of two kinds. First, feature movement is totally unable to account for the numerous instances in which *o*-fronting is contradicted in the surface representation. These are the morphemes containing [C'ɔ], where the vowel after the soft consonant is an [ɔ], rather than the expected [ɛ]. Second, feature movement predicts the wrong output in the analysis of *j*-deletion, an aspect of Ukrainian phonology that has nothing to do with PAL-*e*. Therefore the conclusion is that opacity exists in Ukrainian, which raises the question of how it should be handled.

An appeal to sympathy theory to solve the opacity problem brings no solace, because for independent reasons Fronting is better viewed as an allomorph-selecting process. This view derails the sympathy-theoretic analysis, since the crucial count of faithfulness violations becomes impossible. For the most part, such violations do not occur, because the underlying representation has allomorphs containing both ‖ɔ‖ and ‖ɛ‖.

The failure of sympathy theory is not paralleled in derivational OT, which is not hampered by the fact that the existence of allomorphs reduces violations of faithfulness. The crux of the analysis is the reranking of two markedness constraints, PAL-*e* and *e*-DEPAL, between the stem level and the word level.

REFERENCES

Bethin, Christina Y. (1998). *Slavic prosody: language change and phonological theory*. Cambridge: Cambridge University Press.

Bilodid, I. K. (1969a). *Suchasna ukrayins'ka literaturna mova: fonetyka*. Kiev: Naukova Dumka.

Bilodid, I. K. (1969b). *Suchasna ukrayins'ka literaturna mova: morfolohiya*. Kiev: Naukova Dumka.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

Buryachok, Andrey A., Leonyd C. Palamarchuk, Vytalyj M. Rusanovskyj & Hyna I. Tockaya (1973). *Dobidnyk z ukrayins'koho pravopysu*. Kiev: Radyanska Shkola.
Chen, Matthew (1973). Predictive power in phonological description. *Lingua* **32**. 173–191.
Chomsky, Noam & Morris Halle (1968). *The sound pattern of English*. New York: Harper & Row.
Chukina, Vitalija, Halyna S. Pochtarenko & Ol'ha M. Mykolayivna (1998). *Ukrayins'kyj pravopys*. Kiev: Logos.
Clements, G. N. & Elizabeth V. Hume (1995). The internal organization of speech sounds. In John A. Goldsmith (ed.) *The handbook of phonological theory*. Cambridge, Mass. & Oxford: Blackwell. 245–306.
de Bray, R. G. A. (1980). *Guide to the East Slavonic languages*. Columbus: Slavica.
Flemming, Edward S. (1995). *Auditory representations in phonology*. PhD dissertation, UCLA. Published 2001, New York: Garland.
Foster, James M. (1966). *Some phonological rules of Modern Standard Ukrainian*. PhD dissertation, University of Illinois at Urbana-Champaign.
Gryshchenko, A. A. (1986). *Ukrayinskaya gramatika*. Kiev: Naukova Dumka.
Halle, Morris (1992). Phonological features. In William Bright (ed.) *International encyclopedia of linguistics*. Vol. 3. New York & Oxford: Oxford University Press. 207–212.
Halle, Morris, Bert Vaux & Andrew Wolfe (2000). On feature spreading and the representation of place of articulation. *LI* **31**. 387–444.
Idsardi, William J. (1998). Tiberian Hebrew spirantization and phonological derivations. *LI* **29**. 37–73.
Itô, Junko & Armin Mester (1997). Sympathy theory and German truncations. In Viola Miglio & Bruce Morén (eds.) *University of Maryland Working Papers in Linguistics 5. Selected Phonology Papers from Hopkins Optimality Workshop/ University of Maryland Mayfest 1997*. 117–139.
Jakobson, Roman, C. Gunnar, M. Fant & Morris Halle (1951). *Preliminaries to speech analysis*. Cambridge, Mass.: MIT Press.
Kager, René (1996). On affix allomorphy and syllable counting. In Ursula Kleinhenz (ed.) *Interfaces in phonology*. Berlin: Akademie Verlag. 155–171.
Kaisse, Ellen M. (1977). *Hiatus in modern Greek*. PhD dissertation, Harvard University.
Kiparsky, Paul (1971). Historical linguistics. In William O. Dingwall (ed.) *A survey of linguistic science*. College Park: University of Maryland Linguistics Program. 576–642.
Kiparsky, Paul (1973). Phonological representations. In Osamu Fujimura (ed.) *Three dimensions of linguistic theory*. Tokyo: TEC. 3–136.
Kiparsky, Paul (1997). LP and OT. Handout, Cornell Linguistic Institute.
Kiparsky, Paul (2000). Opacity and cyclicity. *The Linguistic Review* **17**. 351–365.
Lombardi, Linda (1998). Evidence for Max Feature constraints from Japanese. *University of Maryland Working Papers in Linguistics* **7**. 41–62.
Łubowicz, Anna (2002). Derived environment effects in Optimality Theory. *Lingua* **112**. 243–280.
McCarthy, John J. (1999). Sympathy and phonological opacity. *Phonology* **16**. 331–399.
McCarthy, John J. (2003). Sympathy, cumulativity, and the Duke-of-York gambit. In Caroline Féry & Ruben van de Vijer (eds.) *The syllable in Optimality Theory*. Cambridge: Cambridge University Press. 23–76.
McCarthy, John J. & Alan Prince (1993). *Prosodic morphology I: constraint interaction and satisfaction*. Ms, University of Massachusetts, Amherst & Rutgers University.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press

