A bad case of excessive computation: the role of morphology in palatalization-related alternations in Russian

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The rôle of morphology in palatalization-related alternations in Russian

Pavel Iosad
Universitetet i Tromsø/CASTL
pavel.iosad@uit.no

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Talk outline

1. Context
2. Two case studies from Russian
   - Backness switch
   - Palatalization
3. The advantages of modularity
4. Incursion of the idiosyncratic
5. Conclusion

Historical context

- Generative phonology is said to basically start with Russian: Halle (1959)
- Classic generative accounts such as Lightner (1972); Hayes (1984)
- Also taken up within Lexical Phonology, figures in Kiparsky (1985)
- Most analyses very abstract, sometimes even more so than Chomsky & Halle (1968)
- Of course there is much work on Slavic within GP/DP (e. g. Gussmann 2007), but I am insufficiently familiar with that…

A typical example

- From Halle & Matushansky (2002)
- The following rules are all extrinsically ordered:

1. Palatalization: [αback] spreads C ← V
2. Velar mutation: $\text{dorsal}_{[-\text{back}]} \rightarrow$ [coronal −ant +strident]
3. Iotacism: $\text{V}_{[-\text{high}]} \rightarrow$ [i] / $\text{C}_{[-\text{back}]}$_
4. Depalatalization: š ž c → [+back]
5. Velar palatalization: k g x → [−back] / _$\text{V}_{[+\text{high} -\text{round}]}$
6. Hi-switch: [αback] spreads C → $\text{V}_{[+\text{high} -\text{round}]}$

Example derivation

šerstIstʲij	‘furry’
⇓	by Palatalization
šʲerstʲIstʲij	
⇓	by Iotacism
šʲirstʲIstʲij	
⇓	by Depalatalization
širstʲIstʲij	
⇓	by Hi-switch
širstʲIstʲij	

The OT era

- Significant body of work arguing that Russian (and more broadly Slavic) data conclusively show that some sort of multiple-level serialism is unavoidable
  - Palatalization: Rubach (2000, 2005, 2007), Plapp (1999), Blumenfeld (2003) (Stratal OT)
  - Vowel reduction: Rubach (2000); Padgett (2004); Mołczanow (2007)
  - Yers: Mołczanow (2008); Gribanova (2009)
- Mostly occupied with recasting the SPE/LP analyses: well, of course you can’t do them in parallel OT!
- Scheer (2010, §6.1.3): “[t]he whole derivational issue hinges on reranking, and on nothing else”.

What is at stake?

- The analysis of Russian
  - ☞ I am not aware of any work specifically refuting the serialism-based analysis of Russian
- The issue of intermediate levels
  - ☞ Where do the levels come from?
  - ☞ What is the distinction between a multi-level phonology and non-trivial components of a modular theory of grammar?
- The value of phonology-internal evidence
  - ☞ Can we say that purely phonological data can have a decisive say on the previous issue?
  - ☞ If yes, how overwhelming must the evidence be?

Goals of this talk

- The analysis of Russian
  - ☞ Discuss some specific alternatives to a serialism-based analysis
- The issue of intermediate levels
  - ☞ Show that given a narrow (essentially Trubetzkoyan) understanding of phonology and serious modularity, the case for serialism appears overstated
- The value of phonology-internal evidence
  - ☞ Discuss how the validity of the phonological analysis hinges on interface considerations which are rarely explored or even explicitly discussed (again cf. Scheer 2010 *passim*)

Assumptions I

- Minimalist feature theory (Morén 2003, 2007; Blaho 2008)
  - Only privative features
  - Contrastivist Hypothesis (Dresher 2009; Hall 2007): only contrastive features are active in the phonological computation (see Dresher *passim* on why this is essentially the Trubetzkoyan position)
  - Substance-free I: phonetic representation of a feature not necessarily uniform either across or within a language
  - Substance-free II: assignment of phonological features based on phonological activity within the language at hand
- Consequences:
  - Surface underspecification
  - Non-trivial phonetic component

Assumptions II

- Not every change you can write using IPA is the job of phonology
- Potential sources of variable realization of underlying phonological symbols (“phonetic grammar”)
  - Allomorphy (not phonology: e. g. lexical insertion)
  - Manipulation of phonological symbols (“phonology”, “computation”)
    - General (“phonology” *per se*)
    - Item-specific (“morpheme-specific phonology”)
  - Language-specific differences in the realization of (bundles of) symbols (“phonetics–phonology interface”)
  - Phonetic factors: speech rate, aerodynamics, elasticity effects etc. (“phonetics”)
- Consequence: even if “phonology” is monostratal, the feed-forward model of grammar still introduces a kind of serialism, but with principled restrictions

