Morphological Conditioning of Phonological Regularization*

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Abstract

We analyze three types of cases in which exceptional morphemes become regular in the presence of other morphemes (*regularization effects*). Vowel deletion in some Russian prepositions depends on the root that follows the preposition and also on the suffix that follows the root. In Japanese, dominant suffixes assign an accentual pattern to accented roots, but in Slovenian, dominance is conditional—revoked by another suffix. Finally, Tagalog and Dutch loanwords can contain non-native segments, except when certain affixes are present. We account for these phenomena in a new constraint-based framework, Lexical MaxEnt with regularization factors. In this framework, constraint weights are rescaled for exceptional morphemes, and some affixes carry regularization factors that reduce or cancel rescaling. We argue that regularization is a property of morphemes rather than whole words, and that it follows from how these morphemes are combined in the grammar rather than from whole-word storage in the lexicon.

1 Introduction

In phonologically conditioned alternations, the shape of a morpheme usually depends on its immediate environment. For example, the indefinite article in Standard American English has two phonologically conditioned allomorphs: [ə] before consonant-initial words (as in [ə haʊs] "a house") and [ən] before vowel-initial ones (as in [ən aʊns] "an ounce"). The conditioning environment is partly lexical for some speakers, for whom the word "historical" atypically conditions [ən], [ən həstɔrəkl̩]

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(cf. the phonologically similar "hysterical" or "Hispanic", which condition [ə]). In contrast to the typical cases of alternations conditioned by the immediate environment, we document a case from Russian where the shape of a preposition depends not only on the root that follows it but also on the suffixes that follow the root. Some Russian prepositions have variable vowel deletion, conditioned by the phonology and sometimes the specific identity of the morpheme that follows. For example, the preposition [s/z/sə/sa] 'with' always loses its vowel when the following word starts with a consonant followed by a vowel (see (1a)), but deletion is blocked when the following word starts with a sibilant-obstruent cluster (see (1b)). Certain word-initial clusters condition free variation (see (1c)), and certain words exceptionally block deletion in the preposition, even though other phonologically similar words allow it (see (1d)). Our new finding is illustrated in (1e): there are suffixes that can turn off this exceptional behavior of roots (*regularize* them), so the shape of the preposition depends not only on the root that follows it but also on the suffix the root is combined with.

(1) Russian prepositional alternation and a regularization effect, in brief

a.	*Deletion before CV words*:	s karópkəj	'with the box'
b.	*Deletion blocked before [st] clusters:*	sa stúpəj	'with the mortar'
c.	*Variation before certain other clusters:*	s rtút^{j}ju ∼ sa rtút^{j}ju	'with mercury'
d.	*Morpheme-specific blocking of deletion*:	sə dvaróm	'with the yard'
	cf.	z dvér^{j}ju	'with the door'
e.	*Regularization effect of suffix*, [-ov]:	z dvaróvɨm	'with the yard-adj'

To account for this regularization effect, we extend Lexical MaxEnt, an existing lexically indexed weighted constraints account (Coetzee and Pater 2011, Coetzee and Kawahara 2013, Linzen et al. 2013), to include a provision allowing certain suffixes to regularize the morphemes with which they combine. We show how our proposal can account for other, seemingly unrelated phenomena: dominance effects in lexical stress/accent systems and loanword nativization effects in morphologically derived contexts.

There are several conceivable approaches to lexically conditioned phonological exceptions. For instance, exceptionality could be the property of the whole complex word, or even a whole phrase. In Russian, one could say that the phrase [sə dvaróm] 'with the yard' is stored as an exception, and [z dvaróvɨm] 'with yard-adj' follows the regular phonological pattern. By contrast, our theory treats exceptionality as a property of morphemes. The morpheme 'with' is exceptional in that it displays a deletion alternation; not all Russian prepositions do. The morpheme [dvór] 'yard' is exceptional in that it cannot be preceded by a preposition that consists of a single consonant. The morpheme [-ov] 'adj' is exceptional in that it can regularize the root that precedes it. We argue that our view explains certain systematic properties of the phenomenon that the lexical storage view does not explain: some affixes are always regularizing, regardless of the root they attach to; and even more generally, only some syntactically-defined classes of affixes can have a regularizing effect. We also contrast our approach with another theory of morpheme-specific phonology, cophonology theory (Orgun 1996, Inkelas 1996, Anttila 2002, Inkelas and Zoll 2007). We show that cophonology theory has difficulty localizing the deletion to specific contexts: if the suffix responsible for the regularizing effect can condition deletion in the preposition, it is difficult to prevent this effect from applying elsewhere in the prepositional phrase.

The remainder of the paper is organized as follows. Section 2 presents some background on the Russian prepositional alternation. It then introduces and expands Lexical MaxEnt, a framework for analyzing morpheme-specific phonological patterning in Maximum Entropy. Section 3 presents the pattern of morphological regularization effects in Russian, and section 4 presents our proposal accounting for these effects. The proposal is extended to accentual dominance in 5, and to loanword nativizing effects in section 6. Section 7 discusses alternatives, and section 8 concludes.

2 Russian prepositions in Lexical MaxEnt

2.1 Basic data

Russian has many prepositions that do not alternate (e.g., [na] 'on' and [u] 'by, next to'). Yet three prepositions alternate between single-consonant (C) and consonant-vowel (CV) forms: [k] 'towards', [v] 'in, into' and [s] 'with, from' (Matushansky 2002, Timberlake 2004, Steriopolo 2007, Gribanova 2009, Blumenfeld 2011). As shown in (2), the vowel in /so/ 'with/from' deletes if the following morpheme starts with a singleton consonant, [s sókəm], but is preserved before a sibilant-initial consonant cluster, [sa ʂkáfəm].[1] For /vo/, the vowel is preserved when the following cluster begins with [f] or [v], as in [və flóti]; for /ko/, however, a following dorsal normally conditions deletion, as in [k krému].

(2) Basic phonological conditioning of prepositional vowel deletion in Russian

a.	/so sok-om/	s sókəm	*sa sV. . .	'with juice'	*vowel deletes before singleton C*
b.	/so ʂkaf-om/	sa ʂkáfəm	*s ʂk. . .	'with a closet'	*no strident-C clusters*
c.	/vo flot-e/	va flóti	*v fl. . .	'in a fleet'	*no labial-fricative-C clusters*
d.	/ko krem-u/	k krému	*ka kr. . .	'towards the cream'	*dorsal kkC clusters are allowed*

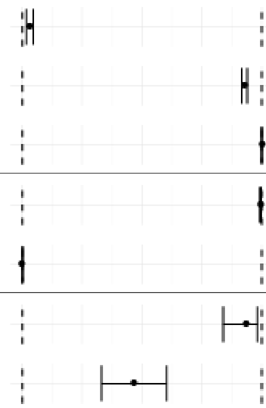
Vowels in all three prepositions normally tend to delete in contexts other than those listed in (2), although there are certain phonological factors that make vowel deletion less likely. For example, the prepositional vowel is less likely to delete before a falling sonority cluster such as [vd] or before a stressed syllable. But even when these factors are controlled for, some of the variation is conditioned lexically: not only the phonology but also the identity of the following morpheme matters. As shown in (3), rates of deletion differ dramatically before morphemes that are phonologically similar in all the relevant respects.

We identified exceptions such as [va dvór] as statistical outliers in a larger dataset obtained by systematically searching the orthographic Russian National Corpus (RNC, http://ruscorpora.ru) for cluster-initial nouns; the corpus study is described in more detail in Linzen et al. (2013). In the miniature graphs in (3) and in the rest of the paper, the position of the dot represents the ratio C/(C+CV), namely the proportion in the corpus of C forms out of all occurrences of the preposition before the wordform. The further the dot is to the left, the more likely is the prepositional vowel to be deleted. The bars show 95% confidence intervals—the larger the total number of hits for C and CV forms combined, the higher the confidence in our estimate, and hence the smaller the distance between the bars.

[1]Our transcriptions represent Moscow Russian pronunciations in IPA, except that we use an acute accent to mark stressed vowels, and we do not transcribe palatalization before [i] and [e] for readability. Vowel reduction is transcribed broadly (e.g., the pretonic non-high vowel is transcribed as [a] rather than [ʌ] or [ɐ] for orthographic convenience). Abbreviations in glosses are as follows: *nom* for nominative, *acc* for accusative, *gen* for genitive, *inst* for instrumental, *dat* for dative, *prep* for prepositional, *dim* for diminutive, *N* for nominalizer, *adj* for adjective, *aff* for affix, *lnk* for compound linker/theme.

(3) Prepositional alternation rates depend on the identity of following morpheme

			C/CV proportion	C vs. CV (RNC)
a.	s/sa mnénijəm	‘with the opinion’	97/3%	
b.	s/sa mnógimi	‘with many’	7/93%	
c.	s/sa mnój	‘with me’	0.01/99.9%	
d.	v/va dvór	‘into the yard’	0.5/99.5%	
e.	v/va dvér^j	‘into the door’	99.9/0.01%	
f.	s/sa l^{j}vóm	‘with the lion’	4/96%	
g.	s/sa l^{j}vóm	‘with Lev’	55/45%	



2.2 Lexical MaxEnt

We capture the combined phonological and lexical variation using Lexical MaxEnt, a modified version of the Maximum Entropy weighted constraint framework (MaxEnt: Goldwater and Johnson 2003, Hayes and Wilson 2008). Like Optimality Theory (Prince and Smolensky 1993/2004), a MaxEnt grammar uses constraints, but they are numerically weighted rather than ranked. In using weighted constraints, MaxEnt is similar to Harmonic Grammar (Smolensky and Legendre 2006, Potts et al. 2010); it differs from Harmonic Grammar in that it returns output probabilities rather than categorical winners and losers. We first show how Lexical MaxEnt handles phonological variation, and then take up lexical variation.

The probability of each of the candidates in a tableau is derived from its harmony score (h). Each constraint violation increases the candidate's harmony score by the weight of the constraint that was violated. This means that worse candidates will have a higher harmony score. Formally, suppose that the grammar consists of the n constraints $C_1, C_2, \ldots, C_n$, and that their respective weights are $w_1, w_2, \ldots, w_n$. If v_{ij} is the number of times that candidate j violates C_i, then this candidate's harmony is given by:

$$h_j = \sum_{i=1}^{n} v_{ij} w_i$$

Tableau (4) illustrates how harmony scores are calculated for a simple case of the C/CV alternation in Russian prepositions. For the reader's convenience, we make our tableaux similar to OT tableaux by marking the candidate with the highest probability with a squiggly arrow, ⇝ (meaning roughly "likely to map to"). Inside the tableau, the subscript v is use to indicate the number of times the constraint is violated by the candidate; c indicates the weight of the relevant constraint. In what follows, we will occasionally leave out the subscripts whenever the role of the number is clear from context. Likewise, whenever the candidate doesn't violate a constraint (i.e., $v_{ij} = 0$), we leave the corresponding cell in the tableau empty. Finally, whenever a candidate violates a constraint only once, we will typically leave out the number of violations.

