Slavic Morphology: Recent Approaches to Classic Problems, Illustrated with Russian*

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Abstract: This state-of-the-field article traces some recent trajectories of morphological theory, illustrated via four classic problems of Slavic morphology: vowel-zero alternation, stem consonant mutations, paradigmatic gaps, and animacy-determined accusative syncretism. Using Russian as the primary illustrating data, one theme that emerges is that theories that leverage the distributional properties of the lexicon have made progress against previously intractable aspects of these phenomena, including idiosyncratic lexical distributions, unexpected (non)productivity, and distributions shared by distinct exponents. In turn, the analyses raise new questions.

1. Introduction

This article comes at an interesting time for the field of Slavic morphology. As is well known, morphological theory largely went into hibernation in the middle of the 20th century within general linguistics circles, especially in North America, where it was nearly swallowed up on the one side by syntax and on the other by phonology. The generative program pursued the hypothesis that morphology could be reduced to these two other components and has no autonomous structure. This left Slavic morphology in an isolated position. Prague and Moscow School Structuralism put morphology (along with phonology) at the center of investigation, and this focus continued to echo among many Slavic-centric linguists. Moreover, the rich morphological patterns of Slavic continued to entice. Slavic linguistics and general linguistics fell out of step with each other, particularly with regard to morphological theory. However, this article comes after years of slow but steady re-emergence and growth of morphological theory as a field of study in its own right, and Slavic language data have played an important role in this renewed interest and the direction of research. As the same time, much of this recent work is informed

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primarily by the ways that general linguistics has developed as it spiraled back around to morphology and less directly by the Slavic linguistic tradition.

As part of these new directions, Slavic morphology has undergone diversification in both methods and theory. Methodologically, the most notable developments have to do with the growth in corpus-based and experimental approaches. Corpus work on Slavic morphology has explored topics such as productivity (e.g., Antić 2012; Kapatsinski and Vakareliyska 2013; Sims and Parker 2015) and variation and ongoing change (e.g., Gorbova 2014; Krasovitsky et al. 2008; Nesset and Makarova 2012). Experimental methods are likewise being used to investigate Slavic morphological structures in normally developed adult native speakers (e.g., Kapatsinski 2010; Makarova 2016; Mirković et al. 2011; Pertsova and Kuznetsova 2015; Sims 2006) and there is additionally now a sizeable literature on the cognitive and neurological processing of Slavic word structures (for a review, see Sims in prep). (In comparison, computational modeling is still relatively sparse, but see Daland et al. 2007; Milin et al. 2011; Mirković et al. 2011.) This has fed and been fed by a paradigm shift in the conceptualization of the relationship between grammar and lexicon that has led to a re-evaluation of (Slavic) morphological phenomena and even the questions that are asked. It is impossible to do justice to all of the relevant work in such a short space, particularly because it represents centrifugal forces more than a single, coherent research program. Still, my goal in this paper is to give an overview of some of the trajectories of recent research, illustrated via some classic problems of Slavic morphology.

The bulk of this paper is divided into two parts. In §2 I survey three classic problems related to Slavic morphophonology (mostly illustrated with Russian). The discussion in §3 narrows the focus to a single morphosyntactic pattern—animacy-based syncretism in the accusative of Russian—and compares different formalist approaches to this issue. The goal of both sections is to illustrate a few of the ways in which Slavic language data play a unique and particularly important role in the development of modern morphological (especially inflectional) theory, as a placeholder for a broader range of issues. Finally, in §4 I offer some conclusions.

2. Morphophonology

In this section I look at three morphophonological patterns: vowel-zero alternation in Russian and Polish, velar palatalization in Russian, and first person singular verbal gaps in Russian.[1] All three are classic problems, in large part

[1] These are, of course, not the only morphophonological alternations in Russian. Accentual alternations are particularly notable (Brown et al. 1996; Feldstein 1996; Nesset 1994; Stankiewicz 1993). For a recent general overview of Russian morphophonology, see Itkin (2007).

because of lexically idiosyncratic distributions and/or nonproductivity, traits that have made them resistant to adequate analysis in classical generative linguistic models. While the particular debates surrounding each phenomenon differ, one theme that emerges has to do with the importance of lexical distributions.

2.1. Vowel-zero Stem Alternation

Vowel-zero stem alternation (also sometimes called "fleeting vowels" or "mobile vowels") is a shared legacy of the historical loss of the yers. While the full story of the phonological change is complicated (Flier 1988; Isačenko 1970; Kiparsky 1979; Nesset 2016), the well-known basic facts are that in the Late Common Slavic period there were two yers—short vowels with the quality of /ɪ/ and /ʊ/, roughly—that disappeared when the following syllable contained a full vowel. When the following syllable contained another yer, yers strengthened and merged with existing full vowels, following an alternating-syllable pattern known as Havlík's Law. This produced widespread allomorphy (vowel-zero alternation) stem-finally in both inflectional and derivational contexts since a given stem frequently occurred in both yer loss and yer strengthening environments. Because of subsequent developments, not all historical yers produced modern alternations, nor does all vowel-zero alternation trace back to historical yers. Nonetheless, vowel-zero alternation remains a defining trait of the morphophonological structure of the modern Slavic languages, as illustrated in (1) for Contemporary Standard Russian and (2) for Polish.

(1) Russian vowel-zero alternation (examples from Timberlake 2004: 88)

nožek [noʒɨk]	'foot$_{DIM.GEN.PL}$'	nožk-a [noʃk-ə]	'foot-DIM-NOM.SG'
bobër [bɑbʲoɾ]	'beaver$_{NOM.SG}$'	bobr-a [bɑbr-ɑ]	'beaver-GEN.SG'
vësel [vʲosʲil]	'oar$_{GEN.PL}$'	vesl-o [vʲisl-o]	'oar-NOM.SG'
mox [mox]	'moss$_{NOM.SG}$'	mx-a [mx-ɑ]	'moss-GEN.SG'

(2) Polish vowel-zero alternation (examples from Rubach 2016: 422)

oset [ɔsɛt]	'thistle$_{NOM.SG}$'	ost-u [ɔst-u]	'thistle-GEN.SG'
bez [bɛs]	'lilac$_{NOM.SG}$'	bz-y [bz-u]	'lilac-GEN.SG'
palec [palɛts]	'finger$_{NOM.SG}$'	palc-a [palts-a]	'finger-GEN.SG'
klusek [klusɛk]	'noodle$_{GEN.PL}$'	klusk-a [klusk-a]	'noodle-NOM.SG'

Vowel-zero stem alternation has been the subject of numerous analyses. The fundamental theoretical challenge lies in the fact that whether a stem alternates or not is lexically specific. While the choice of stem alternant is phonologically conditioned, which stems will be subject to alternation is not de-

terministically predicted by the quality of the (surface) vowel or its phonological environment. See (3) in which Polish nouns that are near minimal pairs may exhibit alternation (3a, c) or not (3b, d).

(3) Polish stems that alternate vs. ones that do not (examples from Rubach 2016: 423)

a.	bez [bɛs]	'lilac$_{NOM.SG}$'	bz-y [bz-ɨ]	'lilac-NOM.PL'
b.	bez [bɛs]	'meringue$_{GEN.PL}$'	bez-y [bɛz-ɨ]	'meringue-NOM.PL'
c.	ost-u [ɔst-u]	'thistle-GEN.SG'	oset [ɔsɛt]	'thistle$_{NOM.SG}$'
d.	post-u [pɔst-u]	'Lent-GEN.SG'	post [pɔst]	'Lent$_{NOM.SG}$'

For the sake of space, the discussion here only takes up vowel-zero alternation in nominal inflectional stems, as in (1)–(3), but for recent work on alternation in other environments see, e.g., Gribanova (2009), Jarosz (2008), Linzen et al. (2013), and Steriopolo (2007).

Analyses mostly take one of two broad approaches: specifying alternating vowels as exceptional at the level of the underlying representation, or specifying alternating stem morphemes as being subject to special rules of morphophonology. The fundamental question thus has to do with whether alternating stems are phonologically exceptional or morphologically exceptional.[2]

Starting in the 1970's, generative transformational grammar treated alternation as a property of the underlying representation (UR). See Rubach (2016: 430) for a list of analyses. These come in two flavors. Most famously, Lightner (1972) posits alternating stems contain yers (high vowels with phonological feature sets distinct from those of other vowels) at the position of alternation, which are either deleted or merged with other vowels in the course of the derivation, based on phonological conditioning.[3] Halle (1994), along with subsequent work (e.g., Halle and Matushansky 2006), is a direct development of this earlier approach. However, Kenstowicz and Rubach (1987) offer an alternative UR-based analysis that draws on the organization of phonological segments into prosodic tiers. They posit that yers are vowels that are unassociated to the syllabic nucleus (x-tier) underlyingly.[4] The core insight of this approach

[2] Deletion analyses, in which a vowel is posited to exist underlyingly and is deleted in certain conditioning environments, dominate. However, insertion analyses are often presented in textbooks on the structure of Russian (e.g., Levin 1978). See Scheer (2011) for citations and arguments against an insertion approach.