The basic facts

- Most consonants have a palatalized counterpart, e. g. [t tʲ] [x xʲ] [ɬ lʲ] etc.
- Exceptions: [ts ʂʷ ʐʷ] (only non-palatalized), [ʧʲ] (only palatalized)
- Palatalized consonants have a pretty free distribution
  - But [kʲ gʲ xʲ] are impossible word-finally
  - And rare before non-front vowels, though not impossible and even created by the morphophonology (Timberlake 1978; Flier 1982)
- Conversely, [k g x] are impossible (word-internally) before front vowels

The traditional assumptions

- Traditional as in going back to at least Halle (1959) and rarely challenged
- Six vowels, including [ɨ] which is at least [+high +back −round]
- Complementary distribution of [ɨ] and [i] depending on palatalization of the previous consonants
- Note this requires [ʂʷɨ] [ʐʷɨ] [tsɨ] but [ʧʲi]
- Assumption: at least [ʂʷ] and [ʐʷ] are underlyingly palatalized (we’ll see why in a minute)

☞ Not available in a contrastivist theory: (non-)palatalization is redundant on the “unpaired” segments

The palatalizations I

- Mostly before front vowels:
  - C → C^{j}
  - But the same affixes often trigger [k g x] → [ʧ^{j} ʂ^{w} ʐ^{w}]

(1)

a.	(i)	[ˈsvʲet]	‘light’ (n.)
	(ii)	[svʲɪˈtʲitʲ]	‘to illuminate’
b.	(i)	[ˈmukə]	‘torment’ (n.)
	(ii)	[ˈmuʧʲɪtʲ]	‘to torment’

- Another type where only the velars are affected:

(2)

a.	(i)	[ˈstoɬ]	‘table’
	(ii)	[stɐˈɬi]	‘tables’
b.	(i)	[ˈkrʲuk]	‘hook’
	(ii)	[krʲʊˈkʲi]	‘hooks’

The palatalizations II

- Yet another type where everything undergoes surface palatalization

(3)

a.	(i)	[ˈstoɬ]	‘table’
	(ii)	[stɐˈɬʲe]	‘table (loc. sg.)’
b.	(i)	[ˈkrʲuk]	‘hook’
	(ii)	[krʲʊˈkʲe]	‘hook (loc. sg.)’

- Transitive palatalization: [t d s z] → [ʧ^{j} ʐ^{w} ʂ^{w} ʐ^{w}]
  - ☞ No relation to the frontness of the following vowel
  - ☞ Same output as [i]-palatalization

The traditional approach

- Palatalization: triggered by [i]
  - [ti ki] → [tʲi ʧi]
- The other palatalization: triggered by [ɨ] with later fronting following velars; ordering crucial
  - [tɨ kɨ] → [tɨ ki] → [tɨ kʲi]
- Across-the-board surface palatalization: word-level (Blumenfeld 2003) or some boundaries reproducing this effect (Plapp 1996); multiple levels crucial for counterfeeding of [i]-palatalization
- Transitive palatalization: often ignored or relegated to morphology despite the clear affinity to [i]-palatalization

Reanalysis

- Joint work with Bruce Morén-Duolljá
- Email for details of analysis or see `http://www.hum.uit.no/a/iosad/cv.html`
- Redux:
  - There is no [ɨ]
  - There is very little actual C ← V spreading of [αback]
  - The various outcomes of palatalization are ascribed to a floating feature
  - Lexical indexation allows Russian to realize a fair bit of the factorial typology for this floating feature

Backness switch and [ɨ] I

- There is no /ɨ/ in Russian
  - Phonetically it is a sort of diphthong: textbook knowledge in Russia, also Padgett (2001)
  - Basically the target is [i]
  - Phonologically it is not necessary
- The relationship between frontness and palatalization properties is complex
- Some non-front vowels trigger palatalization:

(4) a. [pʲɪˈsok] ‘sand’
b. [pʲɪˈʃːjanɨj] ‘sandy’

- Vice versa: slightly complicated
- All /e/’s do trigger palatalization (historical accident)