(4) Stochastic phonological variation in MaxEnt

/vo dver^j/ 'into the door'

	*PrepV$_7$	*#CCC$_3$	h	p
a. va dvér^j	$1_v \times 7_c$		7	2%
b.⇝ v dvér^j		$1_v \times 3_c$	3	98%

The notation *PrepV$_7$ indicates that the cover constraint *PrepV 'assign a violation mark to a preposition with a vowel' has weight 7 (i.e., $w_1 = 7$). The constraint violated by the deletion candidate—*#CCC, which penalizes word-initial three-consonant clusters—has a lower weight of $w_2 = 3$. For the first candidate [va dvér^j], *PrepV is violated once ($v_{11} = 1$) and *#CCC is not violated ($v_{12} = 0$); its harmony score is therefore:

$$h_1 = v_{11}w_1 + v_{12}w_2 = 1 \times 7 + 0 \times 3 = 7$$

In the next stage, we calculate the candidate's "MaxEnt value", an intermediate quantity computed by taking the exponential of the inverse of its harmony score. Finally, to obtain the probability of the candidate, we normalize its MaxEnt value by dividing it by the sum of all of the candidates' scores (Goldwater and Johnson 2003, Hayes and Wilson 2008). In other words, if we have m candidates, then the probability of candidate j is given by:

$$p_j = \frac{e^{-h_j}}{\sum_{k=1}^{m} e^{-h_k}}$$

In the rest of this paper, we select the weights of the constraints so as to approximate the probabilities of the variant forms we found in the Russian corpora. In some cases, we assume near-categorical outcomes of 100% or 0% because we do not have more detailed quantitative data (as in the Japanese example in section 5.1); to analyze those, we use constraint weights that are arbitrarily spaced widely enough apart to approximate the lack of variation (cf. Boersma and Hayes 2001 on getting near-categorical outcomes from stochastic grammars).

In order to account for lexical variation, Lexical MaxEnt adopts the idea that constraint weights can be adjusted for specific lexical items (Coetzee and Pater 2011, Coetzee and Kawahara 2013). This can be seen as a weighted constraint implementation of lexical indexation (Pater 2000 et seq.). Both approaches capture the idea that certain constraints have non-uniform effects across the lexicon: for [dver^{j}], the prohibition against three consonant clusters is weaker than the pressure to delete the preposition's vowel, whereas for [dvor], it is stronger. The difference between OT-style lexical indexation and Lexical MaxEnt is that lexical indexation creates multiple instantiations of constraints in the hierarchy (i.e., it is a modification of the constraint set Con or the constraint hierarchy), whereas Lexical MaxEnt evaluates the same constraints differently depending on the lexical content of the candidate (i.e., it can be thought of as a modification of Eval). Formally, a morpheme l can have a lexical scaling factor s_i for constraint C_i, which is added to the constraint's weight w_i when evaluating a candidate's harmony score (with some locality caveats that we address in section 4.2):[2]

$$h_j = \sum_{i=1}^{n} v_{ij}(w_i + s_i)$$

Lexical constraint scaling is illustrated in (5). The weight of *#CCC is increased by 9 for

[2]In some proposals, scaling factors are added to the weight of a constraint (Coetzee and Kawahara 2013), and in others, they are multiplied (Kimper 2011). We are not aware of theoretical arguments for multiplicative over additive scaling factors, so we have chosen to use the arithmetically simpler additive scaling factors, allotting a different role to multiplication in our theory.

[dvór]: when a candidate contains a three-consonant cluster containing some material from [dvór], satisfaction of *#CCC is more important, and deletion is blocked. The outcome for [dvór] is the opposite of [dvér^{j}] (cf. (4) and (5)). The larger the scaling factor of the morpheme following the preposition, the less likely is the prepositional vowel to delete; thus, the scaling factor is even higher for [mnoj] than for [dvor], but smaller for [mnógimi]. The table adjacent to tableau (5) is what we term a *factor table*, listing the scaling factors for each of the lexical items in the tableau that have a non-zero scaling factor. The number 9 under the heading *#CCC and sub-heading s indicates that the scaling factor of [dvor] for *#CCC is 9; the role of the sub-heading r will be explained in section 4. A number labeled with the subscript s inside a tableau cell is a scaling factor; thus, the violation of *#CCC is calculated as $1 \times (3_c + 9_s)$. For the reader's convenience, all of the formal notational conventions are summarized in the Appendix.

(5) Lexical variation with morpheme-specific scaling factors

/vo dvor/ 'into the yard'

	*PrepV$_7$	*#CCC$_3$	h	p
a.⇝ va dvór	7_c		7	99%
b. v dvór		$3_c + 9_s$	12	1%

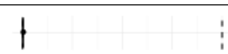
	*#CCC	
	s	r
dvor	9	

When a constraint is subject to lexical scaling, it is important to be explicit about how it is violated, since it needs to have access to morphological and phonological information. In this, lexically scaled constraints differ from unindexed markedness constraints, for which phonological representations without a morphological annotation are sufficient for evaluation. In the case of *#CCC, we assume that the constraint is violated by a consonant trapped between two other consonants—that is, by the [d] in [vdvór]. If this trapped consonant is morphologically associated with an indexed morpheme, that violation of *#CCC is scaled up; otherwise, it is not. We discuss locality in constraint scaling in more detail in section 4.2.

3 Affixes turn off the idiosyncratic status of roots

We now turn to the main problem. Some morphemes condition the C/CV alternation differently depending on the suffix they are combined with. The root [dvór] 'yard, court' exceptionally conditions CV prepositions by itself, with case suffixes, or with diminutive suffixes (see (6 a–c)). By contrast, with suffixes such as the adjectival [-ov] or the various nominalizing suffixes (glossed as N1, N2, etc.), [dvór] conditions C prepositions—much as other [dv]-initial morphemes (see (6 d–e)). A similar pattern holds with [krést] 'cross', which combines with many of the same suffixes (see (7)). Even though [krést] and [dvór] differ in their baseline CV rates, those CV rates decrease in a similar way for both roots in the context of certain affixes: for example, the [-in] in (6c) and [-jan] in (7c) are the same suffix meaning 'someone associated with'. The mini-graphs below summarize the counts from Yandex, http://yandex.ru. The Yandex search engine corpus is much larger than the RNC, and therefore has data for many morphologically complex words that are not attested in sufficient numbers in the RNC. Since Yandex as a search engine corpus is a lot messier than the carefully curated RNC, we will not aim to capture the exact CV rates in our analysis, and will restrict ourselves to replicating qualitative trends.

(6) Special behavior of [dvor-] 'court, yard' lost with certain suffixes

		Gloss	Yandex (C vs. CV)
a.	v/va dvór into court	'into the yard'	
b.	v/va dvór-**ik** into court-**dim**	'into the yard (dim)'	
c.	z/sə dvər-**in**-ín-əm with court-**N1**-N2-inst	'with the nobleman'	
d.	z/sə dvar-**óv**-ɨm with court-**adj**-inst	'with yard-adj'	
e.	z/sə dvór-**nik**-əm with court-**N3**-inst	'with the janitor'	

(7) Special behavior of [krést] 'cross' lost with certain suffixes

		Gloss	Yandex (C vs. CV)
a.	k/kə krist-ú to cross-dat	'to the cross'	
b.	k/ka krést-**ik**-u to cross-**dim**-dat	'to the cross (dim)'	
c.	k/kə krist-**ján**-in-u with cross-**N1**-N2-dat	'to the peasant'	
d.	k/kə krist-**óv**-əmu with cross-**adj**-dat	'to cross-adj'	
e.	k/ka krést-**nik**-u with cross-**N3**-dat	'to the godson'	

The clear trend here is that some derivational suffixes (/-ov/, /-nik/) revoke a root's exceptionality. Not all affixes have this ability to revoke exceptional status completely: for example, the suffix [(ə)stv] reduces a root's ability to condition CV prepositions exceptionally, but doesn't take it away completely.[3] Words derived with [(ə)stv] have lower CV rates than their counterparts without the suffix (see (8)). For example, based on how most [sv]-initial words pattern, the rate of [və] expected in (8f–g) is close to zero. The suffix [-nik] similarly does not always bring the rate of CV prepositions down to 0%—rather, it is reduced to what might be expected based on the word's phonological shape. The rates of CV prepositions in [kr]- and [dv]-initial words plummet to almost zero, whereas [ft]-initial words show variation, consistent with general phonological patterns in Russian.

[3] This suffix conditions a mutation on stem-final dorsals [g/k/x], which become strident [ʐ/ʧ/ʂ] (Kapatsinski 2010, Padgett 2010), the [ə] vowel appears when the preceding consonant is a strident (Revithiadou 1999).

(8) A neutral category-assigning suffix: /-estv/

		Gloss	Yandex (C vs. CV)
a.	s/sa mnóg-imi with many-inst.pl	'with many'	
b.	s/sa mnóz̧-**əstv**-əm with many-**N4**-inst.sg	'with a multitude'	
c.	s/sə ftar-ɨ́m with second-inst.sg	'with second-adj'	
d.	s/sə ftər-a-gód-**nik**-əm with second-lnk-year-**N3**-inst.sg	'with a student repeating a grade'	
e.	s/sə ftər-a-gód-**nitʃ-istv**-əm with second-lnk-year-**N3-N4**-inst.sg	'with repeating a grade'	
f.	f/və s-vid-ét-il^j-ə in with-see-V-N5-acc.sg	'in a witness'	
g.	f/və s-vid-ét-il^j-**stv**-ə in with-see-V-N5-**N4**-acc.sg	'in testimony'	

To summarize, certain suffixes can revoke the exceptional status of a root, other suffixes reduce it, and still others are neutral.

4 Proposal: Morphological regularization in Lexical MaxEnt

4.1 Regularization factors

To capture the morphological regulatization effects described in section 3, we enhance the Lexical MaxEnt framework by proposing that lexical scaling factors can be multiplied by *morphological regularization factors* associated with individual suffixes. Like scaling factors, morphological regularization factors are also constraint-specific. Formally, if a candidate consists of a root that has scaling factors $s_1, \dots s_n$ corresponding to each of the constraints $C_1, \dots, C_n$, and an affix that has morphological regularization factors $r_1, \dots r_n$ corresponding to each the n constraints, then the candidate's harmony is given by:

$$h_j = \sum_{i=1}^{n} v_{ij}(w_i + s_i r_i)$$

Most affixes have the default morphological regularization factor of 1, which doesn't affect the root's scaling factor. We assume that any morpheme can have a scaling factor, but only affixes may have a morphological regularization factor, and only some affixes can have a regularization factor lower than 1; we discuss this in more detail in section 5.2. The restriction that regularization factors can only be associated with affixes has a parallel outside of phonology: it is sometimes assumed that only affixes but not roots have grammatical features (Embick and Noyer 2007).

As an illustration of morphological regularization factors, consider the two scenarios in (9). The first candidate in (9) includes a root with a scaling factor of 9 and a neutral affix, whose regularization factor is 1. Multiplying the scaling factor by 1 does not affect the resulting violation of *#CCC, favoring the candidate in which prepositional vowel deletion is blocked in (9a). On the other hand, when the same root combines with a suffix whose regularization factor is 0 (see (9c–d)), the scaling factor is multiplied by zero and the weight of the constraint to which it is indexed will return to the baseline level of 3 for the purposes of computing violations of *#CCC. Thus, suffixes with a regularization factor of 0 make exceptional roots behave as if they were phonologically regular. Note that the r column in the factor table specifies the morphological regularization factor for each suffix (in what follows we will occasionally leave neutral regularization factors, i.e. $r = 1$, out of the factor table, in the same way that we leave out neutral scaling factors, i.e. $s = 0$).