[3] See also Gussmann (1980) for a classic generative analysis of vowel-zero alternation.

[4] Szpyra (1992) follows essentially the inverse approach, offering a tier-based analysis of Polish in which yers are analyzed as consuming timing slots but as not having any

was updated and extended by Yearley (1995) for Russian and then adapted by Scheer (2011) for Slovak and Rubach (2016) for Polish. In Rubach's analysis, yers have the same phonological-feature structure as non-yer /e/ but are not associated in the underlying representation with moras. In the process of the derivation, they are then subject to yer vocalization (i.e., association with a mora) or deletion, depending on the phonological context.

As Kenstowicz and Rubach (1987) point out, this latter kind of analysis addresses two problems of the phonological feature approach. First, alternating vowels are never distinct on the surface from non-alternating vowels. Analyses like Lightner's and outgrowths of it must therefore assume coincidental full neutralization of vowel quality in every Slavic language even though yers neutralize with different vowels in different languages.[5] This problem does not arise in Kenstowicz and Rubach's analysis and successors to it. Second, yers condition phonological and morphophonological alternations in exactly the same manner as the vowels with which they are neutralized. This argues against yers and non-yer vowels having underlyingly different vowel quality, something that falls out naturally from analyzing yers as moraless vowels. At the same time, it is questionable whether an analysis based on defective URs—of either flavor—offers the best solution. For one thing, nothing in either kind of analysis prevents yers from occurring in any position in the word in principle, so they fail to capture that alternation occurs only in the final syllable of a morpheme (Gouskova 2012).[6]

Gouskova (2012) and Gouskova and Becker (2013) argue that the fundamental problem lies in the fact that UR-based analyses of both types treat the phonological segment as the locus of exceptionality. They argue that exceptionality should instead be specified at the level of the morpheme. They propose an analysis of Russian vowel-zero alternation that dispenses entirely with the notion of yers—in their analysis, alternating vowels are not underlyingly distinct from nonalternating /e/ and /o/ in any way. Following a proposal by Pater (2006), they offer an Optimality Theoretic analysis in which constraints can be "cloned" (duplicated) and appear in different positions in the constraint hierarchy. "[C]onstraints are indexed to morphemes in the pro-

phonological features.

[5] In Contemporary Standard Russian both /o/ and /e/ participate in alternation, requiring two different underlying yers, but in Polish only /e/ is involved in neutralization. In Slovak a wider range of vowels participate (Scheer 2011).

[6] However, a rejoinder might be that this is an issue of learnability. The right edge of morphemes is the only place where the environment for yer realization is variable. The final syllable is thus the only position in which evidence is likely to be sufficient for the learner to posit an underlying yer. This might be taken as an argument that proposals along the lines of Lightner, Rubach, etc. should not be *responsible* for accounting for the fact that yers occur only in the final syllable of stems.

cess of learning the lexicon... When the learner detects an inconsistency in the target language (e.g., mid vowels delete in some words but not in other phonologically similar words), the relevant constraints are cloned to resolve the inconsistency" (Gouskova and Becker 2013: 742). Morphemes that undergo vowel deletion are indexed to a high ranking version of *MID, a markedness constraint that assigns violations to mid vowels. In interaction with other constraints, this forces mid-vowel deletion in the final syllable of indexed stems when it would not produce a phonotactic violation. By contrast, nonindexed stems are subject to a low ranked version of the same *MID constraint, which forces vowel reduction instead of deletion. Perhaps the most interesting aspect of their analysis is thus that it connects vowel-zero alternation to vowel reduction.[7] Gouskova and Becker analyze that vowel reduction and vowel-zero alternation as alternative solutions to a cross-linguistic dispreference for mid vowels.

This analysis has both strengths and weaknesses. Together, *MID and a series of constraints on syllable structure and phonotactic structure succeed in restricting alternation to the final syllable of indexed morphemes, at least for monosyllabic and disyllabic stems—a distributional pattern that UR-based analyses do not even tackle. However, the fact that a given morpheme can alternate in verbal forms but not in nominal forms, even when the phonological context in the noun predicts deletion, presents a challenge.[8] For example, *vere̲teno* 'spindle' does not alternate in the inflected forms of the noun, whereas the related verb form *vertet´* 'to spin' exhibits mid-vowel deletion.[9]

Gouskova (2012) argues that mid-vowel deletion operates according to different principles in nouns, verbs, and prefixes and prepositions (121–128), and thus "… a unified account is neither possible nor appropriate" (122). She

[7] In Russian, unstressed /o/ generally reduces to [ɑ] or [ə] after hard consonants, depending on position relative to the tonic syllable, and reduces to [i] after soft consonants. Unstressed /e/ generally reduces to [i].

[8] And even within nouns, the model makes a number of predictions. For example, since mid-vowel deletion in initial syllables is governed by whether a nonsyllabifiable cluster would result, the model seems to predict that mid-vowel deletion will occur in the initial syllable of a disyllabic root when preceded by a prefix that allows all consonants to be syllabified. The noun *uroven´* 'level, degree' alternates—*urovnja* (gen. sg). The root is probably *-rov-*, but if, for the sake of argument, the root of *uroven´* were analyzed as *-roven´-*, it would have to be analyzed as an indexed root. The word would then represent an environment where deletion of the /o/ is (counterfactually) predicted in all inflected forms since syllabification could be *ur.ven´*.

[9] Thanks to Yuliia Aloshycheva (p.c.) for bringing this pair of words to my attention. Daniel Collins (p.c.) reports that the noun and verb stem forms historically reflect an ablaut alternation: reconstructed **vert* (full grade) vs. **vrt* → **virt* (zero grade). The Slavonic outcome of the full grade—*vrěteno*—is attested in Old East Slavic. I also thank Jeff Parker and Ekaterina Kibler for discussion of examples.

suggests that verbs and nouns based on the same root can be indexed to different constraints, leading to mid-vowel deletion in one but not the other (90, 101). Her theory is thus not falsified by pairs like *vereteno* 'spindle' and *vertet´* 'to spin'. However, a full analysis would require multiple indexation patterns and possibly multiple sets of indexed constraints, all of which govern mid-vowel deletion. One question is whether this multiplies coincidences into a considerable conspiracy of the grammar. Moreover, Gouskova argues that the difference between nouns and verbs derives in part from a phonotactic constraint, Triconsonantal Cluster Blocking, that applies in nouns but not in verbs. This leads to retention of mid vowels in nouns where they would create a three-consonant cluster but deletion in verbs. Yet a number of pairs like *vereteno* and *vertet´* follow the same distribution (the vowel /e/ is retained throughout the nominal paradigm but lost in the verbal paradigm), but vowel retention in the noun cannot be explained as a result of Triconsonantal Cluster Blocking. This parallelism raises questions about the (purely) phonotactic nature of the distributional pattern.

Overall, while the general approach of treating alternating stems as morphologically (rather than phonologically) exceptional is probably a step in the right direction, questions remain about the exact nature of the generalization. There is not space here to offer a new analysis,[10] but at the very least, moving the discussion from the level of the segment to the level of the morpheme opens up new questions about the relationship between alternation in different lexical categories and frames the issue as one of investigating how the phenomenon inhabits the intersection of morphology and phonology.

