18 Rule Application in Phonology

Morris Halle and Andrew Nevins

18.1 Introduction

The purpose of this chapter is to outline and defend a theory of phonology employing ordered rules, by illustrating how the theory accounts for certain complex phenomena central to the phonologies of the Slavic languages Russian, Czech, and Serbo-Croatian. We focus on three important principles of phonological rule application:

(1) The application of phonological rules is subject to the principle that when more than one rule applies to a given string, the interaction is determined by rule order. Counterfeeding opacity results from the fact that rules do not get a "second chance" to apply.

(2) Phonological rules are organized into two blocks: cyclic and postcyclic. Cyclic rule application respects morphological constituency and applies to each nested constituent of the word in turn. Postcyclic rules apply once to the entire word, after all cyclic rules.

(3) If a lexical item is an exception to a particular rule R_k, this exceptionality only affects application of R_k; all rules $R_{1...k-1}$ and $R_{k+1...n}$ apply as usual.

We assume that morphological structure building precedes phonological rule application, and specifically that all Slavic nouns have the tripartite form Root + Theme + Case-Number, although the phonological exponent of some of the parts may be subsequently deleted by various rules. For instance, even when traditional methods of surface analysis do not reveal three distinct morphemes in a word such as Czech *žen* 'woman, gen. pl.', we assume that there are in fact three underlying morphemes here, but that both the theme and the case-number suffix are deleted by rules of the phonology, which obscure this structure. As we discuss below, adopting this approach—which sharply distinguishes underlying representations from their surface manifestations—makes it possible to bring out clearly the regularity both of

the morphological structure of a word and of the phonological rules that relate its underlying and surface representations.

That a word such as Czech or Russian genitive plural *žen* is underlyingly composed of a root plus two suffixes (one the theme vowel, and one the case ending), of which neither surfaces in this particular environment, is in part a consequence of the discovery by Jakobson (1948) that Russian (and Slavic generally) is subject to a rule of Vowel Truncation. This rule deletes a vowel immediately preceding another vowel and explains why the noun theme vowel /a/, which surfaces in the instrumental plural *žen* + *a* + *mi*, is absent in the accusative singular *žen* + *u*, from underlying /žen + a + u/. Jakobson's rule, originally formulated to account for facts of the Russian conjugation, thus explains a number of facts in the declension of nouns as well as other aspects of the phonology of Czech and other Slavic languages (see Lightner 1972, Gussmann 1980, Rubach 1993).[1]

One main focus of attention of the chapter is the genitive plural form of nouns in the Slavic languages. Historically, the phonetic exponent of the genitive plural in Common Slavic was the short vowel /u/, commonly referred to as *back yer* and represented below with a capital *U*. As noted above, the case endings of all nouns in Slavic consist of a theme vowel followed by the case-number suffix. Since in the genitive plural this gives rise to a sequence of two vowels, Jakobson's rule of Vowel Truncation applies and deletes the theme vowel, leaving the short /U/ as the phonetic marker of the genitive plural. Having caused the deletion of the theme, the short /U/ is itself deleted by a subsequent rule. The genitive plural thus surfaces as the bare stem for many nouns. Russian examples of such genitive plurals are *žen* 'women's', *fabrik* 'factories'', (fem.), *mest* 'places'' (neut.), *volos* 'hairs'' (masc.).

Not all nouns have the bare stem form in the genitive plural. In Russian, for example, certain nouns are subject to a readjustment rule in the genitive plural, which inserts a glide—either /j/ or /w/—between the theme vowel and the case ending. The insertion of the glide between these two vowels has the effect of blocking Vowel Truncation in these forms. In this way, genitive plural forms like Russian /stol + ov/ 'tables'' and /car, + ej/ 'tsars'' are generated (for discussion, see Halle 1994, Bailyn and Nevins 2008).