(9) Regularization factors of suffixes can either preserve or revoke special status of roots

/vo dvor-ik/ 'into the yard (dim)', /so dvor-nik-om/ 'with the groundskeeper'

	*PrepV$_7$	*#CCC$_3$	h	p
a.⇝ va dvórik	7		7	99%
b. v dvórik		$3_c + 9_s \times 1_r$	12	1%
c. sa dvórnikəm	7		7	2%
d.⇝ z dvórnikəm		$3_c + 9_s \times 0_r$	3	98%

	*#CCC	
	s	r
dvor	9	
-ik		1
-nik		0

In order to allow a suffix to affect a root that it is not adjacent to, we assume that the scaling factor of a root is multiplied by the regularization factors of all the affixes. Formally, if there are p affixes which have morphological regularization factors $r_{i1}, \ldots, r_{ip}$ for each constraint C_i, the harmony score for candidate j is given by:

$$h_j = \sum_{i=1}^{n} v_{ij}(w_i + s_i \prod_{k=1}^{p} r_{ik})$$

This is demonstrated in (10). The scaling factor of [ftor-] is in principle affected by both [-nik] and [(ə)stv], although the effect of [(ə)stv] is masked by [-nik], whose regularization factor is 0. (The cover constraint *[sft] stands for the markedness constraints that make deletion less likely in this case; see Linzen et al. 2013 for discussion.)

(10) Regularization factors are multiplied

/so vtor-o-god-nik-stv-om/ 'with repeating a grade'

		*PrepV$_7$	*#CCC$_3$	*[sft]$_4$	h	p
a.⇝	sə ftəragódnitʃəstvəm	7			7	50%
b.⇝	s ftəragódnitʃəstvəm		$3_c + 9_s \times 0_r \times 0.5_r$	4	7	50%

	*#CCC	
	s	r
vtor	9	
-nik		0
-stv		0.5

Two predictions follow from the way scaling and regularization factors interact:

(11) A suffix with a regularization factor should have an effect on the root no matter how deeply the root is embedded.

(12) Exceptionality should be reduced more dramatically if two partially regularizing affixes occur in the same input than if just one of the suffixes were present (e.g., two suffixes that individually cut a root's scaling factor in half would reduce it to a quarter of its value if they occurred together: $0.5 \times 0.5 = 0.25$).

We are assuming that both scaling factors and regularization factors cannot be negative numbers, which means that no morpheme can receive rewards for its constraint violations. We have not found any suffixes that *increase* the exceptional status of roots in the Russian prepositional alternation. If this gap is not accidental, we can capture it by stipulating that regularization factors cannot be greater than 1. In that case an affix can have three kinds of effects on exceptionality:

(13) For any given constraint C_i, an affix can be:

(a) neutral ($r_i = 1$),

(b) partially regularizing ($0 < r_i < 1$), or

(c) fully regularizing ($r_i = 0$).

At first blush, it may seem that regularization factors could also be implemented as additive rather than multiplicative constants. If all exceptional morphemes had the same scaling factor s_i for a given constraint, then the additive regularization factor for a fully regularizing suffix (such as [-nik] in (9)) would simply be $-s_i$, such that the weight for the full word would come out to 0. This solution would not work in the Russian case, however, where many morphemes are neither completely exceptional (always blocking deletion in the preposition) or completely regular (never blocking deletion). Different roots are associated with different deletion probabilities, necessitating root-specific scaling factors. If root a has a scaling factor of 9 and b has a scaling factor of 5, there is no single additive regularization factor that would bring the full word weighting to 0 for both of these morphemes: either the word derived from a would not have its exceptionality completely reduced, or the word derived from b will be counterintuitively rewarded for violating the constraint.

4.2 Tracking loci of violation by morpheme

4.2.1 Loci of violation for lexically indexed constraints and Lexical MaxEnt

The previous section outlined the basic proposal that affixes can regularize scaling factors. In this section, we elaborate the notion of locality in Lexical MaxEnt. Suppose a candidate violates a constraint more than once, and contains a morpheme with a scaling factor for the constraint. Our intuition is that a scaling factor should apply only to violations contributed by the morpheme that is associated with that scaling factor; likewise, regularization factors should not affect violations that are not scaled in the first place. In order to formalize this intuition, we need a more precise notion of what it means for a morpheme to violate a constraint. Consider first how locality works in a related framework, OT with lexically indexed constraints (Pater 2006, Flack 2007, Gouskova 2007, Becker 2009, Jurgec 2010).[4] A morpheme-specific faithfulness constraint is violated when a

[4]This version of indexation theory belongs to a family of proposals that assume that constraints can refer to morphosyntactic entities such as roots and affixes (McCarthy and Prince 1994 et seq.), syntactic categories (Smith 2000), morphological heads (Revithiadou 1999), and individual morphemes (Hammond 1995). We discuss several of these proposals and how they differ from our theory in the subsequent sections. Note that locality works the

segment belonging to the morpheme is not mapped faithfully (e.g., it is deleted or its features are changed). A morpheme-specific markedness constraint is violated when the locus of violation of the constraint contains a phonological exponent of the morpheme (see (14)):

(14) Locality convention (Pater 2006)

$*X_L$: assign a violation mark to any instance of X that contains a phonological exponent of a morpheme specified as L

For example, in a language that allows codas in roots but not affixes, this approach could posit the ranking NoCoda$_{\text{Affix}}$≫Dep≫NoCoda. NoCoda$_{\text{Affix}}$ is violated just in case the consonant in coda position is affiliated with an affix. A mapping such as /mat$_{\surd}$-pak$_{\text{Aff}}$/→[mat-pakə], with a coda in the syllable corresponding to the root, would then incur a violation of NoCoda but not NoCoda$_{\text{Affix}}$ (this is shown in (15); the root is boldfaced and the affix is italicized to highlight how loci are tracked by different constraints). This approach has the virtue of precise control over the locus of application of lexically specific alternations.

(15) Schematic illustration of locality in OT with lexically indexed constraints

/**mat**$_{\surd}$-*pak*$_{\text{Aff}}$/	NoCoda$_{\text{Affix}}$	Dep	NoCoda
☞**mat**.*pa.kə*		*	* (**t**)
mat.*pak*	*! (*k*)		* (*k*)
ma.tə.*pa.kə*		**!	

To replicate this control over loci in Lexical MaxEnt, the violations contributed by different morphemes need to be tracked and scaled separately (for similar ideas, see Flemming 2011, Kimper 2013). The weight of the constraint is scaled only if the violation belongs to a morpheme with a non-zero scaling factor. Formally, instead of a single violation count v_{ij} representing the number of times candidate j violates constraint i, we have a set of $p+1$ violation counts, $v_{ij}^0, v_{ij}^1, \ldots, v_{ij}^p$,

way we describe in the proposals inspired by Pater 2006, but not in all theories that assume morpheme- or class-specific constraints. For example, in Benua's (1997) account of the overapplication of deletion in English (*dam<n>* vs. *dam<n>ing*$_{\text{Class II}}$ vs. *damn-ation*$_{\text{Class I}}$), Dep-OO$_{\text{Class II}}$ is violated by the *n* in the non-deleting candidate **damning*—any instance of insertion in the candidate that contains the *-ing* morpheme counts as a Dep violation, even when the segments that are not in correspondence do not belong to *-ing*. Earlier proposals restrict indexation to faithfulness only (Ito and Mester 1995, 1999, Fukazawa et al. 1998, Ito and Mester 2003), but this does not fully eliminate the need for a precise notion of what it means for a constraint to be violated in one morpheme but not the other (see, e.g., McCarthy 2012 for discussion of Linearity).

one for the root (v^0_{ij}) and one for each affix (v^1_{ij} through v^p_{ij}). Let the scaling factor of the root be s^0_i, and the scaling factors for each of the affixes be $s^1_i, \ldots, s^p_i$ (if the l-th morpheme doesn't have a lexically assigned scaling factor, we assume that $s^l_i = 0$). The definition of harmony becomes

(16)

$$h_j = \sum_{i=1}^{n} \sum_{l=0}^{p} v^l_{ij} (w_i + s^l_{ij} \prod_{k \neq l} r_{ik})$$

We're now summing not only over constraints but also over the candidate's morphemes. Note that the iteration over regularization factors, $\prod_{k \neq l} r_{ik}$, includes the regularization factors for C_i associated with all of the affixes in the word except the one currently being evaluated. This ensures that a morpheme's regularization factor cannot apply to its own scaling factor (see section 5.1). Another implication of this definition is that the scaling factor for a morpheme is affected both by affixes that linearly precede the morpheme and by affixes that linearly follow it: the assumption is that constraint violations are evaluated on a linearized candidate rather than a hierarchical tree structure. An example in which an inner affix regularizes an outer affix is analyzed in 5.1.4.

The Lexical MaxEnt implementation of morpheme-by-morpheme constraint evaluation is illustrated in (17) for the schematic example discussed in (15) above: the violation of NoCoda that is incurred by the [t] from [mat] is weighted at 1 and is insufficient to trigger epenthesis (see (17a)), but the violation incurred by [k] from the suffix [pak] in (17b) is scaled up by 20 and is enough to make epenthesis happen after the affix consonant but not after the root.

(17) Tracking loci of violation by morpheme in Lexical MaxEnt

input: /**mat**-*pak*/

	NoCoda$_1$	Dep$_{10}$	h	p
a.⇝ **mat**.*pa*.*k*ə	$\underbrace{1_c}_{\text{mat}}$	10	11	100%
b. **mat**.*pak*	$\underbrace{1_c}_{\text{mat}} + \underbrace{(1_c + 20_s)}_{\text{pak}}$		22	0%
c. **ma**.**t**ə.*pa*.*k*ə		$2_v \times 10_c$	20	0%

	NoCoda	
	s	r
pak	20	

A morpheme can violate a constraint more than once. For example, suppose that a language has the constraint *Labial ("assign a violation mark for every labial consonant") weighted at $w = 5$. The root *mup* has a scaling factor of $s^{mup} = 10$ for *Labial. The bimorphemic candidate *mup-nip* violates *Labial three times: twice in *mup* and once in *nip*, that is, $v^{mup} = 2$ and $v^{nip} = 1$. The total contribution of *Labial to the candidate's harmony score would therefore be:

$$v^{mup}(w + s^{mup}) + v^{nip}w = 2 \times (5 + 10) + 1 \times 5 = 35$$

4.2.2 Loci of violation for various constraint types

The above solution works for relatively simple cases: the [t] in [mat.pak] in tableau (17) is clearly a coda, and the coda contains a segment belonging to the root but not the affix. But even this familiar constraint can present interesting complications. NoCoda prohibits consonants in a specific syllable position—it does not just assign violation marks to syllable-final consonants, for example (thus, in a language with syllabic consonants, [bɪ.gɹ̩] 'bigger' would not violate NoCoda). NoCoda also assigns just one violation to a branching coda—e.g., [bɪnz] violates NoCoda once (this is Prince and Smolensky's 1993/2004 interpretation of the constraint). But is the locus of violation of NoCoda in [bɪnz] the entire cluster, or just one of the consonants?