Interestingly, Jarosz (2008) offers a cophonology approach to vowel-zero alternation in Polish that is somewhat similar in that constraint ranking is conditioned by specific morphological operations (she focuses on diminutives

[10] Gouskova and Becker (2013) briefly consider a third possible type of account for vowel-zero alternation, namely via lexical specification of the forms of alternating stems—essentially treating vowel-zero alternation as suppletive stem allomorphy. This possibility has received little attention, but they argue against it based in part on the fact that it requires the assumption that suppletive allomorphy can have outwards-sensitive phonological conditioning. Carstairs (1988), among others, argues that such conditioning is impossible, but more recently Wolf (2013) has argued that cases exist. The issue is important because models of serial derivation, in which affixes are attached to stems one after the other in a series of transformational steps, preclude outwards-sensitive phonologically-conditioned allomorphy on principle. In contrast, theories of parallel evaluation (including many variants of Optimality Theory) are in principle consistent with it. The weight of Gouskova and Becker's criticism—and correspondingly, the viability of a stem suppletion approach to vowel-zero alternation—depends on resolution of this broader issue.

and the nominalizing suffix [-stv]).[11] However, Jarosz treats vowel-zero alternation as an issue of paradigm uniformity based on the fact that stress in Polish nouns (unlike Russian ones) is always on the penultimate syllable. Since the outermost suffix determines the cophonology (i.e., ranking of constraints) that applies to a complex word, overriding the properties of the stem (and inner suffixes) where they are in conflict, the strength of the paradigm-uniformity effect produces nonalternation that is unexpected based on the phonological environment alone.[12] The comparison to Russian, in which stress paradigm uniformity does not play an obvious role, highlights that while vowel-zero alternation is a legacy of the fall of the yers that is shared by the various Slavic languages, each individual language offers an opportunity to observe how vowel-zero alternation reflects language-specific properties and their interaction with general constraints.

In summary, analyses of vowel-zero alternation reflect general trends in the development of linguistic theory, with early (and some current) analyses focused on the structure of underlying representations and uniform rules that manipulate those structures, but with more recent analyses reflecting a shift towards positing a uniform underlying representation but an architecture in which grammar is fragmented, with different(ly ordered) sets of constraints applying over sublexicons.

Unlike traditional transformational generative models, some such models can formulate rules either in terms of the base form ("source-oriented generalizations") or in terms of the output form ("product-oriented generalizations"), raising the question of the relative role of each in grammar. This issue was raised already in Bybee (1985) but has gained in importance as models that allow product-oriented generalizations have grown. Becker and Gouskova (2016) find that Russian speakers' judgments of the acceptability of vowel-zero alternation in nonce words reflect sensitivity to both source-oriented generalizations (e.g., there is a strong preference for the stem allomorph that includes the vowel, e.g., *ogon´* 'fire$_{NOM.SG}$', to not end in a consonant cluster) and prod-

[11] Cophonology and indexed constraints are similar approaches to morphophonological alternations in that they both treat constraint ranking in Optimality Theory as conditioned by specific morphological operations (e.g., affixes). However, in the indexed constraint theory there is one constraint ranking for the language as a whole, but some constraints are duplicated, with the higher-ranking version of the constraint being relevant only to morphological operations to which it is indexed. In cophonology theory, by contrast, each morphological operation is associated with its own phonological grammar, and thus there may be multiple distinct constraint rankings within a single language. For overview discussion, see Inkelas and Zoll (2007).

[12] In Jarosz's analysis the ranking requirements of stems and suffixes combine when (and only when) not in conflict. This seems to predict an interesting range of interactions between stem and suffix requirements, but there is not space here to explore them.

uct-oriented generalizations (most importantly, clusters resulting from vowel deletion preferably end in an obstruent followed by a sonorant, for instance [gnʲ] in *ognja* 'fire$_{GEN.SG}$'). Emerging questions have to do with whether and how this kind of sensitivity to lexical distributions defines sublexicons, and the implications of both source-oriented and product-oriented generalizations for morphological theory.

2.2. Velar Mutation and Other Palatalizing Alternations

Some of the same issues arise in the analysis of stem consonant alternations. Palatalizing alternations occur in both inflection and derivation. Some patterns of alternation are found across Slavic (e.g., [k, g, x] ~ [tʃ, ʒ, ʃ], known as "velar mutation" and a remnant of the proto-Slavic First Palatalization of Velars); others are more language specific (e.g., [t, d, s, z] ~ [tʲ, dʲ, sʲ, zʲ] in Russian nominal inflection, or [k, g, x] ~ [ts, z, s] in Croatian nominal inflection). While these can be gathered under the same conceptual umbrella of "palatalizing alternations," in fact they form a family of morphophonological processes, each with its own conditions, distribution, and effect on the stem, rather than being a single coherent process. Even within a single language like Russian, several different "sets" of palatalized alternants (consonant grades) must be recognized (Timberlake 2004: 82–84).

Reflecting this diversity within and across languages, it is not surprising that palatalizing alternations have frequently been the subject of study, including most recently in Polish (Czaplicki 2013; Gussmann 2007), Russian (Gouskova et al. 2015; Gribanova 2008; Kapatsinski 2010; Magomedova and Slioussar 2017a, 2017b; Nesset 2008: Ch. 9), Serbian (Mitrović 2012; Morén 2006), Slovak (Padgett 2011), and Slovenian (Jurgec 2016). Theoretical analyses range across formalist models (e.g., Gribanova 2008; Gussmann 2007; Padgett 2011), the schema- and usage-based approach of cognitive linguistics (Nesset 2008: Ch. 9), and the laboratory phonology tradition (Kapatsinski 2010, 2013), to name just a few.

I focus here on velar mutation in Russian, which represents a particularly interesting example of a mismatch between regularity and productivity. In the established lexicon of Russian, velar mutation always applies before some derivational and inflectional suffixes, including the diminutive suffixes *-ok*/*-ek*/*-ik* and verbal *-i*, shown in (4).

(4)	lu[k]	'onion'	lu[tʃ]-ok	'little/nice onion'
	čelove[k]	'person'	čelove[tʃ]-ek	'little/nice person'
	ban[k]	'bank (financial)'	ban[tʃ]-ik	'little/nice bank'
	dura[k]	'fool'	dura[tʃ]-i-t′	'to fool'
	dru[k] (< /g/)	'friend'	dru[ʒ]-i-t′	'to be friends'
	gre[x]	'sin'	gre[ʃ]-i-t′	'to sin'

Yet Kapatsinski (2010: 362) finds that "... with recent loanwords found in the discourse of Russian-speaking internet users, velar palatalization fails about 50% of the time before [verbal] *-i* and [diminutive] *-ik* while remaining fully productive before *-ek* and *-ok*." Magomedova and Slioussar (2017a, 2017b) find a similar pattern for a wider range of suffixes that condition velar mutation. The challenge is thus twofold: explaining why velar mutation fails at a fairly high rate in borrowings and novel words, despite being fully regular in the established lexicon, and why only with some suffixes. Fundamentally, these get at the question: What makes a morphophonological pattern productive or unproductive?

Analyses that allow reference only to the structural input to alternation (phonology of the input base and suffix) face problems with both issues. They would be forced either to posit distinct, suffix-specific rules of stem morphophonology, but at the cost of failing to capture similarities across the rules (e.g., Cubberley 2002: 134–140), or to posit one general rule at the cost of failing to capture the idiosyncratic application of alternations across different morphological contexts. Moreover, neither predicts the nonproductivity of velar mutation in any obvious way. Recent work has thus shifted towards exploring the role of lexical distributions (incl. sublexicons) and product-oriented generalizations in determining (non)alternation.

Kapatsinski (2010) shows that making statistical generalizations over the lexicon, along with joint selection of stem allomorphs and suffixes, allows his model to capture that the productivity of velar mutation is suffix-specific. He observes that while four suffixes (diminutive *-ok*, *-ek*, *-ik*, and verbal stem extension *-i*) all provide the context for velar mutation, they differ significantly in their likelihood of attaching to stems that end in velar consonants (henceforth, *velar stems*). Assuming here a verb with stem-final /k/ for illustration, the idea is that if velar mutation + suffixation is a joint-selection process,[13] there is competition between three rules/patterns: (i) *k* → *tʃi*, (ii) *k* → *ka* and (iii) *C* → *Ci*, where C stands for any consonant. Using the Minimal Generalization Learner (Albright and Hayes 2002), Kapatsinski models this competition as a probabilistic function of the number of times that the context for a rule occurs in the lexicon and the number of times that a rule actually applies in this context. The more populous the context and the higher the rate at which a rule applies, the higher that rule's confidence. Velar stems tend to form verbs with theme vowel *-a*, rather than theme vowel *-i* (i.e., they overwhelmingly fall into the *k* → *ka* pattern), but *-i* occurs robustly after nonvelars. This boosts the confidence of the general rule *C* → *Ci*, making it greater than the more narrowly

[13] In fact, Kapatsinski argues that in a purely source-oriented model this is a necessary assumption, contrary to the assumptions of traditional generative models in which suffix selection precedes and serves as input to morphophonological alternations.

defined rule *k* → *tʃi*. This predicts the nonproductivity of velar mutation in borrowed and newly coined verbs with theme vowel *-i*. By contrast, velar stem nouns frequently form diminutives with *-ek* and *-ok*, leading a velar palatalization rule, e.g., *k* → *tʃok*, to have greater confidence relative to a more general rule *C* → *Cok*. Sensitivity to lexical distributions is thus central to the model's ability to correctly predict differing productivity of the "same" alternation across different morphological contexts.