Backness switch and [ɨ] II

- If all /ɨ/’s are /i/’s, they are an example of front vowels failing to trigger palatalization
- Exception: /ki/ still comes out as [kʲi]
- It is in fact the only C ← V spreading process that does not fail
- The ban against [kɨ gɨ xɨ] is in fact a robust surface-true generalization (modulo boundary effects)
- Spreading of [αback] to [dorsal] but not other places can be achieved by local conjunction
- Obviates the frankly weird rule fronting /ɨ/ following non-palatalized dorsals only in order to front them afterwards
- Also solves the problem of the postalveolars
- The only part of the phonology where [ʂʷ ʐʷ] behave like non-palatalized consonants is where they cause [ɨ] to appear instead of [i]

Backness switch and [ɨ] III

- But [i] → [ɨ] is not a phonological process: just the interface imposing velarization on non-palatalized consonants
- Therefore [ʂʷ ʐʷ] should in fact be palatalized in the output of phonology (corroborated by vowel reduction)

☞ Serialism involving non-contrastive features comes for free from the modular architecture

- Backness switch à la Rubach (2000) is unnecessary

☞ Promising general line of attack on much of “postlexical phonology”

Representational assumptions

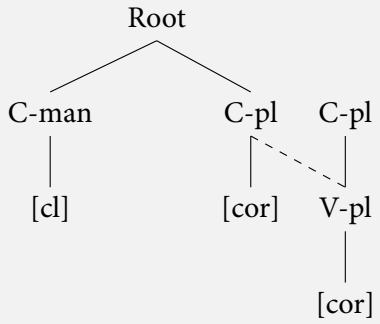
- Based on a holistic approach to Russian phonology
- V-place[coronal]
  - Palatalization in consonants with a C-place (à la Clements)
  - The only place feature for the postalveolars
  - On its own: /i/
- Floating V-place[coronal] (unattached to a Root node) must attach to something to surface
- Factorial typology for floating feature

The constraints

- MAX(V-pl[cor]), or MAXFLT (Wolf 2007): self-explanatory
- DEPLINK(V-pl[cor]): do not create a new attachment for V-pl[cor]
- *C-pl[lab]/[cor]/[lab]: self-explanatory
- Conjunction of *C-pl and DEPLINK: "do not attach V-pl[cor] to this type of consonant"
  - Can be undominated ⇒ no docking
  - Can be repaired by undoing the violation of DEPLINK ⇒ no docking
  - Can be repaired by undoing the violation of *C-pl ⇒ deletion of C-pl and attachment of V-pl[cor] = postalveolars
  - Can be dominated ⇒ docking of V-pl[cor] leads to surface palatalization
- Ignoring additional complications which don't change the picture…

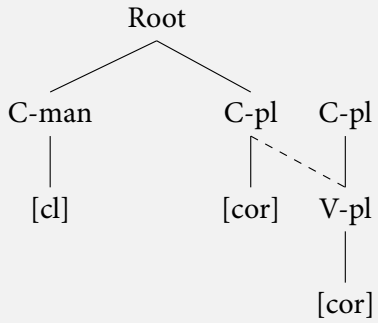
Surface palatalization

- MAX(V-pl[cor]), MAX(C-pl) ≫ DEPLINK(V-pl[cor])
- Realize both the consonant's underlying feature and the floating feature



Place-changing palatalization

- Unified name for velar and transitive palatalization: same output, would be good to have a unified representation
- MAX(V-pl[cor]), *C-pl&DEPLINK(V-pl[cor]) ≫ MAX(C-pl)



No-docking scenarios

- The feature may fail to surface at all ⇒ non-palatalizing suffixes, such as the /ɨ/
- It may also force the epenthesis of some material to attach to
- Attested as labial epenthesis: /p b m f v/ → /pʲ bʲ mʲ fʲ vʲ/
- But the ranking is clearly contradictory: how can all these be attested in a single language?

Lexical indexation I

- For the sake of the argument, I propose accommodating the different palatalizing properties of Russian suffixes via lexical indexation (Pater 2009)
- So each class of suffixes has a corresponding ranking of the relevant constraints
- Contrast this with the Stratal OT approach of Blumenfeld (2003):
  - SOT: velar palatalization happens at the stem level, surface palatalization happens at the stem level, differences accommodated via stratum-specific ranking
  - Proposed approach: differences in the outcome of palatalization are due to arbitrary lexical indexes
  - Loss of generalization relative to SOT, even though the insight can still be expressed ("such-and-such indexes are associated with word-level suffixes")