We follow McCarthy (2003), who argues that all markedness constraints should be defined in such a way that a single phonological constituent is the locus of violation (see Crowhurst and Hewitt 1997, Eisner 1999, Potts and Pullum 2002 for related ideas). A phonological constituent is a feature node, a segment, or a constituent in the prosodic hierarchy. This is a starting point, but identifying a single locus of violation is easier for some markedness constraints than others. It is most straightforward for *paradigmatic* markedness constraints, which are violated by feature nodes (e.g., *[round], Beckman 1997) or by segments with certain feature combinations (e.g., *VoicedObstruent, Lombardi 1995, or $*\mathrm{V}_{[+\mathrm{nasal}]}$). As long as the segment or feature node is associated with a morpheme, the locus counts for morpheme-specific scaling. A more complex type of markedness is *syntagmatic*: these constraints are violated by segments that occur in specific structural/hierarchical positions or adjacent contexts. One example of such a constraint is $*\mathrm{NV}_{[\text{-nasal}]}$, which prohibits oral vowels that are adjacent to nasals (McCarthy and Prince 1995). The locus of violation for this constraint is the vowel, but nasals are a necessary part of the definition. NoCoda is another example of such a constraint, although the precise definition of a coda and whether it is a primitive varies by theory (Hayes 1989, Blevins 1995, Zec 1995, Steriade 1999). Still more complex are syntagmatic markedness constraints that target "symmetric sequences" of elements of the same kind: *Lapse and *Clash (Prince 1983) are examples of this, as are constraints of the OCP family (McCarthy 1986, inter alia). There are also constraints against heterogeneous strings, such as *NC̥ (Pater 1999), *AI (Anttila 2002, Pater 2006), *[−ATR][+ATR] (Mahanta 2012)—for these, it may be hard to identify a specific locus a priori, without a more principled investigation of the constraint. Finally, there are constraints whose loci of violation are constituents above the segmental level. One example is the Exhaustivity family (Selkirk 1995): these constraints are violated by elements of the prosodic hierarchy such as feet and prosodic words (see McCarthy 2008 for a typological argument in favor of replacing Parse-σ with Exh(Pwd), which partly hinges on there being only one locus of violation regardless of the number of unfooted syllables in a candidate). If the locus of violation is the Pwd node, then presumably, any segment dominated by it counts as part of the locus of violation, and any morpheme contained in the prosodic word can scale the weight of Exh(Pwd) or regularize a scaling factor for that constraint.

Mahanta (2012) argues that even heterogeneous string constraints can be understood as having single-segment loci of violation: in effect, the analyst chooses which of the elements in the string constitutes the locus. Unfortunately, most existing cases of morpheme-specific phonology do not supply crucial evidence to bear on this. For example, Pater (2006) treats the entire sequence [ai] as violating the anti-diphthong constraint in Finnish, but the analysis is consistent with just [i] being the locus since [-i] is the only morpheme triggering special alternations. In analyzing Russian prepositional vowel deletion, we applied scaling and regularization factors to *#CCC. The first of the three consonants in the clusters is contributed by the preposition undergoing the alternation, and the second and third—by the following morpheme. There are no CC prepositions in Russian, and the prepositions [v] 'in', [k] 'towards', and [s] 'with' cannot be stacked, so there is no straightforward way to test how the morphological affiliation of each consonant contributes.[5] Thus, we assume that heterogeneous string constraints are violated by individual segments; in the case of *#CCC, it is

[5]We have one example where the initial cluster incorporates consonants from three different morphemes: [f s-vid-et-il^j-ə] 'in a witness' vs. [f s-vid-et-il^j-stv-ə] 'in testimony'. This example does not tell us a lot about morpheme-specific triggering, since baseline rate of deletion in /vo/ is fairly high with 'witness', so the [stv] suffix does not have a huge effect (see the graphs in (8f–g)). The [s-] prefix is etymologically related to the preposition 'with' but is distinct from it in Modern Russian; see Matushansky (2002) vs. Gribanova (2009).

the medial consonant. This consonant can be argued to be in a perceptually poorly cued position compared to the first consonant and the consonant released into the vowel, so our assumption is not entirely arbitrary.

4.2.3 A real example of morpheme-by-morpheme scaling: Turkish voicing

We wrap this section up by illustrating morpheme-by-morpheme scaling on a real example, Turkish voicing alternations (building on the analysis of Becker et al. 2011). In Turkish, some morphemes undergo intervocalic voicing, and others do not, though in general, the language does not have a productive rule of intervocalic voicing. The two constraints are *VTV, which assigns a violation to a voiceless consonant that is preceded and followed by vowels, and IDENT[voice], the familiar correspondence-theoretic faithfulness constraint. *VTV is a canonical example of a syntagmatic constraint violated by a single segment—the consonant—so we treat it as such in the analysis. As shown in (18iii), the weight of *VTV is increased for the exceptional suffix but not for the regular one.

(18) Loci of violation: scaling factors for violations by morpheme

i. Regular word, no intervocalic voicing: /at-ɨ/ 'horse (acc)'

	/at-ɨ/	$^*\text{VTV}_1$	ID[voice]_6	h	p
a.⇝	at-ɨ	1		1	99%
b.	ad-ɨ		6	6	1%

ii. Exceptional undergoer root: weight of *VTV scaled up: /kap-ɨ/ 'container (acc)'

		$^*\text{VTV}_1$	ID[voice]_6	h	p
c.	kap-ɨ	$\underbrace{1_c + 20_s}_{\text{ka}\underline{\text{p}}}$		21	0%
d.⇝	kab-ɨ		6	6	100%

	*VTV	
	s	r
kap	20	

iii. Exceptional undergoer suffix: weight of *VTV scaled up for *ta* but not *kɨ:* /juva-ta-kɨ/ 'the one in the nest'

		*VTV$_1$	ID[voice]$_6$	h	p
e.⇝	juva-da-kɨ	$\underbrace{1_c}_{\text{kɨ}}$	6	7	99%
f.	juva-ta-kɨ	$\underbrace{(1_c + 20_s)}_{\text{ta}} + \underbrace{1_c}_{\text{kɨ}}$	6	28	0%
g.	juva-ta-gɨ	$\underbrace{1_c + 20_s}_{\text{ta}}$	6	27	0%
h.	juva-da-gɨ		$2_v \times 6_c$	12	1%

	*VTV	
	s	r
-ta	20	

Thus, the weight of a constraint is not scaled up for the entire word, just for the loci of violation that belong to morphemes with scaling factors.

4.3 Interim summary

The preceding sections presented our main empirical contribution and the key details of our proposal. In the remainder of the paper, we expand our proposal to a couple of different empirical domains, lexical accent (section 5.1) and nativization of loanwords in morphologically derived contexts (6). In section 5.2, we consider substantive restrictions on which morphemes can have non-neutral regularization factors; this section also identifies the morphosyntactic types of affixes that can be accentually dominant in different ways in our theory. Some alternatives to our proposal are discussed throughout the remaining sections, but section 7 is dedicated to cophonology theory and whole word storage.

5 Extension: dominance effects

5.1 Combining scaling and regularization factors

Can an affix have both a scaling factor for a constraint and a regularization factor that affects the scaling factors of other morphemes for the same constraint? The case of Russian prepositions is not useful in answering this question, since the constraint tied to lexical variation, *#CCC, is irrelevant to the phonology of the affixes (because the root either has at least one vowel or is not followed by a consonant-initial suffix; see Gouskova 2012). This section discusses phenomena from other languages that can be fruitfully analyzed using affixes that carry both a scaling and a regularization factor. Scaling the violations of an affix with a regularization factor will have different phonological effects depending on whether the scaled constraint is a markedness or faithfulness constraint; this section discusses the interaction between the two types of factors in markedness constraints alone, in faithfulness constraints alone, and finally across the two types of constraints.

5.1.1 Scaling and regularizing markedness

If an fully regularizing affix cancels another morpheme's scaling factor for a markedness constraint, this would result in the rule failing to apply in the stem but applying in the affix. This hypothetical scenario is exemplified in (19), which is based on Turkish voicing. Here, voicing is exceptionally triggered in a root in (19a–b), but root voicing is blocked when there is a special suffix, which itself undergoes the rule (19c–e). Recall from formula (16) that a given morpheme's regularization factor never applies to the same morpheme's scaling factor.

(19) Example of a rule applying to an affix but not to the stem: Pseudo-Turkish

inputs: /pok-a/, /pok-op-a/

	$*\text{VTV}_1$	Ident_6	h	p
a.⇝ poga		6	6	100%
b. poka	$\underbrace{1_c + 20_s}_{\text{po\underline{k}}}$		21	0%
c. pogoba		$2_v \times 6_c$	12	1%
d.⇝ pokoba	$\underbrace{1_c + 20_s \times 0_r}_{\text{po\underline{k}}}$	6	7	99%
e. pokopa	$\underbrace{(1_c + 20_s \times 0_r)}_{\text{po\underline{k}}} + \underbrace{(1_c + 30_s)}_{\text{o\underline{p}}}$		32	0%

	*VTV	
	s	r
pok	20	
-op	30	0

5.1.2 Scaling and regularizing faithfulness: deaccenting dominance

If a fully regularizing affix cancels a scaling factor for a faithfulness constraint, the prediction is that contrasts will be neutralized in the stem but not in the affix. Accentual dominance can work in this fashion: affixes in Japanese cause accentual contrasts on stems to neutralize while contrasting in accentedness themselves (Poser 1984, Alderete 1999). The examples below are taken from Kawahara (2013); pitch accents are marked with acute diacritics. The recessive affixes in (20) demonstrate the normal accentual patterns: underlying accents surface; if neither of the morphemes is accented, no accents are inserted on the surface; if both the root and the affix are accented, the root accent wins.

(20) Recessive affixes in Japanese: accented suffix (a–b), unaccented suffix (c–d)

a.	/mage-tára/	magetára	'if bent'	c.	/sáke-ga/	sákega	'salmon-nom'
b.	/tabé-tára/	tabétara	'if eat'	d.	/sake-ga/	sakega	'alcohol-nom'

On the other hand, dominant affixes cause root accents to be deleted, whether or not the affixes are accented themselves:

(21) Dominant deaccenting affixes in Japanese: accented suffix (a–c), unaccented affix (d–f)

a.	/adá-ppó-i/	adappói	'coquettish'	d.	/kéizai-teki/	keizaiteki	'economic'
b.	/kaze-ppó-i/	kazeppói	'sniffly'	e.	/búngaku-teki/	bungakuteki	'literature-like'
c.	/kíza-ppó-i/	kizappói	'snobbish'	f.	/rónri-teki/	ronriteki	'logical'

Our theory suggests an analysis of this pattern: a dominant affix turns off the stem's accentual faithfulness while retaining such faithfulness itself; a recessive affix is merely faithful to its own accent without modifying the stem's faithfulness. In the analysis sketched below, we assume that any morpheme that realizes a root, marked with $\sqrt{}$ in our tableaux, is automatically associated with a scaling factor of 10 for MAX-ACCENT, the constraint against deleting underlying accents (following Alderete 1999). This is our implementation of the idea from positional faithfulness theory that roots have a special faithfulness status compared to affixes (McCarthy and Prince 1994, Beckman 1997, Urbanczyk 2006).[6] We will assume that the absence of accent is enforced by *ACCENT, since accent is not inserted on underlyingly unaccented words; according to Kubozono (2011) and Kawahara (2013), anywhere between one-third and half of all Japanese words are unaccented, as are many loanwords. CULMINATIVITY is the markedness constraint that prohibits more than one accent per

[6]Since all roots are associated with the scaling factor of 10, we do not include this factor in the factor table; however, the scaling factors s_i^l in formula (16) should be understood as reflecting the sum of all relevant scaling factors, whether they are related to the lexical identity of the morpheme, to its morphological status as a root, to its register (see Linzen et al. 2013) and so on.

phonological word (Alderete 1999).