In Kapatsinski's analysis, full-word lexical storage is employed to account for the fact that velar mutation after diminutive *-ok* and *-ek* is fully regular in the established lexicon, despite its nonproductivity—instances of (nonproductive) velar mutation reflect word-form storage rather than generation by rule. By contrast, Magomedova and Slioussar (2017b) analyze velar mutation as a question of learning selectional restrictions of affixes based on sublexicons (a cophonology analysis). All instances of both alternation and nonalternation are thus products of the grammar, and since the establishment of sublexicons is part of the acquisition process, they seem to assume no particular role for word-based lexical storage. See also Gouskova et al. (2015), in which generalizations derived from the sublexicons are transferred to diacritics on affixes (within Distributed Morphology). Both assume a less direct relationship between grammar and lexicon than Kapatsinski does.[14]

Despite this and other differences, one interesting convergence among these accounts has to do with the importance of product-oriented generalizations. Based on an artificial grammar learning task with data resembling Russian diminutives, Kapatsinski (2010) argues that whereas "conditioned" product-oriented generalizations (i.e., ones that are based on the transitional probabilities of the consonant and vowel) do not make correct predictions for Russian velar palatalization, "nonconditional" product-oriented generalizations do. (See also Kapatsinski (2013) for discussion of the role of product-oriented schemas in morphophonology.) Similarly, Gouskova et al. (2015) find that product-oriented generalizations are strong predictors of the form of the diminutive allomorph and velar mutation in Russian, and source-oriented generalizations play a more minor role.[15] The relevance of product-oriented

[14] At the other end of the spectrum, see also Nesset (2008), who analyzes palatalizing alternations in Russian verb conjugation using a schema-based approach that makes no principled distinction between lexicon and grammar.

[15] At the same time, Stave et al. (2013) question whether the core generalization underlying nonalternation is morphological in the first place. In an artificial grammar task with English speaking participants, they find that morphophonological alternation similar to Russian velar mutation was more likely to be accepted in a perceptual judgment task than it was to occur in production. Based on this, they argue that pressure towards nonpalatalization derives from perseveration on articulatory gestures—a phonetic pressure. In an artificial grammar task presented to Serbian speakers, Mitrović (2012) finds a similar discrepancy in the production and acceptability of

generalizations to velar mutation extends beyond Russian as well. Perhaps most unusually, Jurgec (2016) finds a dissimilatory effect in Slovenian velar mutation. Mutation in Slovenian is conditioned by particular inflectional and derivational affixes, but for the diminutive suffixes *-c* and *-ica* in particular, velar palatalization is variable; see (5).

(5)	obla[k]	'cloud'	obla[tʃ]-ca	'little cloud'
	bar[k]a	'boat'	bar[tʃ]-ica	'little boat'
	šču[k]	'pike'	šču[k]-ca	'little pike'
	čr[k]a	'letter'	čr[k]-ica	'little letter'

Jurgec argues that nonalternation results from a long-distance phonotactic restriction: "[t]he crucial generalization is that sequences of postalveolars cannot be created by palatalization [...] whereas there are no restrictions applying to underlying postalveolars" (Jurgec 2016: 18–19). This entails the joint relevance of product-oriented and source-oriented generalizations.

Ultimately, the point here is that velar mutation and other palatalizing alternations in Russian, and elsewhere in Slavic, raise issues for the grammar-lexicon relationship. Two themes emerge—the sensitivity of alternation to lexical distributions and the need for product-oriented generalizations—but these leave room for implementation within different theoretical frameworks.

2.3. 1SG Paradigmatic Gaps in Russian Verbs

Paradigmatic gaps—instances of "missing" inflected word-forms, such as in the first person singular of Russian verbs (e.g., **pobežu* 'I will be victorious'; see Table 1), present a different kind of issue for the productivity of inflection. Given that speakers are generally able and willing to produce a full set of inflected forms for novel lexemes, perhaps without even being consciously aware that they are doing so, why is it that for one or more cells in the paradigm of established lexemes, sometimes there is no form at all that speakers will accept or use? Paradigmatic gaps seem to contradict the nearly ubiquitous productivity of inflection.

The Russian 1SG verbal gaps have attracted attention (Albright 2009; Baerman 2008; Baronian 2005; Baronian and Kulinich 2012; Daland et al. 2007; Halle 1973; Pertsova 2016; Sims 2006, 2015) because their distribution follows that of a morphophonological alternation. Specifically, the defective verbs belong almost universally to the subclass of second conjugation verbs that have dental consonants stem-finally (henceforth, *dental stems*). Verbs in this class

palatalizing alternations, although she focuses on questions related to the naturalness of the alternation.

Table 1. Example of paradigmatic gap in the 1sg of Russian verbs (pobedit′, cf. videt′)

videt′ 'to see (ipfv)'	singular	plural	pobedit′ 'to conquer (pfv)'	singular	plural
1st person	vižu	vidim	1st person	—	pobedim
2nd person	vidiš′	vidite	2nd person	pobediš′	pobedite
3rd person	vidit	vidjat	3rd person	pobedit	pobedjat

are subject to a morphophonological alternation in the 1sg (e.g., *vi*[dʲ]*et´* 'to see' ~ *vi*[ʒ]*u* 'I see'). On the other hand, gaps affect only a small percentage of such verbs—about 100 defective verbs conventionally (Halle 1973), although the number may be higher in use (Pertsova 2016)—and the exact relationship between the alternation and the 1sg gaps is open to debate. In other languages in which gaps follow the distribution of an alternation, the predominant approach has been to analyze the gaps as a byproduct of grammar uncertainty (Albright 2009). However, the Russian 1sg gaps are particularly challenging because of the regularity of the alternations, which apply uniformly in the 1sg of second-conjugation verbs in the established lexicon of Contemporary Standard Russian, (*vi*[dʲ]*et´* 'to see' ~ *vi*[ʒ]*u* 'I see'). As with velar mutation in the previous section, this makes them an important test case that informs general questions of productivity and morphological organization.

While the 1sg gaps have long been noted within the Russian grammatical tradition, Halle (1973) brought them to the attention of theoretical linguistics. He proposed a lexically-specified surface filter [–Lexical Insertion] that prevents productively generated inflected forms from being inserted into syntax, resulting in a gap. However, Halle's analysis fails to predict that the distribution of the gaps follows a morphophonological alternation, since in principle any lexeme can be specified as [–Lexical Insertion] (Albright 2003). This and other issues have driven a range of alternative analyses that seek to explain the 1sg gaps in terms of the structure and function of the inflectional system of verbs. Three main approaches can be discerned. I will call these the grammar uncertainty argument, the analogical learning argument, and the lexical conservatism argument.

The essence of the grammar uncertainty argument is that paradigmatic gaps get "caught" between different rules/schemas, with no acceptable output form. Albright (2009) proposes that paradigmatic gaps occur when the rule does not meet some minimal threshold of confidence. Within the Minimal Generalization Learner, one way that this can happen is if generalizations are sufficiently fragmented because rule confidence is a function of the number of word types that follow the rule and the total number of word types to which a rule is applicable. Albright sketches (but does not fully implement) a possible analysis of the Russian 1sg gaps that focuses on different stress patterns

within the present tense paradigm in combination with the regular 1SG alternations as the basis for fragmentation of generalizations about the 1SG form.

Baronian and Kulinich (2012) likewise offer a grammar uncertainty argument, but their approach is to deny the regularity of the 1SG alternations, bringing Russian in line with other languages in which gaps parallel the distribution of a variable alternation. It is widely documented via controlled production experiments and internet data that Russian speakers do not uniformly produce the 1SG alternations in borrowings, nonstandard native words, and nonce inflection tasks (Baronian and Kulinich 2012; Pertsova and Kuznetsova 2015; Sims 2006; Slioussar and Kholodilova 2013). Baronian and Kulinich posit that this fragmentation, in combination with different alternations in the past passive participle, lead to a series of small, fragmentary schemas for the 1SG. They argue that 1SG gaps occur deterministically when verbs "slip through the cracks" of existing schemata.