Lexical indexation II

- Better empirical adequacy
  - Unified expression of place-changing palatalization
  - Correctly expresses the lack of a principled relationship between vowel frontness and palatalizing properties (other than diachronically)
  - Correctly expresses the types of palatalizing processes possible in Russian
- Give me empirical adequacy over loss of generalization any day

Marrying OT and modularity

- Scheer (2010): the "strict parallelism" rhetoric of OT tends to take (some of) its practitioners too far down the non-modular path
- One way of reconciling OT with modularity: letting go of many of the alternations commonly assumed to fall within the purview of phonology
  - Phonology = categorical operations on distinctive features
  - Operations on non-distinctive elements of the signal: phonetics–phonology interface, phonetics
  - Operations with non-phonological conditioning: allomorphy galore?
- Presumption of guilt: not phonological unless proved otherwise

The phonetics–phonology interface I

- Massive pile of "data": until the rise of Laboratory Phonology, the working assumption is "if you can write it in IPA, it's phonology", appealing to Jakobson et al. (1951); Chomsky & Halle (1968) and the idea of a "universal phonetics", where all differences among the sound grammars of different languages are phonological by definition; also Hale & Reiss (2008)
- In much of LabPhon and its ilk the pendulum swings the other way: there is no separate module catering for categorical phonology, it is at best emergent (too many references to do justice to)

The phonetics–phonology interface II

- Other options (a selection):
  - Phonetics and phonology are orthogonal but simultaneously present: "sound phenomena can be classified on several dimensions, most of them continuous, which all together make the phenomenon relatively phonetic or relatively phonological" (Tucker & Warner 2010)
  - Phonetics and phonology are in principle separate but difficult if at all possible to disentangle (Cohn 2006)
  - Phonetics and phonology are strictly separate:
    - No universal phonetics: phonetics (or the interface) is non-trivial, e. g. Kingston & Diehl (1994); Kingston (2007)
    - Phonetics–phonology duplication is not a problem but an empirical fact, and the two can be disentangled: Myers (2000); Przezdziecki (2005); Barnes (2006); Bermúdez-Otero (2010)

The phonetics–phonology interface III

- Some corollaries of a modular architecture
  - The interfaces must be non-trivial, and consequently they can do (some of) the job of an expansionist phonology
  - There are also clear consequences: we cannot cure opacity just by shunting the lateish processes to the interface: evidence required (Myers 2000)
  - We have to live with a lot of duplication such as Bermúdez-Otero's (2010) "rule scattering"
    - ☞ But it's OK if it gives better empirical adequacy
- What about the other side?

Handling incursions of the idiosyncratic

- Can we bite the bullet and accept enormous duplication?
- This means another rethink of the balance between storage and computation (Booij 2002; Embick 2010)
- If parochial phonology is out, morphology (e. g. lexical insertion) eats another big chunk of phonology: cf. Green (2006, 2007)
- "Frankly boring" (p. c.)
- But should we accept it, just as with phonetics?

How good is phonological evidence?

- It is not my purpose here to argue for this specific analysis
- But it does seem that many of the facts previously argued to absolutely require serial derivation in phonology could in principle be reanalyzed
- What would the compelling evidence look like?
  - Demonstrably phonological
  - Crucially ordered processes
  - Operating categorically on contrastive symbols
  - Not amenable to a representational analysis (e. g. preservation of subsegmental elements as opposed to spreading-and-deletion)
- Place to look for: languages with really long derivations: Sanskrit? Sámi? Finnish?

Battling the idiosyncratic I

- Going back to Russian palatalization, it is arbitrary in at least two ways:
  - Despite repeated attempts to analyze it as driven by the surface phonology, these analyses appear to be around ten centuries late: the mere triggering of palatalization is not a surface-phonological fact
  - The distribution of palatalization types among triggering morphemes is quite arbitrary
- The second point means that I am not enough of a syntactician to convince myself one way or another whether the different palatalization-related rankings have some principled morphosyntactic rationale

Battling the idiosyncratic II

- But I suspect it's a very tough nut to crack, especially considering the fact that allomorphs of the same morpheme can have differing palatalization properties.