The basic phonology is sketched in (22). A word with two underlying accents will keep the one on the root: the winner [tabétara] receives one violation of *Accent for the root, weighted at 10, and one violation of Max-Accent for the suffix, valued at 20. The most interesting loser here is [tabetára]—its violation of faithfulness is scaled up to 30: 20 for the lexically specific factor of [tabé] and an extra 10 because it is a root.

(22) Accented vs. unaccented contrast: basic grammar (recessive affixes)

/tabé-tára/

		Culm$_{40}$	*Accent$_{10}$	Max-Accent$_0$	h	p
a.	tabétára	40	$2_v \times 10_c$		60	0%
b.⇝	tabétara		10	$\underbrace{0_c + 20_s}_{\text{tara}}$	30	100%
c.	tabetára		10	$\underbrace{0 + 20_s + 10_{\surd}}_{\text{tabe}}$	40	0%

	Max-Accent	
	s	r
tabé	20	
-tára	20	

Conversely, the dominant suffix [-ppo] turns off the root's scaling factors for Max with its regularization factor while retaining its own scaling factor for faithfulness, as shown in (23). The result is that the suffix's accent survives, whereas the root's accent is deleted. If the suffix is dominant and unaccented, as in (24), then the winner will have no accent at all, reverting to the language's default phonology (unaccented words). Culminativity is left out of these tableaux to save room—all of the candidates in this set satisfy it, and including *[adáppói] in the set in (23), for example, would not materially affect the probability of the others.

(23) Dominant accented suffix: scaling and regularization factors for MAX-ACCENT

/adá-ppó-i/

		*ACC$_{10}$	MAX-ACCENT$_0$	h	p
a.⇝	adappói	10	$\underbrace{0_c + (20_s + 10_{\surd}) \times \overbrace{0_r}^{\text{ppo}}}_{\text{ada}}$	10	100%
b.	adáppoi	10	$\underbrace{0_c + 20_s}_{\text{ppo}}$	30	0%
c.	adappoi		$\underbrace{(0_c + (20_s + 10_{\surd}) \times \overbrace{0_r}^{\text{ppo}})}_{\text{ada}} + \underbrace{(0_c + 20_s)}_{\text{ppo}}$	20	0%

	MAX-ACCENT	
	s	r
adá	20	
-ppó	20	0

(24) Dominant unaccented suffix: regularization factor but no scaling factor for MAX-ACCENT

/kéizai-teki-i/

		*ACCENT$_{10}$	MAX-ACCENT$_0$	h	p
a.⇝	keizaiteki		$0_c + (20_s + 10_{\surd}) \times 0_r$	0	100%
b.	kéizaiteki	10		10	0%

	MAX-ACCENT	
	s	r
kéizai	20	
-teki		0

The analysis in (23)–(24) is assumes faithfulness scaling factors for all lexically indexed morphemes. The reason for this is that a regularization factor can only negate a constraint's effect on a morpheme if that morpheme has a scaling factor for the constraint. We do not view this assumption as problematic, since accented morphemes have to be specified for *something* in the lexicon regardless of how deaccenting dominance is analyzed. In some theories, this specification is accomplished through lexical marking alone. In ours, it is accomplished through lexical marking and scaling for those constraints whose effects are contextually turned off by certain affixes.

5.1.3 Antifaithfulness as an alternative theory of deaccenting dominance

We cannot do justice to all of the theories of accentual dominance here, but we can compare our account to antifaithfulness theory (Alderete 2001). (Another major approach to dominance is cophonology theory; we defer the discussion of this theory till section 7.) Antifaithfulness expresses the intuition that dominant suffixes such as [-teki] are associated with a requirement that a base such as [kéizai] mismatch its correspondent [keizaiteki] in some specific way—for example, if an accent is present in the base, it must be deleted in the suffixed output correspondent. This is formally accomplished by requiring a MAX-ACCENT violation in the output-output correspondence between the base, [kéizai], and the derived form [keizaiteki]. Our theory differs from Antifaithfulness in that it does not require an output-output base to be available—the output's phonology can be computed just from the input. This is arguably an asset, since bases for derived words with dominant affixes are not always available or easily identifiable. For example, in Alderete's analysis of Russian stress (which exhibits dominance effects not unlike those seen in Japanese), the suffix [-ux] is analyzed as accented and dominant (e.g., [stár-ɨj] 'old' vs. [starúxə] 'old woman'). But many words suffixed with [-ux] in Zaliznjak's (1977) dictionary do not have free-standing bases that would be recognizable to Russian speakers: for example, [zavir-úx-ə] 'liar', [vatr-úx-ə] 'cheese pastry', [apli-úx-ə] 'a smack upside the head'. (It is not surprising from a morphological standpoint that [-ux] derivatives do not have to have bases, since this suffix is a categorizing head; see section 5.2).

Another difference between our theory and Antifaithfulness is that the latter predicts that in cases where the dominant suffix is itself unaccented, the stress pattern should revert to a single default. This prediction does not match the range of patterns attested in lexical accent systems: different dominant affixes impose accents in different places. In both Japanese and Russian, for example, some dominant affixes impose initial accents; in Russian, dominant affixes can also be pre-accenting, post-accenting, or auto-accenting (see Melvold 1989, Revithiadou 1999, Inkelas and Zoll 2007, Kawahara and Wolf 2010 for additional discussion). Thus, Antifaithfulness is a restrictive theory of dominance, but not a sufficiently rich one.

In our theory, the mechanism of turning off indexed faithfulness that we outlined above is not the only route to dominance. The analytic intuition common to constraint-based analyses is that when dominant affixes impose a predictable stress pattern on a stem, a high-ranking markedness constraint is enforcing a default (Alderete 1999, Inkelas 1999, Revithiadou 1999). In our theory, this is accomplished by supplying an affix with such a large scaling factor for the markedness constraint that it overrides positional faithfulness to stem accent; we analyze a case of this kind in section 5.2.[7]

5.1.4 Conditional dominance: scaling markedness, regularizing faithfulness

One of the predictions of our theory is that dominance can be conditional: a suffix can be accented and dominant, but lose its dominance in the presence of another suffix. We find an example of this in Slovenian (Marvin 2008). Slovenian has lexical accent, whose position is contrastive (see the participles in the leftmost columns of (25) and (26)). The nominalizer suffix [-əts] is dominant, shifting stress to the syllable right before it. As shown in (26), however, the suffix becomes recessive in adjectival passive [-n] nominalizations, whose accents do not move. Thus, intuitively, the [-n] suffix acts as a kind of boundary between the stem and the normally dominant [-əts] suffix—and we implement this intuition by giving [-n] a zero regularization factor.[8]

(25) Slovenian [-əts] is dominant (pre-stressing) (Marvin 2008)

a.	plésal	'danced'	plesáləts	'dancer'
b.	plával	'swam'	plaváləts	'swimmer'
c.	brúsil	'sharpened'	brusíləts	'sharpener'
d.	darovál	'donated'	darováləts	'donor'

[7]There are two ways to analyze initial-accenting suffixes given our assumptions of locality. First, a scaling factor could be posited for a markedness constraint whose locus of violation is the prosodic word node. Of course, this predicts final-accenting prefixes, as well, and we are not aware of any examples of those. The alternative is to assume initial accent as the "true" default while treating other locations as affix-specific; this is sometimes done for Russian (see Halle, 1973, 1996, Gouskova, 2010).

[8]The data have been modified from Marvin's (2008) orthographic representations as follows: "c" has been replaced with [ts], and we have added transcriptions of schwas. We kept transcriptions phonemic otherwise. A reviewer notes that in a random check of a dictionary, about 5% of the words with the [-əts] suffix have stress inconsistent with Marvin's generalization: for instance, [múʧən] 'uneasy'∼[muʧénəts] 'a tortured person' rather than the expected *[muʧénəts]. Our own inquiries with native speakers of Slovenian indicate that there is quite a bit of dialectal variation with respect to accent location in the same word (e.g., the feminine participle of 'dance' is either [plésala] or [plesála]; there are a few other verbs that have such alternations, including *voditi, peljati, ʃivati*; Tatjana Marvin, p.c.). We can assume that the feminine and neuter suffixes are dominant preaccenting for some speakers, just like [-əts] is. This variation in accentual patterns is unsurprising in a language with lexical stress, especially since Slovenian has as many as 40 dialects (Petek et al. 1996, Greenberg 2003).

(26) Slovenian [-ets]: recessive (stress-neutral) in the presence of passive [-n]

c.	tsépljen	'vaccinated'	tsépljenəts	'somebody vaccinated'
d.	pítan	'fed'	pítanəts	'an animal for feeding'
e.	obdarován	'rewarded'	obdarovánəts	'a person that was rewarded'
f.	ránjen	'injured'	ránjenəts	'an injured person'

We attribute the dominance of [-əts] to a scaling factor for a markedness constraint that favors stress on the syllable before the suffix, which we will call "Preacc".[9] This scaling factor is subject to a regularization factor carried by the passive suffix [-n]. We illustrated this in (27): The weight of this constraint is sufficiently large that it overrides root faithfulness (encoded again as scaling for Max-Accent). In (27a–b), the root *plés-* receives a root faithfulness boost for Max-Accent, but [-əts] overrides it through the high scaling factor that this affix carries for Preacc. In (27c–d), dominance is turned off because [-n] is in the string: its regularization factor for Preacc is zero, and so it cancels the pattern imposed by [-əts] and allows faithfulness to the stem accent to prevail.

(27) Analysis of conditional accentual dominance in Slovenian

	/plésal-əts/	Max-Accent$_1$	Preacc$_0$	h	p
a.	(plésa)ləts		$0_w + 20_s$	20	0%
b.⇝	ple(sáləts)	$1_w + 10_{\checkmark}$		11	100%

	/píta-n-əts/	Max-Accent$_1$	Preacc$_0$	h	p
c.⇝	(píta)-n-əts		$0_w + 20_s \times 0_r$	0	100%
d.	pi(tá-n-əts)	$1_w + 10_{\checkmark}$		11	0%

	Preacc	
	s	r
-n		0
-əts	20	

This case illustrates that dominance is a useful descriptive notion, but is not an all-or-nothing property—it cannot be reduced to a simple binary feature (as in Melvold's 1989 theory, for example).

[9]"Preacc" is a cover constraint here, but the formalization of preaccenting raises some interesting locality issues. The suffix [-əts] has a yer vowel in it, which deletes whenever a vowel-initial suffix follows (e.g., /plesál-əts-a/→[plesáltsa] 'dancer (gen sg)'), without affecting stress position. Revithiadou (1999) attributes some cases of preaccenting to a requirement that the affix be in the weak syllable/tail of the (trochaic) main stress foot, which would work here as well: in [ple(sá.l<u>əts</u>)], two segments of the affix are in the weak branch of the main stress foot, and in [ple(sál.<u>ts</u>a)], one segment is.

There are several analytic sources for dominant patterns—scaling for a markedness constraint can produce one type of dominance (a default, such as preaccenting, as in Slovenian), and regularization factors for faithfulness constraints produce a different type of dominance (accentual deletion without a default, as in Japanese). As we suggest in the next section, not all of these types of dominance are available to all suffixes.