West and South Slavic display yet another treatment of the genitive plural, which also involves blocking of Vowel Truncation. As explained below, Vowel Truncation in Czech and Serbo-Croatian is blocked not by Glide Insertion, but by marking the genitive plural forms of nouns as exceptions to Vowel Truncation. Since systematic marking of forms as exceptions to a particular rule has rarely, if ever, been invoked as a mechanism of phonological change, we make the case for it below at some length. One result of the discussion is that the development of the genitive plural in the different Slavic languages divides all nouns into three classes: a class where the genitive plural is directly generated from the underlying representation, and two

classes where the rule of Vowel Truncation is blocked. In one class, it is blocked by Glide Insertion, and in the other—and far more interesting—class, it is blocked by marking genitive plural forms as exceptions to Vowel Truncation. As we show, this marking has no effect on the operation of any of the other rules of the phonology.

18.2 The Regularity of Morphological Structure (and How It May Be Obscured)

We begin with a problem that arises in the inflection of verbs in Modern Russian like those in (4a–c). A comma following a consonant indicates that it is palatalized ([−back]); the effects of stress and vowel reduction (ikan'e) have been disregarded.

(4)	*Sg. fem. past*	*1pl. pres.*	*1sg. pres.*	
a.	l,ez + l + a	l,ez, + e + m	l,ez + u	'climb'
b.	laja + l + a	laj + e + m	laj + u	'bark'
c.	zna + l + a	znaj + e + m	znaj + u	'know'

The first form in (4a), /l,ez + l + a/, is composed of three morphemes: /l,ez/, the stem meaning 'climb'; /l/, the past tense morpheme; and /a/, the feminine singular agreement suffix. Each of these pieces has its own motivated semantic and syntactic role. The same three pieces—stem, tense, agreement—appear in the second form in (4a), the first person plural present /l,ez, + e + m/, except that in this form tense and agreement have different exponents: /e/ is the present tense morpheme, and /m/ stands for first person plural. The third form in (4a) has only two pieces: the stem and the suffix /u/. Semantically and syntactically, however, the form is completely parallel to the other two forms. The fact that the first person singular form has only two pieces clearly needs an explanation.[2]

In his 1948 paper, Jakobson relied on a distinction that would now be viewed as one between underlying and surface representations. Jakobson was not the originator of this distinction; in a footnote (p. 156), Jakobson credited this important distinction to the American linguist Leonard Bloomfield (see Bloomfield 1933:218).[3]

Jakobson's discovery communicated in the 1948 paper was that in order to account for the relation between underlying and surface forms of Russian verbs, it is necessary to assume that Russian is subject to the two truncation rules stated informally in (5).[4]

(5) a. *Vowel Truncation*
$V \rightarrow \varnothing \ / \ __ + V$
b. *Glide Truncation*
$j,w \rightarrow \varnothing \ / \ __ + C$

These rules affect vowels and glides that may be present in the underlying morphological structure of a word. Vowel Truncation (5a) provides an answer to the

question that was raised above in connection with (4). The first person singular /u/ in /l,ez + u/ is a case-number suffix, just like the first person plural /m/ in /l,ez, + e + m/, but because the first person singular suffix begins with a vowel, Vowel Truncation (5a) applies in this form and deletes the present tense marker /e/, as shown in (6).

(6) l,ez + e + u ⇒ l,ezu (by Vowel Truncation)
(cf. l,ez + l + a ⇒ l,ezla
l,ez + e + m ⇒ l,ezem)

This analysis also accounts for the forms of the verb in (4b), as shown in (7).[5] The last form in (7) shows two applications of Vowel Truncation (5a). As we will discuss below, Vowel Truncation (5a) is a cyclic rule. Finally, as shown in (8), Glide Truncation (5b) is required for the past tense forms of the verb in (4c).

(7) laj + a + l + a ⇒ lajala
laj + a + e + m ⇒ lajem (by Vowel Truncation (5a))
laj + a + e + u ⇒ laju (by Vowel Truncation (5a) twice)

(8) znaj + l + a ⇒ znala (by Glide Truncation (5b))
znaj + e + m ⇒ znajem
znaj + e + u ⇒ znaju (by Vowel Truncation (5a))

The rules in (5) make possible accounts of great morphological transparency and uniformity for verb forms of different tenses and inflectional combinations. In particular, they make possible accounts where there is only one verbal stem in both past and present tense: the exponent of the present tense is /-e-/ (and, for a second well-defined class of verbs, /-i-/), and all finite verbs have the uniform morphological structure Stem + Theme + Tense + Agreement. These properties of our account reflect the basic working hypothesis of our theory—the *Principle of Morphological Consistency*—which states that, as far as possible, all verbs have the same underlying morphological constituency and that phonological rules are responsible for surface divergences. In other words, we take the position that in the "storage versus computation" trade-off, speakers opt for minimizing storage, and in so doing they opt for uniform morphological structure and a single underlying lexical entry, which is the main locus of unpredictable information.