Grammar uncertainty accounts, of either flavor, have at least two appealing properties. First, they directly connect the 1SG gaps to the 1SG alternation seen in Table 1; the alternation is partly or fully the source for fractured generalizations about inflectional form. Second, they unify the analysis of Russian with that of other languages in which gaps parallel the distribution of an alternation. At the same time, grammar uncertainty accounts rely on data sparsity—they posit that an insufficient number of examples exist to establish a reliable generalization about the 1SG and that Russian speakers are unable to generalize from other verbs. However, Pertsova (2016) finds no correlation between defectiveness in the 1SG of verbs and the sparsity of inflectional subclasses. Baronian and Kulinich's analysis, in particular, is also in tension with the fact that gaps occur in the standard language, yet the alternation is fully regular in the standard language.

Daland et al. (2007) (further elaborated in Sims 2015: Ch. 7) approach the Russian 1SG verbal gaps as a statistical learning problem and model the generational persistence of the gaps as a joint product of word-specific and analogical learning. Using a Bayesian learning algorithm, paradigmatic gaps are modeled as a lexical gang in which morphological behavior (defectiveness) is reinforced by the morphophonological clustering of the defective verbs, parallel to how irregular past tense forms in English are supported by their lexical neighborhoods (e.g., English past tense *hit*, **hitted*) (Bybee and Moder 1983). Gaps in high token frequency lexemes (e.g., POBEDIT′ 'vanquish') are learned based on the frequency distribution of the paradigm—essentially, by observing that the 1SG is encountered significantly less than is expected. In verbs which are sparsely attested and for which the distribution of forms is not by itself sufficient to infer a 1SG gap (perhaps GALDET′ 'make a hubbub'), gaps are generalized based on analogy to lexical neighbors with a similar morphophonological shape. This means that defectiveness is treated as a weakly productive morphological pattern.

The model has been criticized for missing the generalization that gaps follow the distribution of a morphophonological alternation (Baronian and Kulinich 2012), but this criticism is valid only under an overly narrow understanding of explanation. It is true that in Daland et al.'s analysis, the distribution of gaps is not a direct product of the alternation. However, neither does this mean that the model predicts gaps to be randomly distributed. In Russian the gaps are historically related to morphophonological alternation in the first person singular (Baerman 2008), but the insight underlying Daland et al.'s work (largely consistent with Baerman's historical investigation) is that once the morphophonological distribution of defective verbs is established, it can function in its own right to perpetuate the gaps, regardless of the reliability of the 1sg alternation. Indeed, their computational simulations successfully model the generational stability of the 1sg gaps only when given access to information about morphophonological neighborhoods. The model thus locates the explanation for the distributional facts in the structure of lexical neighborhoods and their ability to reinforce and perpetuate irregular morphological patterns, in other words, in historical processes of lexicalization. Moreover, the model uniquely predicts a prototypicality effect whereby verbs that are more phonologically similar to ones with 1sg gaps should be more likely to maintain or develop gaps themselves. There is evidence for such a pattern, centered around stems ending in /dʲ/ and then becoming weaker with greater phonological feature distance (Sims 2015: 213).

One potential weakness of Daland et al.'s model has to do with its prediction that gaps should occur disproportionately in high-frequency verbs. This is an open issue—no convincing data exists regarding the frequency distribution of the defective verbs relative to the lexicon as a whole. However, Daland et al.'s model makes the opposite prediction to other models. Evidence that gaps in Russian occur disproportionately among low-frequency verbs would pose problems for Daland et al.'s model in particular.

Finally, Pertsova (2016) offers an account based on the idea of lexical conservatism (Steriade 1999). Her analysis is rooted in the fact that the past passive participle (along with some other inflectionally and derivationally related forms) often but not always has the same alternation as the 1sg (e.g., vyrazit' 'to convey (pfv)', 1sg *vyra*[ʒ]*u*, ppp *vyra*[ʒ]*ennyj* but videt' 'see', 1sg *vi*[ʒ]*u*, ppp *vi*[dj]*ennyj*).[16] She shows convincingly that failing to have the alternation in the participle, or in another morphologically related form, statistically predicts having a gap in the 1sg. Based on this, she argues that speakers are reticent to innovate new stem allomorphs.[17] As formulated in Harmonic Gram-

[16] See Feldstein (1986) for discussion of these alternations synchronically and Baerman (2008) from a historical perspective.

[17] A reviewer challenged this idea of lexical conservatism on the grounds that innovative stems do not always (probably not even frequently) produce paradigmatic gaps.

mar, if the alternating stem does not independently exist in the past passive participle or elsewhere in the system, this lowers the well-formedness of a 1SG candidate with the alternation, and if the most optimal candidate is below a certain threshold of well-formedness, defectiveness is the result. The essence of the analysis is thus that dental stem verbs are defective in the 1SG *except* when the same alternation is found in morphologically-related forms, such as the past passive participle.

Pertsova's account is appealing for the way it connects 1SG defectiveness to alternation in the past passive participle and other related forms. In this respect it is similar to Baronian and Kulinich's account, but Pertsova's additionally predicts the demonstrated gradience of the 1SG gaps. At the same time, it leaves unresolved *why* speakers should be reluctant to use the alternating stem. Her model treats the 1SG alternation as "saveable" based on paradigmatic implications. But it is unclear why alternation should be problematic to start with, given its regularity in the standard language. (Unlike Baronian and Kulinich's model, variability of the alternation in nonstandard varieties plays no direct role in Pertsova's model.) Moreover, it is unclear why alternation in the 1SG should become less well-formed by virtue of its relationship to the past passive participle. Recent work on the implicative structure of paradigms has suggested that knowledge of other paradigmatic forms can facilitate, but not worsen, the predictability of an inflected form (Ackerman et al. 2009). Contrary to this, Pertsova's model proposes that knowing another form of the same verb can inhibit the predictability of the 1SG.

These analyses raise a range of empirical questions, making different predictions about the 1SG verbal gaps, as shown in Table 2. The analyses also engage with important questions about the relationship between rules versus lexicalized forms and the nature of paradigmatically associated structures in the lexicon. Some of the empirical questions remain open, but progress made towards solving the problem of the Russian 1SG gaps derives in no small part from models leveraging information about lexical and paradigmatic distributions.

The reviewer cited the case of *tkat´* 'weave' and a small number of similar examples—the form *tkëš´* 'you weave' (historically from *tъčeš´*) produced not only a paradigmatically novel stem, but also a new quasiphoneme of Russian /kʲ/ (Flier 1982; Parker 2015). It did not produce a gap. While this is an interesting issue and example, it is a complicated one because lexical conservatism is not meant to be deterministic—it is certainly not impossible for people to innovate new stems. Pressures towards lexical conservatism must be considered in the context of other systemic pressures. So a full evaluation of the idea requires more careful explication of the issues than is possible here.

Table 2. Predictions for 1sg verbal gaps in Russian

Prediction	Albright (2009)	Baronian and Kulinich (2012)	Daland et al. (2007)	Pertsova (2016)
Gradient gaps?	Y	N	Y	Y
Phonological prototypicality effect?	?	N	Y	N
Related to past passive participle?	not central	Y	not central	Y
Affects mostly low frequency verbs?	Y	Y	N	Y

2.4. Interim Summary

These three phenomena—vowel-zero stem alternation, velar palatalization, and first person singular verbal gaps—are all classic problems of Slavic linguistics, in large part because they have been resistant to adequate analysis in classical generative models. The studies discussed here start from very different assumptions and highlight ways in which models that intertwine the lexicon and grammar have made progress in analyzing previously intractable aspects of the phenomena, including their idiosyncratic lexical distributions and problems of productivity. In turn, this progress raises new theoretical questions that pull classic problems of Slavic morphology into current debates in linguistics.

3. Morphosyntax: Animacy-determined Syncretism

I now turn to a single phenomenon at the morphology-syntax interface: animacy-determined syncretism in the accusative of Russian nouns, pronouns, and adjectives. Syncretism is when a single morphophonological word-form realizes two or more distinct sets of morphosyntactic properties that are syntactically-licensed for a given lexeme. It thus represents a situation in which the morphology is insensitive to a distinction made within the syntax. Syncretism has become central to theorizing about inflectional morphology and the morphology-syntax interface because of the challenges that it presents for formal description, and the Russian accusative occupies a particularly important place within this debate.[18] In this section I illustrate a

[18] The other Slavic languages with nominal case marking have similar patterns of animacy-based syncretism. However, I leave these aside since the facts differ to some extent from language to language.