5.2 Syntactic restrictions on neutral and regularizing affixes

We propose that any morpheme can be associated with a scaling factor, but morphological regularization factors are restricted to affixes that appear in certain morphosyntactic configurations. This is not the first proposal of this type; the phonological neutrality of an affix has been linked to its syntactic status before. For example, Marvin (2008) casts the generalization about the Slovenian nominalizer suffix [-ət͡s] in terms of argument structure: it is dominant when it represents an external argument, but it is recessive in adjectival passive [-n] nominalizations, where it corresponds to an object. Revithiadou (1999) ties accentual dominance to morphological head status, assuming that derivational affixes and roots are heads whereas inflectional affixes are not. Bachrach and Wagner (2007) similarly draw a connection between cyclic effects and the syntactic status of affixes in Brazilian Portuguese. Category-assigning head affixes are unremarkable in that they are fully integrated phonologically with the stems. On the other hand, morphosyntactic diagnostics show that Brazilian Portuguese diminutives are adjuncts; for example, they do not change a noun's gender, whereas a category-assigning affix often do, as shown in (28). An affix's ability to assign syntactic category, gender and declension class is a standard diagnostic for its status as a head as opposed to a modifier/adjunct (Bierwisch 2003, Steriopolo 2008). See also Lieber (1980), Selkirk (1982), Zwicky (1985) for related ideas.

(28) Diminutives are syntactic adjuncts in Brazilian Portuguese (Bachrach and Wagner 2007)

a.	ˈzebr-a	(fem)	zeˈbr-ĩɲ-a	'zebra dim (fem)'
b.	ˈpork-o	(masc)	porˈk-ĩɲ-o	'pig dim (masc)'
		cf.	porˈk-ãd-a	'bunch of pigs (fem)'

Diminutives in Brazilian Portuguese are also phonologically cyclic. Stressed vowels are normally nasalized before nasals, but unstressed ones are not. In diminutives, the rule of vowel nasalization overapplies, as shown in (29) (stress is marked following IPA conventions in these examples). Bachrach and Wagner's syntactic spell-out-based analysis ties the syntactic cycles to phonological ones: stress is assigned to /ˈkãm-a/ first, nasalization is conditioned, and then stress is moved to the diminutive but nasalization on [kãm-] sticks around even though that morpheme is not stressed.

(29) Diminutives are phonologically cyclic: overapplication of regressive nasalization (Bachrach and Wagner 2007)

a. ˈfãm-a ‘fame’ faˈm-os-o ‘famous’

b. ˈkãm-a ‘bed’ kãˈm-ĩɲ-a ‘small bed’

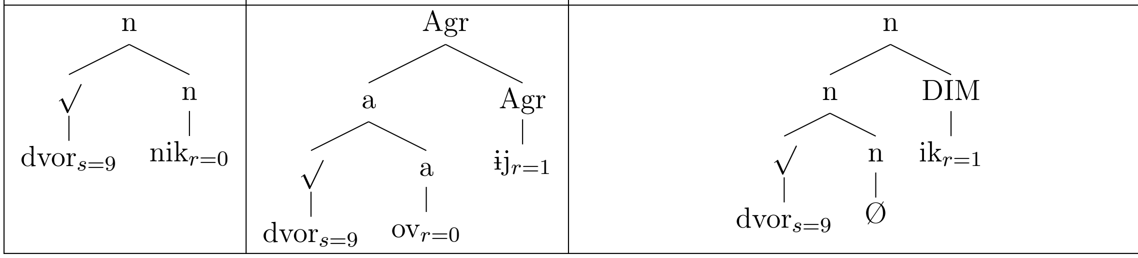
In both Slovenian and Brazilian Portuguese, then, differences in the phonological effect that the affixes have on the root's exceptionality correlate with their morphosyntactic properties.

5.2.1 Syntactic conditions on morphological regularization

In our theory, tying phonological non-neutrality to phonology-external factors would require identifying some non-phonological property common to affixes that have regularization factors other than 1. In the Russian case, diminutives are neutral (for us, they have r = 1), whereas /-nik$_{\text{N}}$/, /-ov$_{\text{Adj}}$/ and /-(ə)stv$_{\text{N}}$/ are not ($r < 1$). Phonological neutrality appears to align with the same substantive distinction as in Brazilian Portuguese: suffixes that assign syntactic category are non-neutral, and suffixes that do not assign syntactic category are. Russian diminutives are morphosyntactic adjuncts: the gender of the diminutive noun is predictable from the base (Kempe et al. 2003, Steriopolo 2008, Gouskova and Newlin-Łukowicz 2013). Thus, we could stipulate that adjuncts are limited to a morphological regularization factor of 1. A more interesting solution would be to implement the distinction structurally or derivationally, by restricting an affix's regularization ability to a specific configuration: an affix's regularization factor can only have an effect on the scaling factors of the morphemes in the stem if the affix and the stem are spelled out in the same cycle. If a spell-out cycle is initiated by each phonologically non-null categorizing affix (Embick 2010:48), then only such affixes will have detectable regularizing effect. Diminutives and other adjuncts would always be in a different cycle from the stem, and as such cannot affect the exceptional status of a root (see (30)).

(30) Effects of affixes vary depending on their structural relationship to complements

a. Syntactic heads (can be non-neutral)		b. Syntactic adjuncts (can only be neutral)
'groundskeeper'	'yard-adj'	'yard-diminutive'



The Russian data are consistent with this structural condition on regularization factors: all of the non-neutral suffixes attach to bare roots (we are assuming that roots do not have categories, following Lieber 2006, Embick and Marantz 2008 and others). For example, the suffix [-(ə)stv] attaches to a broad selection of stems, from bound roots (see (31a,b)) to suffixed nouns. There is no evidence that stems must be categorized before combining with [-(ə)stv]—in this, the suffix appears to be parallel to the English suffix *-ity*. Embick and Marantz (2008) argue that *-ity* attaches directly to the root rather than to a previously categorized suffix. The suffix *-ity* can have an idiosyncratic interpretation and is selected for by specific roots; both of these types of interactions are only possible when the categorizing affix is in a specific local structural relationship with the root. The Russian suffix [-stv] is similarly idiosyncratic semantically; the words derived with it refer to states, properties, places, etc. (in striking contrast to the much more consistent [-əst^j], which we discuss shortly).

(31) Morphology of [-(ə)stv]: meaning of derived words not fully predictable

a.	azar-stv-ó naughty-N-neut.nom.sg	‘naughtyness’	cf.	azar-n-ój naughty-adj-masc.sg	‘naughty’
b.	paxáp-stv-ə lewd-N-neut.nom.sg	‘lewdness’		paxáb-n-ɨj lewd-adj-masc.sg	‘lewd’
c.	ʧud-áʧ-istv-ə weird-N-N-neut.nom.sg	‘weirdohood’		ʧud-ák weird-N	‘weirdo’
d.	pri-dát-il^j-stv-ə before-give-N-N-neut.nom.sg	‘traitorhood’		pri-dát-il^j before-give-N	‘traitor’
e.	giròj-stv-ə hero-N-neut.nom.sg	‘playing the hero’		giròj hero	‘hero’
f.	kəral-éf-stv-ə king-fem-N-neut.nom.sg	‘kingdom’		kəral-év-ə king-fem-nom.sg	‘queen’

The suffixes [-nik] and [-ov] are similar: neither requires its stem to be previously categorized, happily attaching to apparently bare roots (e.g., [krést-nik] ‘godson (cross+*nik*)’ and [dvór-nik] ‘janitor (yard+*nik*)’). The [-nik] suffix exhibits some polysemy, and sometimes its semantic relationship to the root is idiosyncratic (such as in ‘cheese pancake’ in (32)). Not all of the stems in (32) are bare roots—they can contain prefixes or be compounds—but there is no indication that the stem must be categorized before [-nik] is attached. Both the semantic and the morphological evidence suggests that it is syntactically similar to [-stv] (see Dubinsky and Simango 1996, Marantz 2008, Embick and Marantz 2008), and its phonological non-neutrality is consistent with this.

(32) Morphology of [-nik]

a.	gréʂ-nik sin-N	‘sinner’	cf.	gréx sin	‘sin’
b.	sɨ́r-nik cheese-N	‘cheese pancake’		sɨr cheese	‘cheese’
c.	biz-bóʐ-nik without-god-N	‘atheist’		biz bóg-ə without god-gen.sg	‘without god’
d.	s-pút-nik with-way-N	‘satellite’		s put^j-óm with way-inst.sg	‘along the way’
e.	ftər-a-klás-nik second-lnk-grade-N	‘second-grader’		ftar-ój klás second-masc.sg grade	‘second grade’
f.	dèriv-ə-ab-dél-aʧ-nik wood-lnk-around-do-N-N	‘woodworker’		dèriv-ə-ab-dél-ək wood-lnk-around-do-N	‘woodwork (gen pl)’

Compare this with [-(ə)st$^j{}_N$], which attaches to adjectival stems (see (33)). There are more than 3000 [-əst^j] derivatives in Zaliznjak's (1977) dictionary, almost of them with corresponding free-standing adjectives. The few exceptions can be treated as containing a null adjectival head: for example, in (33e), [révn-əst^j] would be analyzed as [[[revn$_{\surd}$]-$\varnothing_{\text{adj}}$]-əst$^j{}_{\text{N}}$]. If the structural condition on the effect of regularization factors holds, we would expect [-əst^j] to be phonologically neutral, even though it is a morphosyntactic head.

(33) A nominalizer that attaches to adjectival stems: [-(ə)st^j]: predictable semantics for derived words

a.	glás-n-ɨj voice-adj-masc.sg	'voiced'	glás-n-əst^j voice-adj-N	'openness'
b.	sláb-ɨj weak-masc.sg	'weak'	sláb-əst^j weak-N	'weakness'
c.	xrúp-k-ij fragile-adj-masc.sg	'fragile'	xrúp-k-əst^j fragile-adj-N	'fragility'
d.	rivn-ív-ɨj jealous-adj-masc.sg	'prone to jealousy'	rivn-ív-əst^j jealous-adj-N	'proneness to jealousy'
e.	rivn-av-át^j jealous-v-inf	'to envy, be jealous'	révn-əst^j jealous-N	'jealousy'

The sample in our case is quite small, as we are studying subpatterns within an already small set of exceptions. But if this syntactic asymmetry between affixes holds up cross-linguistically, our theory has a way to account for it by restricting regularization factor effects to specific syntactic contexts.

5.2.2 Accentual dominance and syntactic status

The syntactic distinction between Russian suffixes has an interesting phonological correlate: the affixes that are capable of attaching to uncategorized stems (the two nominalizers /-(ə)stv/, /-nik/) have less consistent accentual properties than those that attach to categorized stems (/-əst^j/ 'deadjectival nominalizer', /-ik/ 'diminutive'). Words with the first two suffixes sometimes follow an idiosyncratic final stress pattern, whereas words derived with the latter suffixes always have stress to the left of the suffix (Zaliznjak 1985). We confirmed this by examining all the stems with these suffixes in Zaliznjak (1977). Of 1056 words derived with [-(ə)stv], 35 have final stress (e.g., [xvəst-af-stv-ó] 'boasting', [məstir-stv-ó] 'mastery'). Of the 1529 stems derived with [-nik], 106 have final stress (e.g., [bəlav-ník] 'naughty kid', [mis-ník] 'butcher'). There are 3196 words with [-əst^j], all with stress to the left of the suffix. Diminutives with [-ik] invariably have stress on the syllable right before the suffix (Zaliznjak 1985:85–87, Polivanova 1967). Due to space limitations, we leave an in-depth analysis of these stress facts for another paper. They do suggest, however, that the relationship between stress dominance and syntactic structure is not a simple one.