The existence of truncation rules in the phonology of a language highlights one of the most difficult problems in the study of speech perception: once truncation rules are admitted, a given output is compatible in principle with any number of underlying representations. For example, [laju] could in principle derive not only from /laj + a + e + u/ as in (7), but also from /laj + e + u + e + a + u/ or any other sequence of heteromorphemic vowels. Assuming the uniformity of underlying mor-

phological structure based on an informed theory of morphology is thus crucial to constraining the representations onto which surface [laju] can map.

Another striking phenomenon found throughout Slavic is a pattern of vowel/zero alternations. These vowel/zero alternations derive historically from the fact that the two short high vowels became susceptible to deletion at a late stage in Common Slavic (see Townsend and Janda 1996). These vowels are called *yers* in the philological tradition, and we use the term *yer* here as a synchronic description of abstract vowels that undergo vowel/zero alternations under the specific conditions explained below.[6]

As an example, consider the Russian words in (9). In the genitive singular (9a), the two masculine nouns have stems of the same form, but their nominative singular forms are different (9b).

(9)	a. *Gen. sg.*	b. *Nom. sg.*	
	park + a	park	'park'
	turk + a	turok	'Turk'

The existence of numerous pairs of this type makes it apparent that, unlike cases of vowel/zero alternations encountered in other languages, those in Slavic cannot be handled by epenthesis, as there is no distinction between the phonological environment of the nominative singular forms of *turk* and *park* that might trigger such a rule. Since the two stems appear in identical contexts, their different behaviors can be attributed only to differences in their underlying representations. Specifically, we propose that in its underlying representation, *turk* contains a yer, but *park* does not. We propose in addition that the nominative singular suffix of these nouns is yer, rather than zero. We illustrate this in (10), where *U* stands for the [+high, +back] yer. (The [+high, −back] yer is represented by *I*.)

(10)	a. *Gen. sg.*	b. *Nom. sg.*
	park + a	park + U
	turUk + a	turUk + U

These underlying forms with their "abstract" yer vowels are subject to the rules in (11) and (12).

(11) *Yer Lowering*
Yer → [−high] / __ C_0 Yer

(12) *Yer Deletion*
Yer → ∅

The difference between the nominative and genitive singular of *park* and *turk* is thus captured by the presence or absence of a yer in the underlying form. In (13),

we show the application of Yer Lowering (11) and Yer Deletion (12) to the underlying forms of the minimal pair from (9).[7]

(13) a. park + U ⇒ park (by Yer Deletion (12))
park + a ⇒ parka
b. turUk + U ⇒ turokU (by Yer Lowering (11)) ⇒ turok (by Yer Deletion (12))
turUk + a ⇒ turka (by Yer Deletion (12))

The important point about the behavior of yers, then, is that vowel/zero alternations arise from a simple and regular sequence of computations: when there are two yers in adjacent syllables, the first one surfaces as a mid vowel, and the second one deletes, and so do all yers elsewhere.

The same behavior is found in the verbal system. The verbs /tolUk/ 'pound' and /polz/ 'crawl' show alternations like those in (14).

(14) a. tolUk + e + u ⇒ tolku (by Vowel Truncation (5a), Yer Deletion (12))
tolUk + l + a ⇒ tolkla (by Yer Deletion (12))
tolUk + l + U ⇒ tolokl (by Yer Lowering (11), Yer Deletion (12))
b. polz + e + u ⇒ polzu (by Vowel Truncation (5a))
polz + l + a ⇒ polzla
polz + l + U ⇒ polzl (by Yer Deletion (12))

The forms in the last lines of (14a) and (14b) surface as *tolok* and *polz* owing to an additional rule of word-final *l*-deletion whereby the past tense *l* deletes in the context C + __#, yielding masculine/feminine past tense pairs such as *čital*/*čitala* 'read' but *l,ez*/*l,ezla* 'climbed', as well as *tolok*/*tolkla* and *polz*/*polzla*. In sum, the underlying difference between the verbs *tolUk* and *polz* exactly parallels that between the nouns *turUk* and *park*.