Table 3. Animacy-based syncretism in Russian nouns

	I INAN	I ANIM	III INAN	III ANIM	IV INAN	IV ANIM
	ZAVOD 'factory'	OTEC 'father'	KOST′ 'bone'	MAT′ 'mother'	MESTO 'place'	ČUDOVIŠČE 'monster'
NOM SG	zavod	otec	kost′	mat′	mesto	čudovišče
ACC SG	zavod	otca	kost′	mat′	mesto	čudovišče
GEN SG	zavoda	otca	kosti	materi	mesta	čudovišča
DAT SG	zavodu	otcu	kosti	materi	mestu	čudovišču
LOC SG	zavode	otce	kosti	materi	meste	čudovišče
INS SG	zavodom	otcom	kost′ju	mater′ju	mestom	čudoviščem
NOM PL	zavody	otcy	kosti	materi	mesta	čudovišča
ACC PL	zavody	otcov	kosti	materej	mesta	čudovišč
GEN PL	zavodov	otcov	kostej	materej	mest	čudovišč
DAT PL	zavodam	otcam	kostjam	materjam	mestam	čudoviščam
LOC PL	zavodax	otcax	kostjax	materjax	mestax	čudoviščax
INS PL	zavodami	otcami	kostjami	materjami	mestami	čudoviščami

subset of the issues involved by comparing two specific options for formally accounting for the Russian accusative pattern—referrals and impoverishment.

3.1. The Russian Accusative

The basic facts of the Russian accusative are well known; the pattern for nouns is as shown in Table 3. In the plural of all declension classes, accusative is syncretic with nominative when the referent of the noun is inanimate and syncretic with genitive when animate.[19] In the singular, the same pattern is found only in Class I, the prototypical masculine class. In Class III (virtually all of which are feminine) and Class IV (neuters), nominative and accusative are syncretic regardless of animacy. Class II nouns (e.g., KNIGA 'book', not shown) never have the accusative syncretism pattern in singular, even when masculine (e.g., DEDUŠKA 'grandfather': ACC SG *dedušku*, GEN SG *deduški*).

Adjectives follow a similar pattern. As shown in Table 4, adjectives have genitive-accusative syncretism in plural when agreeing with an animate controller and nominative-accusative syncretism otherwise. Masculine adjectives likewise parallel Class I nouns in having animacy-based syncretism in accusative singular. Russian thus illustrates *metasyncretism* (Williams 1994), in which a pattern of syncretism is repeated across inflection classes and/or parts of speech, but instantiated by different phonological forms. By contrast, personal pronouns always have genitive-accusative syncretism regardless of gender, number, or animacy. These distributional patterns are important because they strongly suggest that the syncretism reflects a systematic fact of the grammar, not simply accidental homophony.

Table 4. Animacy-based syncretism in Russian adjectives

		MASCULINE SINGULAR	NEUTER SINGULAR	FEMININE SINGULAR	PLURAL
NOMINATIVE		xorošij	xorošee	xorošaja	xorošie
ACCUSATIVE	INANIMATE	xorošij	xorošee	xorošuju	xorošie
	ANIMATE	xorošego			xorošix
GENITIVE		xorošego	xorošego	xorošej	xorošix
DATIVE		xorošemu	xorošemu	xorošej	xorošim
LOCATIVE		xorošem	xorošem	xorošej	xorošix
INSTRUMENTAL		xorošim	xorošim	xorošej	xorošimi

[19] Which referents count as "animate" has expanded over time, with nouns like GUBKA 'sponge' and MIKROB 'microbe' representing the current leading edge of the expansion. These exhibit variation; see Timberlake (2004: 165–71) for discussion.

The Russian accusative is also an example of what Baerman et al. (2005) call *convergent bidirectional syncretism*. Directional syncretism is the term for a distribution of forms in which the shared exponent is somewhere in the inflectional system associated uniquely with only one of the cells (morphosyntactic property sets), allowing us to identify "source" and "recipient" cells for the exponent. (The terms "source" and "recipient" are meant here in a purely descriptive sense.) For instance, in inanimates, /-i/ is an exponent of nominative plural even when not syncretic with accusative. The "source" cell is thus nominative; accusative is the "recipient" cell. In animates, the genitive is the "source" cell and accusative is the "recipient" cell by the same logic. Convergent bidirectional syncretism is when two directional syncretisms form a symmetric pattern in which cell A (accusative) is syncretic sometimes with cell B (nominative) and sometimes a different cell C (genitive).

Virtually all modern theories employ feature underspecification to account for at least some kinds of syncretism, particularly ones that affect natural classes or can be construed as default forms. However, there is a general consensus that underspecification is not sufficient by itself to account for directional syncretism (Baerman et al. 2005; Harley 2008; Stump 2001), and debate has centered on identifying which formal tools need to be added to the toolbox.[20] The Russian accusative is an important test case for several reasons: because of the convergent bidirectionality of the pattern, which creates interesting rule interactions, because of the different distributions of syncretism in singular and plural, and because of the parallelism (and lack thereof) between nouns, adjectives, and pronouns.

3.2. Referrals

In many respects the debate over which formal mechanisms to add has been a referendum on rules of referral as a theoretical tool. This makes it a useful place to begin. The fundamental insight behind referrals (and impoverishment) is that syncretism reflects two different kinds of information about inflectional exponence. One is the standard sort of mapping from morphosyntactic properties to morphophonological form. The other relates one set of morphosyntactic properties to another. Metasyncretism, in particular, motivates theoretical tools for stating generalizations about the second kind of

[20] Extrinsic rule ordering can handle some directional syncretisms, including the convergent type (Baerman et al. 2005: 139) and full neutralizations (e.g., the lack of gender expression in plural in Russian) (Bobaljik 2002: 57–58). However, many theories of inflectional morphology prefer specificity-based rule ordering because it is more restrictive and requires less ad hoc machinery. Harley (2008) argues that proper use of impoverishment (see discussion below) will often even obviate the need for extrinsic rule ordering. I do not here consider extrinsic rule ordering approaches to the Russian accusative.

information, independently of morphophonological form. The ultimate goal is to capture a pattern of syncretism through a unified statement about the morphosyntactic property sets that are within its domain. Zwicky (1985) posited *rules of referral*, which map one set of morphosyntactic properties to another (these are thus directional feature-changing rules), and *rules of exponence*, which map morphosyntactic properties to form. Referrals are designed specifically to handle directional syncretisms and/or metasyncretisms, as a complementary tool to underspecification.

Referrals are generally associated with Word and Paradigm models, but Halle's (1994) early illustration of Distributed Morphology based on Russian nominal and adjectival inflection incorporates referrals.[21] Distributed Morphology is a syntactically-oriented transformational theory. Surface morphological forms are derived by application of a series of rules that transform the terminal nodes that are output of the syntax into successive intermediate representations. In the theory's architecture there is no single morphological component (hence morphology is "distributed" within the grammar). Instead, morphological operations are divided among multiple, ordered components of the grammar. Most relevantly here, in his early instantiation of the theory, Halle (1994) posits a Morphophonology component containing Readjustment Rules that can change one morphosyntactic value into another (or delete values). Spell-out rules then interpret abstract morphemes in terms of phonological form.

Halle formulates the four Readjustment Rules in (6) to account for the major part of the syncretic accusative pattern in Russian nouns. I have modified the format slightly for ease of representation. (Note: Halle uses different class labels than in Table 3 above. In his terminology, a-stems (e.g., KNIGA 'book') are class I; the masculine and neuter o-stems (e.g., ZAVOD 'factory', MESTO 'place') are class II; and i-stems (e.g., KOST′ 'bone') are class III.)

(6) a. Acc → Gen / {[+animate]A,N}Q, Pl
b. Acc → Gen / {[+animate, Class II]A,N}Q
c. Acc → Nom / {}Q, Pl
d. Acc → Nom / {Class II}Q

All four rules are referrals. Q stands for an abstract morpheme bearing the properties in curly brackets. Thus, (6c) says that accusative is changed to nominative in the context of plural plus an abstract morpheme with any features. The underspecification of the abstract morpheme's properties treats nominative-accusative syncretism as the "elsewhere" form. Rule (6a) bleeds (6c)

[21] For a more recent analysis of Russian adjectives within Distributed Morphology, see Halle and Matushansky (2006).

because rules are ordered by the Subset Principle (i.e., specificity-based ordering). (6b) likewise bleeds (6d). In Halle's analysis, nominative-accusative syncretism in Class III is handled separately: both the nominative and accusative are subject to a default spell-out rule that is unspecified for case and number features and inserts a jer at the end of the stem. (This is subsequently deleted by a rule of the Phonology.) The analysis thus utilizes underspecification (Class III singular), referrals (other instances of accusative syncretism), and a combination of the two (e.g., underspecified referral in (6c)).