Recall that accentual dominance has two sources in our theory: regularization factors and scaling factors. If regularization factors are something that only some affixes can have, whereas scaling factors are not similarly restricted, this makes predictions for types of dominance associated with affixes of different morphosyntactic types. Namely, adjunct affixes may be dominant in that they can impose a predictable stress pattern on the resulting word (by scaling up a markedness constraint). Head affixes can be dominant in other ways, however: deaccenting dominance and conditional dominance arise only when head affixes have regularization factors. Consistent with this, the Japanese dominant deaccenting suffix [-teki] is a categorizing (adjectival) head, as is the Slovenian dominance-canceling [-n] suffix.

Russian happens to have a dominant adjunct suffix, the diminutive [-ok], and it is dominant in exactly the way predicted in our theory. Russian diminutive suffixes are accentually non-uniform. Some are clearly recessive (e.g., the feminine [-(ə)k]). Diminutives derived with [-ik]—recall [dvór-ik] 'yard (dim)'—generally have stress on the syllable right before the suffix; it is never accented itself (Zaliznjak 1985:84–85). The suffix [-ik] fails the crucial test for dominance, however—it doesn't *move* stress to the stem-final syllable when attaching to lexically accented stems; it simply prefers to attach to stems that already have final stress (Gouskova and Newlin-Łukowicz 2013 analyze this as a selectional restriction of the suffix, without assuming dominance). But the masculine diminutive [-(o)k] is unambiguously dominant, assigning final stress (see (34) and Melvold 1989)):

(34) Russian diminutive suffixes: dominance through scaling factors

UR	Nom sg. /-∅/	Gen sg. /-a/	Dat sg. /-ám/	Dim. nom. sg. /-ok/	Dim. Gen. sg. /-a/
/mólot/	mólot	mólot-a	mólot-am	molot-ók	molot-k-á
/volos/	vólos	vólos-a	volos-ám	volos-ók	volos-k-á

Accounting for the dominance of the diminutive [-ok] does not require a regularization factor—it is sufficient in our theory to give it a big scaling factor for a markedness constraint that imposes the final stress pattern on the stems with this suffix. Here is a brief analysis of this dominance effect. Similar to the Japanese pattern discussed in section 5.1, Russian accented stems keep their stress with regular stressed and unstressed suffixes (such as the case suffixes), whereas unaccented stems get initial stress when there is no stressed affix. We analyze this as an interaction of MAX and ALIGN-L; MAX is scaled up for roots so roots keep their accent when suffixes are stressed (35)). Even though faithfulness to stem accents is weighted high in general, the affix [-ok] has such a high scaling factor for a markedness constraint enforcing its autoaccenting pattern that it moves stress even on accented stems. We call the markedness constraint "AFFIX-IN-$\acute{\sigma}$" in (35), and assume it is violated when no exponent of the suffix is in the stressed syllable.

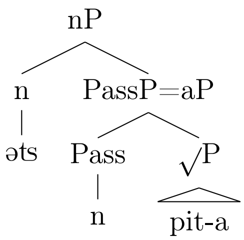
(35) Dominance effects through scaling factors of adjunct suffixes: dominant Russian diminutives

	/$\sqrt{\text{mólot}}$-ám/	MAX-ACCENT$_3$	ALIGN-L$_2$	AFF-IN-$\acute{\sigma}_1$	$\mathcal{H}$	p
a.	molot-ám	$3_c + 10_{\surd}$	2		15	0%
b.⇝	mólot-am	3		1	4	100%
	/$\sqrt{\text{mólot}}$-ok/					
c.⇝	molot-ók	$3_c + 10_{\surd}$	2		15	100%
d.	mólot-ok			$1_c + 30_s$	31	0%

	AFF-IN-$\acute{\sigma}$	
	s	r
-ok	30	

This approach illuminates certain aspects of accentual dominance that are problematic for other theories. First, we can analyze cases where an affix loses its dominance in the presence of another affix. In our analysis of Slovenian, the passive suffix [-n] had a regularization factor, which had the effect of rendering the otherwise dominant suffix [-əts] recessive—without deleting stem accent. This is a puzzle in theories that treat dominance as a binary feature (such as Melvold 1989)—why should dominance be lost in the presence of an affix that is not itself dominant in the traditional sense of the word? This pattern is similarly problematic for the idea that dominance is the purview of the highest morphosyntactic head (Revithiadou 1999): [-əts] is the outermost suffix in both kinds of Slovenian nominalizations, so it should always be dominant. The suffix [-n] is a syntactic head (according to Marvin's analysis, it heads PassP—see (36)). The nominalizing suffix [-əts] is also a head, and this suffix is sometimes dominant and sometimes recessive. We have shown that decoupling dominance from head status analytically allows us to make sense of such cases.

(36) Structure for [pít-a-n-əʦ] ‘animal that is fed’ (Marvin 2008:208)



Finally, a reviewer asks whether inflectional morphemes as well can have regularization factors, or whether this is only something that derivational morphemes can have. We do not formally distinguish between inflectional and derivational morphemes, and we are not aware of any clear diagnostics that unambiguously delineate these classes. So-called inflectional morphemes are generally considered to head functional categories in the syntactic literature (see Pesetsky 2013 for a recent discussion of Russian case). On the other hand, there are derivational morphemes that are adjuncts rather than heads, as we already showed earlier. Standard diagnostics such as productivity do not align with the inflectional/derivational distinction, either; gaps exist in inflectional paradigms, and some derivational morphemes are extremely productive. Thus, we leave the option for inflectional morphemes to have non-neutral regularization factors, though whether they can appear in configurations that allow them to be non-neutral depends on the theory of phonological/syntactic cyclicity.

6 Loanword phonology under affixation: morphological nativizing effects

Morphological regularization in Lexical MaxEnt can also be applied to explain nativization effects in loanword phonology. Loanwords are often allowed to have segments and structures that are not tolerated in the native lexicon (see Kang 2011 for a recent overview), but this special phonological status is sometimes revoked in morphologically defined contexts (Jurgec 2012): a borrowed morpheme is phonologically nativized when it is affixed. For example, in Tagalog, [f] is not allowed in the native vocabulary but is allowed in bare loanwords; in affixed words, [f] is replaced with [p]:

(37) Tagalog: [f] allowed in bare loanwords but not in affixed ones (Zuraw 2000, Jurgec 2012)

bare:	filipino	'Filipino'	fiesta	'feast'
prefixed:	magpilipino	'language'	pam-pista	'fiesta (inst)'
suffixed:	pilipino-ŋ	'the Filipino'	pista-han	'festival'

Jurgec provides another example, from Dutch, whose speakers produce an English-like [ɹ] in isolated words (e.g., Op[ɹ]ah 'Oprah'), or with inflectional suffixes such as the plural (Op[ɹ]ah'[s] 'Oprah (pl)') but not with diminutives, where a native [ʀ] is required (Op[ʀ]ah-tje 'Oprah (dim)'). In Catalan, interdental fricatives are similarly lost in morphologically derived environments (Mascaró 2003, Bonet 2004).

Tagalog and Dutch are similar in the abstract to our Russian case: a subset of morphemes lose their special phonology in morphologically defined contexts. The difference between Tagalog, Dutch, and Russian lies in the affixes that condition the loss of special phonology: in Tagalog, all affixes do; in Dutch, a subset of the affixes (specifically, diminutives); and in Russian, a subset of the derivational affixes (some morphosyntactic heads but not diminutives). Our proposal is general enough to allow these effects to fall out naturally: for Tagalog, faithfulness to /f/ is weighted heavily for loanword roots, but all affixes are associated with a regularization factor of 0 and turn off special loanword faithfulness whenever they are present. In the case of Dutch, some affixes have a regularization factor of 0, whereas others are neutral—for example, inflectional affixes have a regularization factor of 1. It is important to note that Dutch diminutives are not adjuncts, as in Russian, but rather morphosyntactic heads, as in German. They change the gender of the noun they attach to and interact with the semantics of nouns in a way that adjuncts do not (see Wiltschko 2006, Ott 2011). The [ɹ/ʀ] alternation moreover appears to be quite variable both within and between speakers.[10]

Before moving on to general alternatives to our proposal, we briefly consider Jurgec's analysis. Jurgec notes an asymmetry: for the Dutch speakers in his sample, derivational prefixes do not require a native [ʀ] (e.g., Hoofd-op[ɹ]ah 'main, true Oprah'), whereas derivational suffixes do; inflectional suffixes pattern with prefixes. His proposal ties this asymmetry to precedence, positing a family of constraints that are violated just in case the affix is preceded by an instance of some feature F

[10]Thanks to Peter Jurgec and Frans Adriaans for discussion of the Dutch facts.

in a domain (e.g., a word). Thus, a prefix does not have a nativizing effect on its stem because it precedes the non-native [ɹ], but a derivational suffix does have an effect because it follows it. In Tagalog, both prefixes and suffixes have a nativizing effect, which would require two constraints, one for each type of affix.

This account cannot be extended to the Russian pattern, however. In Russian, the regularizing effect does not target a specific feature—rather, it is a matter of triggering deletion of the vowel in three CV prepositions, deletion that is idiosyncratically blocked by specific roots that follow the preposition. It is not the case that the regularizing affixes cannot be preceded by CV prepositions, since non-alternating prepositions such as [za] keep their vowels in all contexts (cf. (38a–b) and (c–d)):[11]

(38) The Russian pattern is not about precedence between phonological structures and affixes

a.	/so dvor-a/	sə dvará	'from a yard'
b.	/so dvor-nik-a/	z dvórnikə	'from a janitor'
c.	/za dvarom/	zə dvaróm	'behind a yard'
d.	/za dvornikom/	za dvórnikəm	'behind a janitor'

Our theory characterizes both the nativizing effect and the regularizing effect as the loss of lexically specific exceptionality in a morphologically defined context. Our proposal is similar in spirit to Jurgec's, however, in that we make the same assumptions about the affix-specific nature of these effects. We discuss alternatives to this view in the next section.

7 Alternatives

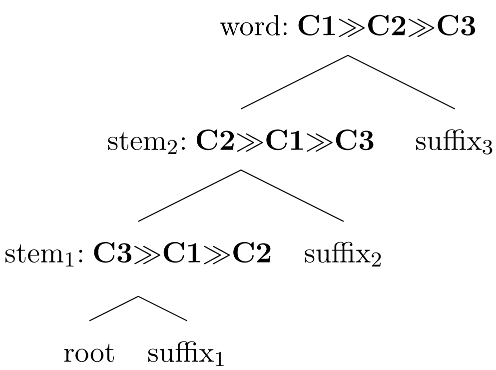
Our empirical domain concerns phonological interactions whereby certain morphemes can turn off or reduce the exceptional phonological status of other morphemes. Our theory decouples these interactions from phonological words: all of the explanation resides in identifying morphemes with exceptional phonology or exceptional morphological regularization power, and restricting the regularization powers of affixes to certain syntactic domains—specifically, phase-based spellout. The

[11] A reviewer suggests that Jurgec's theory can be expanded to account for such cases if it is combined with Hyde's (2012) proposal to extend the Alignment family of constraints referring to larger domains. We acknowledge that with a sufficiently rich theory of constraints, it might be possible to reanalyze some of our examples.

alternatives we consider here fall into two categories: those that associate special phonology with specific affixes or morphological constructions, and those that treat special phonology as a holistic property of words or complex stems.