At this point, an important question arises: what happens to an underlying sequence of several consecutive syllables that have yers in their nuclei? For example, what happens in the mapping of three or more yers in consecutive syllables from underlying to surface form? A simplistic interpretation of Yer Lowering (11) and Yer Deletion (12) might lead us to expect that an alternating pattern such as /U . . . U . . . U/ might surface as [∅ o ∅]. As it turns out, there is no "pure" answer to this question. In particular, Yer Lowering (11) and Yer Deletion (12) do not apply in alternating fashion, for example, lower-delete-lower-delete. Rather, the application of these rules is governed by an important principle, the cyclic character of rule application, introduced into the theory of phonology by Chomsky, Halle, and Lukoff (1956).

Given a bracketed morphological structure [[X Y] Z], the principle of cyclic rule application dictates that if [X Y] and [[X Y] Z] are cyclic constituents and interact

with respect to a cyclic phonological rule such that Y is the trigger for a rule affecting X, and Z is the trigger for a rule affecting Y, the rule affecting X will apply before the rule affecting Y. Cyclic application thus determines a principle of rule-application ordering based on morphological structure.

The Russian noun *ogon,* 'fire' and its derivative *ogon,ek* 'small light' provide an opportunity to consider the interaction of three adjacent yers as determined by the principle of cyclic rule application. Like *turok*, *ogon,* has an underlying form containing a yer.

(15) a. ogUn, + U ⇒ ogon, (by Yer Lowering (11), Yer Deletion (12)) (Nom. sg.)
b. ogUn, + a ⇒ ogn,a (by Yer Deletion (12)) (Gen. sg.)

The addition of the derivational suffix -*Ik*, with a front yer, generates a nominative singular form with the nested structure [[X Y] Z], that is, [[ogUn, + Ik] + U] 'small light'. While (15a) makes it evident that Yer Lowering (11) applies before Yer Deletion (12), applying these rules in this order would not generate the correct output for [[ogUn, + Ik] + U]. In particular, the innermost constituent [ogUn, + Ik] would undergo both Yer Lowering (11) and Yer Deletion (12), resulting in *ogon,* + *k*. This sequence would serve well on the next cycle if the case ending were genitive singular -*a*, yielding *ogon,ka*. It would fail, however, in the nominative singular, where the output is not *ogon,k* but *ogon,ek*. The yer of the diminutive suffix, which lowers the yer of the stem, is in turn lowered by the yer of the case ending. Crucially, each application of Yer Lowering (11) created by considering successively larger morphological constituents will occur before the application of Yer Deletion (12).

To account for this fact, we propose that for [[ogUn, + Ik] + U] to be computed successfully, the rules of the phonology must be organized into two blocks, one cyclic and one postcyclic, as proposed in Halle and Mohanan 1985, Halle and Vergnaud 1987, and Halle and Matushansky 2006 (for an overview, see Kenstowicz 1994:chap. 5). The rules of the cyclic block apply to each nested constituent of the word in turn. After all constituents have undergone cyclic rule application, the rules of the postcyclic block apply once to the entire word, without regard to morphological constituency. Our specific proposal is that Vowel Truncation (5a) and Yer Lowering (11) are cyclic rules, while Yer Deletion (12) is a postcyclic rule.