To the extent that this analysis is successful in capturing syncretism as a systematic fact of the morphology, it does so by formulating separate statements for the two kinds of morphosyntactic information. However, notice that it posits two different referrals for genitive-accusative syncretism and two for nominative-accusative syncretism. If we were to include pronominals, in which genitive-accusative is found in both animates and inanimates, more would be needed since (6a, b) apply only to animates but pronouns exhibit the "animate" pattern (genitive-accusative syncretism) even for inanimates.[22] This repetition of similar patterns of syncretism across classes, number values, and parts of speech is an accident within the analysis.

Within the Word and Paradigm framework, this problem has been solved by combining referrals with richer modeling of morphosyntactic feature structure (a.k.a. inflectional paradigm structure) and lexical knowledge. Here I look specifically at Network Morphology (Baerman et al. 2005; Brown and Hippisley 2012; Corbett and Fraser 1993), which builds in the key observation that when rule application depends on specific properties, greater generalization is possible if those properties can be inferred based on other information about the lexeme rather than stated directly in the rule. The inheritance hierarchy is the primary tool for this.

Network Morphology is a declarative theory, meaning that rules are definitions of the language (licensing statements). Rules in Network Morphology are represented at nodes in lexical networks; nodes are related by inheritance relations. Rules are inherited by default by lower nodes (this is a *hierarchy relation*). However, a node can also directly specify the node from which inheritance should take place for some set of properties (this is a *network relation*). The overarching principle of default inheritance is that the more general (widely distributed) information about exponence is within the inflectional system, the higher it is specified in the hierarchy.

[22] It also requires Halle to assume that adjectives have "inflection classes" defined by gender, such that masculine adjectives are "class II" and so on. This violates a general understanding of inflection classes as being lexically-conditioned; in this analysis, all adjectives belong to all "classes", since they have forms for all genders.

Following Brown and Hippisley (2012: 143–44) (with minor simplification),[23] the realizational rules in (7) are relevant to accusative syncretism in Russian.

(7) a. NOMINAL: <mor sg acc> == ACCUSATIVE: <sg "<syn gender>" "<syn animacy>">

b. NOMINAL: <mor pl acc> == ACCUSATIVE: <pl "<syn animacy>">

c. NOMINAL: <mor case masc animate> == "<mor case animate masc>"

d. NOMINAL: <mor case> == nom

e. NOMINAL: <mor case animate> == gen

f. ACCUSATIVE: <$number> == "<mor $number "<mor case>">"

In the notation of DATR, the string in capitals before the colon specifies a node in an inheritance network.[24] The equation following the colon is a realizational rule specified at that node. The left-hand side of the equation is an *attribute* (also called a *path*) and the right-hand side is the *value*. Notations in quotes, e.g., "<syn gender>", indicate that the value must be evaluated based on information elsewhere in the network structure; the resulting value may differ from one lexeme to another.[25]

There is not space here to walk through the analysis in detail (see Baerman et al. 2005: 248–53; Brown and Hippisley 2012: 143–44), but if a noun lexeme inheriting these rules is animate and masculine, then the accusative eventually evaluates as in (8a, b). If it is inanimate, accusative evaluates as in (8c, d).

(8) a. ACCUSATIVE: <sg masc animate> == "<mor sg gen>"

b. ACCUSATIVE: <pl animate> == "<mor pl gen>"

c. ACCUSATIVE: <sg inanimate> == "<mor sg nom>"

d. ACCUSATIVE: <pl inanimate> == "<mor pl nom>"

[23] The simplification has to do with (6f). Brown and Hippisley posit two separate rules, one for singular and one for plural. For ease of exposition, I have merged these into a single rule containing a number variable. Also note: *mor* is an abbreviation for *morphological*, meaning simply that the rule is part of the morphological information of the lexeme (as opposed to semantic information, syntactic information, etc.).

[24] DATR is a programming language for lexical knowledge representation.

[25] More technically correct, the quotes indicate that the value must be evaluated globally, meaning with scope over the entire network, not only internally to that node (Corbett and Fraser 1993: 123–24).

Rules (7a–e) are all located at the NOMINAL node, which is superordinate to nouns and adjectives. As a result, the evaluated referrals in (8) will be inherited by default by adjectives as well as nouns since both parts of speech inherit from NOMINAL by default. This handles the problem of metasyncretism. In the present context, (7d) and (7e) are of primary importance since they are the formulation of referrals in this analysis. Note that these rules are not conditioned by number or inflection class, unlike Halle's formulation of referrals in (6). This is because the work of restricting the syncretism to certain classes/genders in singular is done by a combination of mechanisms: underspecification, overrides of default inheritance (for class II singular nonsyncretism), path extension (an aspect of feature structure), and statement evaluation. First, we can observe that (7a) extends the path for accusative with gender and animacy values—this is the theory's way of stating that these values are relevant to evaluation of the accusative singular.[26] Second, evaluation of the referral statements in (7d, e) ultimately depends on the animacy and gender values inherited by the target lexeme. It is how Network Morphology can "… talk about properties which may be specific to lexical items without requiring us to state all the specific values in order to formulate the rule" (Brown and Hippisley 2012: 82). Ultimately, path extension and the network-embedding of inflectional information are what allow for a single, unified statement for each of the syncretisms (i.e., one for genitive-accusative identity and one for nominative-accusative identity).

The important point here is that embedding referrals in a rich lexical structure allows Network Morphology to capture parallelisms in how animacy-based syncretism applies throughout Russian nouns, adjectives, and pronouns. This analysis avoids the grand coincidence that Halle's analysis encounters. At the same time, the flip side to this rich expressive power is a (perceived or actual) lack of restrictiveness. Referrals are frequently criticized for being nonrestrictive (e.g., Bobaljik 2002; Müller 2004).[27] After all, nothing inherently prevents one set of morphosyntactic values from being specified

[26] Network Morphology's approach to underspecification is rooted in attribute ordering and path extension. Attribute ordering means that features are ordered lists, so {A B C} and {B C A} are nonidentical. Path extension is based on this: {A B C D} is an extension of {A B C} and {A B} but not {B C A}. The principle of path extension and specification of inheritance source define specificity-based rule ordering. Since {A B C} is more specific than {A B}, a lexeme associated with values {A B C D} will be realized by a rule with conditioning factors {A B C} if that is the most specific realization rule in its inheritance path and in the absence of overriding information.

[27] For a comparison of referrals and impoverishment based on restrictiveness and other evaluation metrics, see Kramer (2016).

as syncretic with any other set of values.[28] Not all linguists agree that restrictiveness is of paramount importance (e.g., Baerman 2004), but it is an omnipresent issue in discussions of theory evaluation—and often considered to be second in importance only to empirical adequacy. For theories in which the importance of restrictiveness is axiomatic, a theory that is equally empirically adequate, but more restrictive, should be preferred. This sets up the debate as a referendum on the necessity of referrals and the restrictiveness of the alternatives. In the following section I discuss a prominent alternative, feature impoverishment, and how it has been applied to Russian accusative syncretism.

3.3. Impoverishment

Impoverishment, a theoretical tool within Distributed Morphology, is rooted in the hypothesis that "directionality" effects in syncretism reflect the markedness of the feature values involved (Bonet 1995). Impoverishment involves feature deletion postsyntactically but prior to Vocabulary Insertion, i.e., prior to realization of morphosyntactic values by morphophonological form. Impoverishment and referrals are similar in many respects. Both allow for statements that two or more sets of morphosyntactic values are realized by the same morphological exponent, independently of what the actual phonological form of the exponent is. (This property derives from the fact that Distributed Morphology and Word and Paradigm theories are both realizational. See Stump 2001 for this terminology.) Impoverishment, like referrals, is thus well suited to accounting for metasyncretisms that cannot be adequately captured by underspecification alone (Harley 2008).

However, there are significant differences between impoverishment and referrals, two of which are relevant here. First, referrals allow for direct reference to the morphosyntactic properties of other paradigm cells (e.g., "accusative plural has the same form as genitive plural in the context of animate"), whereas impoverishment allows feature deletion, but no paradigmatically-oriented references of this sort. Second, it is generally assumed in Distributed Morphology that impoverishment must be in the direction of the unmarked value. So-called directional syncretism thus represents an example of the emergence of the unmarked form. These two properties serve to constrain impoverishment. Bobaljik (2002), among others, emphasizes the role that restrictiveness

[28] Since the interpretation of referrals depends on attribute ordering in Network Morphology, the theory in fact makes predictions about the distribution of syncretism (Brown and Hippisley 2012: 57, 169). And in practice theories that employ referrals tend to implicitly or explicitly restrict their use. At the same time, in Network Morphology the predictions are probabilistic, in the sense that attribute ordering predicts certain patterns of syncretism to be cross-linguistically common or uncommon, but in individual languages these can always be overridden. This is thus not restrictiveness in the strict sense of certain patterns of syncretism being absolutely disallowed.

plays in Distributed Morphology, arguing that impoverishment is superior to referrals and paradigm-based alternatives in general.