(5)	a.	[tʲɪˈku]	'I flow'
	b.	[tʲɪˈtʃot]	'it flows'
(6)	a.	[ˈtku]	'I weave'
	b.	[ˈtkʲot]	'(s)he weaves'

- The empirical advantages are not as clear as in the case of phonetics
  - In the case of phonetics, some manipulation is still there, just of a different kind
  - If morphologically conditioned phonology is morphology, this would seem to be selection, not computation
  - I wash my hands here

Summary

- Analysis of a number of phenomena in Russian which have traditionally been argued to support multiple-level derivations
- Claim: analysis more empirically adequate in terms of the phonological phenomena
- Loss of generality in terms of stating the conditioning, but arguably preferable over an elegant but insufficient analysis

☞ I am not really arguing for fully parallel OT, or even for OT as such

☞ My points regarding the proper domain of phonology hopefully apply to any theory of phonological computation, not just to OT

- Just showing that a number of reasonable assumptions in a modular theory phonological computation can help us run with this ball much further

Quis custodiet ipsos custodies?

- Can phonological data alone be used to resolve (e. g.)the number-of-levels debate?
- Answer: firm no
- "Empirical" arguments for or against this or that specific theory of phonological computation have little value outside of a fully fledged architectural theory
- My contribution in this is hopefully to raise the questions regarding the proper domain of phonological computation in a modular theory

References I

Barnes, Jonathan. 2006. *Strength and weakness at the interface: positional neutralization in phonetics and phonology*. Berlin: Walter de Gruyter.

Bermúdez-Otero, Ricardo. 2010. Currently available data on English *t/d*-deletion fail to refute the classical feedforward modular architecture of phonology. Presentation at the 18th Manchester Phonology Meeting.

Blaho, Sylvia. 2008. *The syntax of phonology: a radically substance-free approach*. Ph.D. thesis, University of Tromsø.

Blumenfeld, Lev. 2003. Russian palatalization and Stratal OT: morphology and [back]. In Wayles Brown, Ji-yung Kim, Barbara Partee & Robert Rothstein (eds.), *Annual workshop on formal approaches to Slavic linguistics: the Amherst meeting 2002*, 141–158. Ann Arbor: Michigan Slavic Publications.

Booij, Geert. 2002. The balance between storage and computation in phonology. In Sieb Nooteboom, Fred Weerman & Frank Wijnen (eds.), *Storage and computation in the language faculty*, 115–138. Dordrecht: Kluwer.

References II

Chomsky, Noam & Morris Halle. 1968. *The sound pattern of English*. New York: Harper and Row.

Cohn, Abigail C. 2006. Is there gradient phonology? In Gisbert Fanselow, Caroline Féry, Ralf Vogel & Matthias Schlesewsky (eds.), *Gradience in grammar: generative perspectives*, 25–44. Oxford: Oxford University Press.

Dresher, B. Elan. 2009. *The contrastive hierarchy in phonology*. Cambridge: Cambridge University Press.

Embick, David. 2010. *Localism versus globalism in phonlogy and morphology* (Linguistic Inquiry Monographs 60). Cambridge MA: MIT Press.

Flier, Michael S. 1982. Morphophonemic change as evidence of phonemic change: the status of the sharped velars in Russian. *International journal of Slavic linguistics and poetics* 25–26. 137–148.

Green, Anthony Dubach. 2006. The independence of phonology and morphology: The Celtic mutations. *Lingua* 116(11). 1946—1985.

Green, Anthony Dubach. 2007. *Phonology limited*. Potsdam: Universitäts-Verlag.

References III

Gribanova, Vera. 2009. Phonological evidence for a distinction between Russian prepositions and prefixes. In Gerhild Zybatow, Denisa Lenertová, Uwe Junghanns & Petr Biskup (eds.), *Studies in formal Slavic phonology, morphology, syntax, semantics and information structure: Proceedings of FDSL 7, Leipzig*, 383–396. Frankfurt: Peter Lang.

Gussmann, Edmund. 2007. *The phonology of Polish*. Oxford: OUP.

Hale, Mark & Charles Reiss. 2008. *The phonological enterprise*. Oxford: Oxford University Press.

Hall, Daniel Currie. 2007. *The role and representation of contrast in phonological theory*. Ph.D. thesis, University of Toronto.

Halle, Morris. 1959. *The sound pattern of Russian: a linguistic and acoustical investigation*. 's Gravenhage: Mouton.

References IV

Halle, Morris & Ora Matushansky. 2002. [αback] assimilation in Russian: an overview. In Aniko Csirmaz, Zhiqiang Li, Andrew Nevins, Olga Vaysman & Michael Wagner (eds.), *Phonological answers (and their corresponding questions)*, vol. 42, MIT working papers in linguistics, 69–80. Cambridge, MA: MITWPL.

Hayes, Bruce. 1984. The phonetics and phonology of Russian voicing assimilation. In Mark Aronoff & Richard Oehrle (eds.), *Language sound structure*, 318–328. Cambridge, MA: MIT press.