Consider the cyclic application of Yer Lowering (11) for the derivationally complex form /ogUn, + Ik/ 'small light' in the nominative and genitive singular. As morphological constituency is crucial for application of cyclic rules, we indicate it in (16). Recall that Yer Lowering (11) applies cyclically, constituent by constituent, and that once this cyclic application is done, the postcyclic block of rules, including Yer Deletion (12), applies. We indicate cyclic application by a set of brackets that denote the current immediate constituent undergoing rule application at each step.[8]

(16) a. Cyclic rule application

ogUn, + Ik + U ⇒ [ogon, + Ik] + U	Derivational affix cycle, Yer Lowering (11) applies
[[ogon, + Ik] + U] ⇒ [[ogon, + ek] + U]	Case cycle, Yer Lowering (11) applies
End of cyclic rule application	
ogon,ekU ⇒ ogon,ek	Postcyclic block, Yer Deletion (12) applies

b. Cyclic rule application

ogUn, + Ik + a ⇒ [ogon, + Ik] + a	Derivational affix cycle, Yer Lowering (11) applies
[[ogon, + Ik] + a] ⇒ [[ogon, + Ik] + a]	Case cycle, Yer Lowering (11) does not apply
End of cyclic rule application	
ogon,Ika ⇒ ogon,ka	Postcyclic block, Yer Deletion (12) applies

Importantly, the sequence of three yers in (16a) yields [o . . . e . . . ∅], resulting from cyclic application of Yer Lowering (11). To better grasp how cyclic application operates, consider the diminutive /ogUn, + Ik + Ik + U/, which has four consecutive yers in the nominative singular and surfaces as *ogon,eček*. All but the last of these four yers lower under cyclic application. In the genitive singular /ogUn, + Ik + Ik + a/, again all but the last of the yers lower under cyclic application, yielding *ogon,ečka*.[9] In both forms, the postcyclic rule of Yer Deletion (12) eliminates the last yer in the sequence.

We now turn to an important consequence of cyclic rule application, resulting from the fact that *not every immediate constituent of a word undergoes it*. That is, affixation of certain morphemes generates constituents that are not subject to the cyclic rules of the phonology. When such a constituent (termed a postcyclic constituent) is encountered in the derivation, it is simply skipped, and the cyclic rules then apply to the next constituent in the structure.

In many languages, including Russian, prefixes are postcyclic constituents.[10] Evidence for the postcyclic nature of constituents with prefixes in Russian comes from the fact that prepositions are not subject to the cyclic rule of Vowel Truncation (5a), as shown in (17).

(17) [[na + uk] + a]	'science'
[[[[pro + igr] + a] + l] + a]	'lost, past fem.'
[[[[po + obed] + aj] + e] + mU]	'we (shall) have dinner'

The fact that Vowel Truncation (5a) does not apply in the prefixed forms in (17) is formally accounted for by assuming that Vowel Truncation (5a) is a rule in the cyclic

block and that constituents formed with a prefix are postcyclic. More precisely, as cyclic application proceeds from the most deeply embedded constituent outward, the constituent [prefix + root] will never undergo cyclic application. Moreover, the application of cyclic rules is subject to the principle of Strict Cyclicity (e.g., Mascaró 1976). This principle prevents Vowel Truncation (5a), which has been skipped on the innermost constituent, from applying during a subsequent pass through the cyclic rules. In accordance with this principle, a rule that had a chance to apply on an earlier cycle, but was skipped because the earlier constituent was postcyclic, may not apply to any part of the earlier constituent on a later cycle.

The effects of these principles are well illustrated by comparing the derivation in (18) with that in (16a). In both cases, three yers appear in sequence in a left-branching syntactic structure. However, the innermost constituent in (16a) is cyclic like the rest, whereas the innermost constituent in (18), consisting of the prefix /sU/ and the root /žIg/, is postcyclic and therefore not subject to the rules of the cyclic block.

The fact that Russian prefixes are postcyclic makes a prediction about the behavior of three consecutive yers in this context, namely, that the yer in the prefix will not undergo cyclic lowering. Examples may thus be found in which there are three yers in adjacent syllables: one from a prefix, one within a monosyllabic verb stem, and one in the masculine past ending. (18), adapted from Halle and Vergnaud 1987, illustrates the skipping of Yer Lowering (11) in the postcyclic prefix in the masculine past tense for the verb *sU-žIg* 'burn'.[11]

(18) Cyclic rule application

sU + žIg + l + U ⇒ [sU + žIg] + l + U	Skipped as prefix is postcyclic
[sU + žIg + l]	Past tense /l/ is cyclic, but Yer Lowering (11) does not apply because of strict cyclicity
[sU + žIg + l + U] ⇒ [sU + žeg + l + U]	Yer Lowering (11) applies
End of cyclic rule application	
sU + žeg + l + U ⇒ s + žeg + l	Postcyclic block, Yer Deletion (12) applies twice
s + žeg + l ⇒ žžok	By other postcyclic rules

The result of derivation (18) is quite different from that of derivation (16a), where all three morphemes are cyclic. In (16a), the sequence /U . . . I . . . I/ surfaces as [o . . . e . . . ∅], whereas in (18), with an innermost constituent that is postcyclic, /U . . . I . . . U/ surfaces as [∅ . . . o . . . ∅].