However, impoverishment is only as restrictive as the assumptions that are built into it about allowed feature structures and allowed operations. The most restrictive versions of impoverishment allow only deletion of marked features. In this context, the bidirectional pattern of accusative syncretism in Russian presents a particularly interesting test case. In broad terms, it is easy to formulate an analysis in which the accusative (or some subvalue of accusative) is deleted prior to Vocabulary Insertion, resulting in accusative "looking like" nominative, because of the widespread assumption of nominative unmarkedness (Bobaljik 2002: 82). However, it is more difficult to account for genitive-accusative syncretism.

Harley (2008) works out an analysis of Baoan (ISO 639-3: peh), which has a convergent bidirectional pattern of syncretism that resembles the Russian accusative.[29] In Baoan, the accusative has the same form as the genitive in nouns, but in pronouns, the accusative has the same form as the dative/locative. In her analysis, Harley subdivides cases into three subfeatures: [+/– structural], [+/– dependent], and [+/– oblique] (partly following Halle 1997). Since accusative and genitive share the feature [+ structural], they are both realized by the same Vocabulary Item in nouns, which bears the same marked feature but is otherwise underspecified. By contrast, syncretism between accusative and dative/locative in pronouns is analyzed as impoverishment of the accusative representation—specifically, deletion of the marked feature [+ structural] in the context of [+ participant].[30] This has the effect of giving accusative and dative/locative the same feature representation for the purpose of Vocabulary Insertion. This thus constitutes a kind of emergence of the unmarked.

We might ask whether a similar kind of analysis could be carried over to Russian. The availability of such an analysis depends crucially on assumptions about the feature structure of the Russian cases and markedness relations in the case system. In a footnote at the end of his paper, Bobaljik (2002) briefly sketches an analysis of Russian accusative syncretism based on the feature structure proposed by Jakobson (1958/1984). Jakobson's system of case features is given in Table 5.

[29] The language is classified under the name Bonan by Ethnologue (https://www.ethnologue.com/language/peh; accessed 9 Oct 2017), but Baoan is the name that Harley uses in her paper. According to Ethnologue it is an Eastern Mongolic language of south central China, with approximately 6,000 speakers.

[30] To make the ordering of Vocabulary Items work out (since they are not fully ordered by the Subset Principle), Harley also employs a feature hierarchy.

Table 5. Jakobson's (1958/1984) system of invariant case features

	Marginal (Peripheral)	Directional	Quantificational
Nominative	—	—	—
Accusative	—	+	—
Dative	+	+	—
Instrumental	+	—	—
Genitive	—	+	+
Locative	+	+	+
Genitive 2	—	—	+
Locative 2	+	—	+

Bobaljik proposes to account for genitive-accusative syncretism by impoverishing [–Quantificational]. However, Jakobson treats positively valued features as marked, and negatively valued ones as unmarked, so Bobaljik's idea either requires a redefinition of markedness relations away from Jakobson's own formulation or has to allow for impoverishment of unmarked features, which would represent a significant loosening of the restrictiveness of impoverishment.[31]

Of course, it is not necessary to use Jakobson's features. Müller (2004) proposes an alternative analysis of Russian nominal inflection that decomposes both inflection classes and morphosyntactic cases into binary subfeatures (for classes: +/– alpha, +/– beta; for case: +/– subject, +/– governed, +/– oblique). A centerpiece of the paper is his use of impoverishment to account for animacy-based syncretism in accusative. The most important thing in this context is to observe that unlike most work in Distributed Morphology, the notion of impoverishment that he employs is quite weak. He proposes two feature-changing rules, one to account for class I singular (9a) and one to account for plural in all classes (9b).

(9) a. [–subj, –obl] → [+subj, +obl] / [+alpha, –beta], [+anim]

b. [–subj, –obl] → [+subj, +obl] / [+pl], [+anim]

Given that genitive has the values [+subj, +gov, +obl] and accusative has the values [–subj, +gov, –obl], the rules in (9) have the effect of changing accusative into genitive in the context of relevant number, animacy, and inflection

[31] The same issue exists if Jakobson's first formulation of case features is used (Jakobson 1939/1984).

class values. However, unlike strict versions of impoverishment in which only deletion of marked values is allowed (Bonet 1995), or value changing is allowed but only in the direction of the unmarked (Noyer 1998), Müller posits feature changing from unmarked (which is inherently defined in terms of a negatively signed feature) to marked, as shown in (9). Ultimately, Müller's proposal is no different in substance than a rule of referral, although it is couched in different terminology.

There may be a distribution of features that allows for an adequate impoverishment-based analysis of the bidirectional syncretism of the Russian accusative. From the discussion here we cannot draw the conclusion that such an analysis is impossible. However, the point is that while evaluation of referrals has centered primarily on their lack of restrictiveness, evaluation of impoverishment centers around their empirical adequacy, and whether restrictiveness needs to be loosened (and how) to maintain empirical adequacy. Any proposal needs to be assessed not only based on its ability to produce the empirically observable facts, but also according to whether it maintains a level of restrictiveness that is greater than that of referrals. As Harley (2008) shows, at least some bidirectional syncretisms can be handled via impoverishment, but as the discussion here highlights, the devil is in the details of feature specifications.[32]

3.4. Interim Summary

In summary, underspecification by itself is insufficient to account for many patterns of syncretism, including Russian animacy-determined syncretism in accusative. The choice then becomes one of what theoretical tools should be added to the mix. Although referrals are not inherently constrained, they must be evaluated in the context of alternatives. The most prominent alternative is impoverishment in Distributed Morphology. The rich notion of lexical relatedness that Word and Paradigm models can capture, and which some Word and Paradigm models offer in trade for restrictiveness, bears fruit when it comes to capturing the accusative distribution. However, if impoverishment can adequately capture the bidirectional pattern while maintaining restrictiveness, then this approach should be preferred. This question is not fully settled. Russian accusative syncretism thus shows how complex patterns of syncretism can offer meaty data for theories of inflectional morphology.

[32] Baerman (2004) argues that divergent bidirectional syncretism is even more challenging than the convergent type.

4. Conclusions

Di Sciullo and Williams (1987: 3) famously said that the lexicon "… is incredibly boring by its very nature […] Those objects that it does contain are there because they fail to conform to interesting laws. The lexicon is like a prison—it contains only the lawless, and the only things its inmates have in common is lawlessness." This reflects a particular conceptualization of the relationship between grammar and lexicon, prevalent in transformational generative grammar, that assigns irregularities to the lexicon and regularities to the grammar. However, one theme that emerges from the work discussed here has to do with the benefits of lexical models in which lexicon and grammar are fundamentally intertwined. A diverse range of empirical phenomena, immune to adequate analysis under older models, have become tractable and better understood in the context of theories that intermingle lexicon and grammar.

In this review perhaps the most striking examples of this are velar palatalization and the 1sg verbal gaps in Russian. The nonproductivity of a regular pattern of velar palatalization makes no sense in the context of a model in which the rule of velar palatalization is divorced from the words that instantiate it. Yet with reference to this information, nonproductivity can be understood as a product of competing generalizations. The persistence of the 1sg verbal gaps is a quite different phenomenon in many respects, but here again, access to rich lexical information about the words that exhibit defectiveness proves crucial to successfully modeling their persistence and distribution. Vowel-zero alternation also bears on questions of this sort. Not surprisingly, rich lexical models are more diverse than models that treat the lexicon purely as a prison for those aspects of language that do not conform to general principles, and the substantial differences between these frameworks are not to be understated. But they illustrate some of the ways in which a structured lexicon has been employed in the analysis of Slavic morphology to productive end.

As the example of Russian accusative syncretism highlights, the version of this debate within formalist models often plays out in terms of questions about the value of different kinds of theoretical tools: Should paradigmatically-oriented generalizations (i.e., referrals) be allowed? Should our theory instead employ subfeatures? Impoverishment? Extrinsic rule ordering? Thus here too the nature of lexical knowledge has become an issue of central debate, with models like Network Morphology exploring and exploiting lexical knowledge to maximize generality, but at a substantial cost to restrictiveness. On the other end, restrictive tools like impoverishment raise questions of empirical adequacy. Slavic morphological data are likely to continue to play a prominent role in this discussion.

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