An example of the first type of theory is cophonology theory (Inkelas et al. 1997, Orgun 1996, Anttila 2002, Inkelas and Zoll 2005, 2007). In this theory, all constraints are fully general, but they can be ranked differently for different morphemes and stems. Contradictory rankings are resolved through morphological nesting: the ranking associated with the affix attached at the highest level is the last ranking to affect the structure. In (39), for example, the ranking for $suffix_3$ is the ranking that holds for the entire word, even though the rankings associated with the lower suffixes may impose different preferences.

(39) Example of morpheme- and stem-specific rankings in cophonology theory

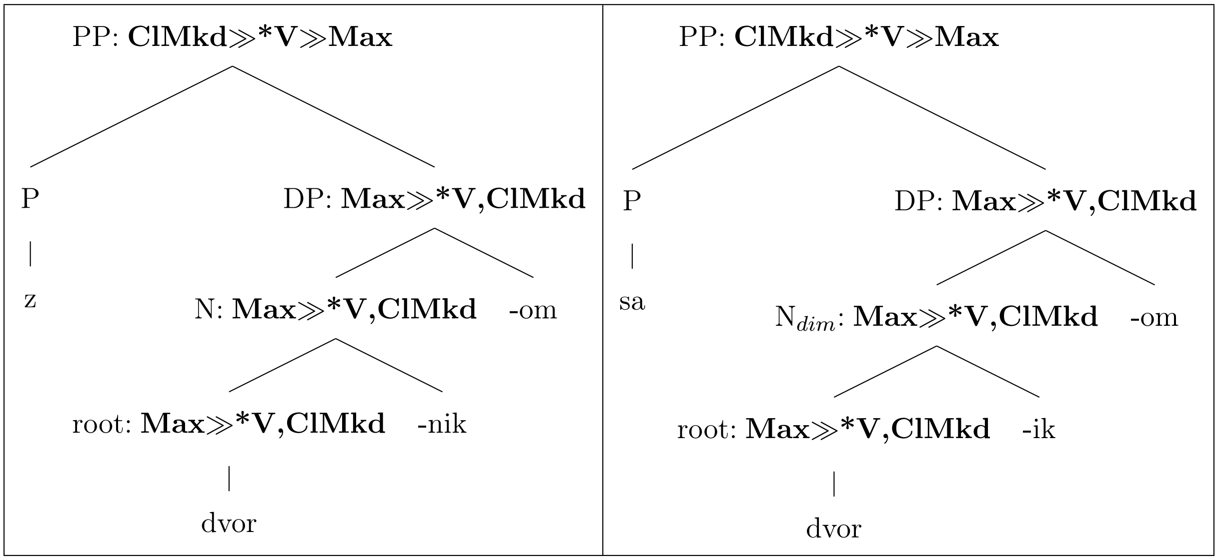


This theory can be illustrated on accentual dominance. In the Japanese example illustrated in (20)–(21), a dominant deaccenting affix such as [-teki] would be associated with a cophonology that bans accent, *ACCENT≫FAITH. A cophonology for the dominant accented affix such as [-ppoi] would enforce a default penultimate mora accent, with faithfulness to the lexical accents of the stem dominated by markedness. Recessive affixes, on the other hand, would be associated with a ranking of faithfulness over markedness, so the accentual patterns of the stems will be preserved. Since recessive affixes may be either accented or unaccented, some additional provisions would be needed to explain what happens in cases where it is impossible to preserve both the stem and the suffix accents. How these conflicts are resolved is an issue for cophonology theory (see Alderete 1999 for some critical discussion). For example, in our theory as well as Alderete's, root accents are preserved over those of recessive affixes' accents because roots are afforded special faithfulness status. In cophonology theory, there is no root faithfulness, so this tendency is either an accident or a language-specific directional preference (see Inkelas and Zoll 2007).

Cophonology theory runs into some problems when applied to the Russian prepositional alternation. The generalization in the Russian case is that suffixes affect deletion in prepositions: deletion applies normally in the context of some suffixes but not others. Since the norm is for prepositional vowels to delete (e.g., the nonexceptional /so dver^j-ju/→[z dvér^{j}ju] 'with the door'), they must be associated with a deletion cophonology: ClusterMarkedness≫*V≫Max (the constraint triggering deletion is not special to the prepositions, since generality of constraints is a central feature of cophonology theory). Prepositions are structurally the highest, so their cophonology would extend to the entire structure they dominate, and it would be necessary to explain why deletion happens in prepositions but not in other morphemes. A much more difficult question, however, is why some suffixes that are lower in the structure allow deletion in prepositions and others do not. The cophonology associated with [-nik] in the tree on the left needs to be different from that of the cophonology associated with [-ik], but this difference affects only deletion in the preposition higher up in the tree. This is essentially a bracketing paradox: the phonology of a higher morpheme is controlled by a lower morpheme. Our account handled this paradox by letting the root and the suffix together block the preposition-specific deletion pattern whenever the marked cluster resulting from deletion includes the root's consonants. It is impossible to reproduce such an analysis without tracking violations in the root separately from the violations in the preposition, and without having preposition-specific constraints that trigger deletion.[12]

[12] A reviewer suggests that the cophonology account could be saved if we assume that prepositions form a "domain" with the following root to the exclusion of suffixes. The domain in question cannot be syntactic, since prepositions scope over the entire DP syntactically and semantically. There is also no special phonological domain that the preposition and the root form to the exclusion of the suffix—prepositions are part of the same phonological word, but there are no arguments we know of for positing any additional domains.

(40) A problem for a cophonology account



Another explanation for the facts we discuss is offered by theories of morphology that allow the grammar to treat morphologically complex constituents as whole unanalyzed objects. In such theories, anything from morphemes to stems, words, phrases and even sentences (i.e., idioms) can be stored in the lexicon in an unanalyzed form, although the size of storable unit varies between theories (Aronoff 1994, Jackendoff 1997; see Marantz 1997 for discussion). What these theories have in common is that morphological decomposition is not obligatory, and lexical exceptions can bypass semantic, morphological and phonological rules. It is well established by now that there are subpatterns within exceptions (Zuraw 2000, McClelland and Patterson 2002, Albright and Hayes 2003, Becker 2009, Becker and Gouskova 2012). Theories without decomposition assume that stored exceptions may be related to each other by analogy (Pinker and Prince 1988, Prasada and Pinker 1993, Marcus et al. 1995, Hay 2003, inter alia). How exceptions relate to the rest of the grammar is the subject of ongoing debate that we cannot do justice to here, but we should point out that the exceptions in the case of Russian do follow subregularities (Linzen et al. 2013). We account for these subregularities by analyzing the exceptions as governed by the grammar.

Our theory claims that the regularizing effects of certain affixes are not just an accident of lexical storage. Affixes have a consistent effect across contexts: words that contain [-nik] are expected to pattern as regular in the prepositional C/CV alternation, regardless of the stem that this suffix attaches to. This prediction does not follow in unanalyzed storage theories of exceptional phonology, since presumably anything can be stored as an exception. In our theory, it is possible for derived words to have special phonology (e.g., if regularization factors greater than 1 are allowed, or if the regularization factor turns off faithfulness in the base and an affix-specific default kicks in, as in accentual dominance). But all of the words with a given affix would follow the same phonological subpattern. On the other hand, in the lexical storage approach, a derived word can be an exception without the base being one, or it can follow its own pattern that is different from other words derived with the same affix. Moreover, we argue that suffixes can only have regularizing effects if they have certain morphosyntactic characteristics. This prediction again does not straightforwardly follow in unanalyzed storage theories, either, although some discuss the connection between phonological decomposability and semantic transparency (Hay 2003, inter alia). For us, both phonological and semantic properties follow from the grammar rather than from storage. There is evidence that even morphologically irregular words are morphologically decomposed in processing (Solomyak and Marantz 2010, Lehtonen et al. 2011, Lewis et al. 2011). Our account of contextual allomorphy and affixal regulairzation of exceptionality assumes the full decomposition view: exceptionality is a property of morphemes in context, not of whole phrases.

8 Conclusion

We described a morphological regularization effect in Russian: in a sequence of three morphemes, the shape of the first morpheme (the preposition) depends on the identity of the second (the root), but the third morpheme (an affix) can turn off the special lexical status of the second morpheme and consequently affect the first morpheme's behavior. Our theory accounted for this unusual interaction in two ways. First, following other work, we assume that some of the constraints in a MaxEnt grammar can be rescaled for specific morphemes, which allows for lexical non-uniformity in phonological patterning. Second, we propose that affixes can have special morphological regularization factors, which can reduce or cancel the morpheme-specific scaling of constraints. These effects are limited to certain morphosyntactic contexts. This theory accounts for the Russian prepositional alternation, and we showed that it can be extended to other, unrelated phenomena: dominance in lexical stress/accent systems and the nativizing effects that affixes can have on loanwords. We argued that exceptionality and regularizing effects result from the interaction between the individual morphemes that make up a word rather than from lexically listed properties of whole derived words.

Appendix: Summary of Lexical MaxEnt notation

A.1 Calculating harmony scores

The final formula for evaluating a candidate's harmony score in Lexical MaxEnt is (16), repeated here:

$$h_j = \sum_{i=1}^{n} \sum_{l=0}^{p} v_{ij}^{l} (w_i + s_i^l \prod_{k \neq l} r_{ik})$$

Where the notation is as follows:

h_j	harmony of candidate j
C_i	the i-th constraint
n	number of constraints in the grammar
p	number of affixes in the word
r_{ik}	morphological regularization factor for C_i of k-th affix ($r_{ik} = 1$ if affix doesn't have a lexically assigned regularization factor)
v_{ij}^l	number of times the l-th morpheme violates constraint C_i in candidate j, where $l = 0$ corresponds to the stem, and $l = 1, \ldots, p$ correspond to the affixes
s_i^l	scaling factor for constraint C_i of the l-th morpheme, where $l = 0$ corresponds to the stem, and $l = 1, \ldots, p$ correspond to the affixes ($s_i^l = 0$ if the morpheme doesn't have a lexically assigned scaling factor)
w_i	weight of constraint C_i

A.2 How to read Lexical MaxEnt tableaux

	Cons$_2$	h	p
a. ⇝ adappoi	$\underbrace{1_v \times (2_c + (3_s + 4_{\surd}) \times \overbrace{0.5_r}^{\text{ment}}}_{\text{depart}}) + 1_v \times \underbrace{(2_c + 5_s)}_{\text{ment}}$	45	100%

	Cons	
	s	r
depart	3	
-ment	5	0.5

- h: harmony score of candidate
- p: probability of candidate
- In cases where the probability of one of candidates is overwhelmigly higher than all of the others, we mark that candidate with a squiggly arrow ($\rightsquigarrow$), by analogy to the winning candidate in Optimality Theory.
- The subscript next to the name of a constraint in the top row of a tableaux represents its weight.
- The factor table to the right of the tableaux shows the scaling factors (under s) and regularization factors (under r) for each of the combinations of morphemes and constraints. For instance, in the example above, the scaling factor of *depart* for Max-Accent is 3. If a cell is empty or a constraint or morpheme are missing from the table, it is understood that the scaling factor is 0 and the regularization factor 1.
- Curly braces under an expression indicate the morpheme that the violations are associated with. Curly braces over the expression indicate the morpheme that a regularization factor is associated with.
- Subscripts next to numbers inside the tableaux cells indicate what the numbers represent:

v	number of violations
c	constraint weight
s	lexical scaling factor
r	morphological regularization factor
$\surd$	root scaling factor

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