McCarthy, John J. & Alan Prince (1995). Faithfulness and reduplicative identity. In Jill N. Beckman, Laura Walsh Dickey & Suzanne Urbanczyk (eds.) *Papers in Optimality Theory*. Amherst: GLSA. 249–384.
Mascaró, Joan (1996). External allomorphy as emergence of the unmarked. In Jacques Durand & Bernard Laks (eds.) *Current trends in phonology : models and methods*. Salford: ESRI. 473–483.
Medushevskyj, A. P. & R. G. Zyatovska (1963). *Hramatyka ukrayins'koyi movy*. Kiev: Radyanska Shkola.
Newton, Brian (1972). *Generative interpretation of dialect*. Cambridge: Cambridge University Press.
Ponomareva, O. D. (2001). *Suchasna ukrayins'ka mova*. Kiev: Lybid'.
Prince, Alan & Paul Smolensky (1993). *Optimality Theory : constraint interaction in generative grammar*. Ms, Rutgers University & University of Colorado, Boulder. Published 2004, Malden, Mass. & Oxford: Blackwell.
Pullum, Geoffrey K. (1976). The Duke of York gambit. *JL* **12**. 83–102.
Rubach, Jerzy (1984). *Cyclic and Lexical Phonology : the structure of Polish*. Dordrecht: Foris.
Rubach, Jerzy (1993). *The lexical phonology of Slovak*. Oxford: Clarendon.
Rubach, Jerzy (1994). Affricates as strident stops in Polish. *LI* **25**. 119–143.
Rubach, Jerzy (1997). Extrasyllabic consonants in Polish: Derivational Optimality Theory. In Iggy Roca (ed.) *Derivations and constraints in phonology*. Oxford: Clarendon. 551–581.
Rubach, Jerzy (2000a). Backness switch in Russian. *Phonology* **17**. 39–64.
Rubach, Jerzy (2000b). Glide and glottal stop insertion in Slavic languages: a DOT analysis. *LI* **31**. 271–317.
Rubach, Jerzy (2002). Against subsegmental glides. *LI* **33**. 672–687.
Rubach, Jerzy (2003a). Duke-of-York derivations in Polish. *LI* **34**. 601–629.
Rubach, Jerzy (2003b). Polish palatalization in derivational Optimality Theory. *Lingua* **113**. 197–237.
Rubach, Jerzy & Geert E. Booij (2001). Allomorphy in Optimality Theory: Polish iotation. *Lg* **77**. 26–60.
Rusanovskyj, V. M., M. A. Zhovtobryukh, E. G. Gorodenskaya & A. A. Gryshchenko (1986). *Ukrayinskaya gramatika*. Kiev: Naukova Dumka.
Sagey, Elizabeth (1986). *The representation of features and relations in nonlinear phonology*. PhD dissertation, MIT.
Shevelov, George Y. (1979). *A historical phonology of the Ukrainian language*. Heidelberg: Winter.
Turska, Halina (1983). Język polski na Wileńszczyźnie. In Janusz Rieger & Wiaczesław Werenicz (eds.) *Studia nad polszczyzną kresową*. Vol. 2. Wrocław: Ossolineum. 15–23.
Walker, Rachel (1999). Esimbi vowel height shift: implications for faith and markedness. Ms, University of Southern California. Available as ROA-336 from the Rutgers Optimality Archive.
Zhang, Jie (2000). Non-contrastive features and categorical patterning in Chinese diminutive suffixation: MAX[F] or IDENT[F]? *Phonology* **17**. 427–478.
Zhovtobryukh, M. A. & B. M. Kulyk (1965). *Kurs suchasnoyi ukrayins'koyi literaturnoyi movy*. Kiev: Radyanska Shkola.
Zilyns'kyj, Ivan (1979). *A phonetic description of the Ukrainian language*. Translated by Wolodymyr T. Zyla & Wendell M. Aycock. Cambridge, Mass.: Harvard Ukrainian Research Institute. Originally published 1932 as *Opis fonetyczny języka ukraińskiego*. Krakow: Polska Akademia Umiejętności.
Zubritskaya, Ekaterina, L. (1995). *The categorical and variable phonology of Russian*. PhD dissertation, University of Pennsylvania.

https://doi.org/10.1017/S0952675705000424 Published online by Cambridge University Press