Jakobson, Roman, Gunnar Fant & Morris Halle. 1951. *Preliminaries to speech analysis*. Cambridge, Mass.: MIT Press.

Kingston, John. 2007. The phonetics–phonology interface. In de Lacy (2007), 401–434.

Kingston, John & Randy L. Diehl. 1994. Phonetic knowledge. *Language* 70(3). 419–454.

Kiparsky, Paul. 1985. Some consequences of Lexical Phonology. *Phonology Yearbook* 2. 85–138.

References V

de Lacy, Paul (ed.). 2007. *The Cambridge handbook of phonology*. Cambridge: Cambridge University Press.

Lightner, Theodore M. 1972. *Problems in the theory of phonology 1: Russian phonology and Turkish phonology*. Edmonton: Linguistic Research.

Mołczanow, Janina. 2007. Russian vowel reduction and phonological opacity. *Slavonic and East European Review* 85(2). 201–230.

Mołczanow, Janina. 2008. Gliding in Russian. *Lingua* 118(8). 1080–1108. doi:10.1016/j.lingua.2008.01.005.

Morén, Bruce. 2003. The Parallel Structures model of feature geometry. In *Working Papers of the Cornell Phonetics Laboratory*, vol. 15, 194–270. Ithaca, NY.

Morén, Bruce. 2007. The division of labour between segment-internal structure and violable constraints. In Sylvia Blaho, Patrik Bye & Martin Krämer (eds.), *Freedom of analysis?* (Studies in generative grammar 95), 313–344. Berlin: Mouton de Gruyter.

References VI

Myers, Scott. 2000. Boundary disputes: the distinction between phonetic and phonological sound patterns. In Noel Burton-Roberts, Philip Carr & Gerard Docherty (eds.), *Phonological knowledge: concepts and empirical issues*, 245–272. Oxford: Oxford University Press.

Padgett, Jaye. 2001. Contrast dispersion and Russian palatalization. In Elizabeth V. Hume & Keith Johnson (eds.), *The role of speech perception in phonology*, 187–218. San Diego: Academic Press.

Padgett, Jaye. 2004. Russian vowel reduction and Dispersion Theory. *Phonological Studies* 7. 81–96.

Pater, Joe. 2009. Morpheme-specific phonology: constraint indexation and inconsistency resolution. In Steve Parker (ed.), *Phonological argumentation: essays on evidence and motivation* (Advances in Optimality Theory 5), 123–154. London: Equinox.

Plapp, Rosemary Kuhn. 1996. Russian /i/ and /☒/ as underlying segments. *Journal of Slavic Linguistics* 4. 76–108.

References VII

Plapp, Rosemary Kuhn. 1999. *Lexical Phonology and Optimality Theory: analysis of Russian*. Ph.D. thesis, University of Iowa.

Przezdziecki, Marek. 2005. *Vowel harmony and coarticulation in three dialects of Yorùbá: phonetics determining phonology*. Ph.D. thesis, Cornell University, Ithaca, NY.

Rubach, Jerzy. 2000. Backness switch in Russian. *Phonology* 17. 39–64.

Rubach, Jerzy. 2005. Mid vowel fronting in Ukrainian. *Phonology* 22. 1–36.

Rubach, Jerzy. 2007. Feature geometry from the perspective of Polish, Russian, and Ukrainian. *Linguistic Inquiry* 38(1). 85–138.

Scheer, Tobias. 2010. *A guide to morphosyntax–phonology interface theories: How extra-phonological information is treated in phonology since Trubetzkoy's* Grenzsignale. Berlin: Mouton de Gruyter.

Timberlake, Alan R. 1978. K istorii zadnenebnyx fonem v severnoslavyanskix jazykax. In Henrik Birnbaum (ed.), *American contributions to the Eighth Iinternational Congress of Slavists*, vol. 1. Linguistics and Poetics, 699–726. Columbus: Slavica Publications.

References VIII

Tucker, Benjamin V. & Natasha Warner. 2010. What it means to be phonetic or phonological: the case of Romanian devoiced nasals. *Phonology* 27(2). 289–324.

Wolf, Matthew. 2007. For an autosegmental theory of mutation. In Michael O'Keefe, Ehren Reilly & Adam Werle (eds.), *University of Massachusetts Occasional Papers in Linguistics 32: Papers in Optimality Theory III*, 315–404. Amherst: GLSA.