When a morpheme contains a yer, it serves as a diagnostic for telling whether a given morphological constituent is cyclic or not. Yers that are in postcyclic constituents never undergo cyclic lowering and never cause cyclic lowering. As we argue

extensively in the next section, and as anticipated in the Principle of Morphological Consistency, all Slavic nouns have the structure Root + Theme + Case-Number suffix. These strings are subject to phonological rules that are assigned to either one or both of the cyclic and postcyclic blocks. In the unmarked case, all constituents of a word are subject to rules of both blocks, with the cyclic rules applying to each immediate constituent in turn, followed by a single pass through the postcyclic rules. In marked cases, specific morphemes—for instance, the Russian prefixes—are exempt from the rules of the cyclic block and are subject only to the postcyclic rules. The postcyclic status of a given morpheme is thus one mechanism that languages use to avoid the application of an otherwise regular rule of the phonology. In the next section, we examine another such mechanism: the marking of a morpheme sequence as an exception to a specific rule.

The highly specific theory developed here imposes severe constraints on how a particular fact is to be accounted for. We take it as evidence supporting the theory that it has made possible a motivated account of the above data, which are quite complex. We conclude this section by reiterating the importance of adopting Morphological Consistency for all nouns and verbs and by pointing out the immediate explanatory unification afforded by separating rules into cyclic and postcyclic blocks, whose application is determined by morphological status and by falsifiable diagnostics of whether a given morpheme is cyclic or not.

18.3 Exceptional Rule Nonapplication in the Czech Declension

The facts of standard (*sprsovná*) Czech (Havránek and Jedlička 1981) discussed in this section argue compellingly for the proposition that there can be exceptions to a particular phonological rule, and that these exceptions are narrowly constrained so they affect that rule only, while all other rules apply normally. The narrow focus of such exceptions sheds interesting light on both the rules and the derivations to which they give rise.

Czech forms are represented below in a mixed orthography that deviates from the official orthography in that vowel length is represented by a colon after the vowel rather than by an acute accent over it. *U* and *I* represent the abstract yer vowels in underlying representations. Following standard Czech orthography, *y* represents a vowel that is phonetically identical to [i] on the surface but differs from /i/ in the contexts in which it occurs. After palatal consonants, only /i/ occurs; but after other consonants, /y/ occurs. We use *E* for the *e-haček* grapheme of Czech that represents /e/, /je/, or /ňe/ (as in *mEst*, which has the phonetic form /mňest/).

Jakobson's rule of Vowel Truncation (5a) also applies in Czech, as shown by the examples in (19), which are all but identical to the Russian examples in (4).

(19)	*Fem. sg. past*	*1pl. pres.*	*1sg. pres.*	
a.	lez + l + a	lez + e + me	lez + e + u	'creep'
	[lezla]	[lezeme]	[lezu]	
b.	kyp + E + l + a	kyp + E + i: + me	kyp + E + i: + m	'boil'
	[kypEla]	[kypi:me]	[kypi:m]	

In (19), we illustrate the first conjugation verb *lez* 'creep' and the second conjugation verb *kip-E* 'boil'. Comparison of (19a) and (19b) shows that the former retains the present tense vowel in the first person plural while the latter does not, as a result of Vowel Truncation (5a). The forms in (19) also show that Czech differs from Russian in having long and short vowels. Moreover, in Czech all verbs of the second conjugation and some verbs of the first conjugation take *m* as the first person singular present exponent; the remaining verbs of the first conjugation take the exponent *-u*.

Having shown in (19) that, like the phonology of Russian, the phonology of Czech includes the rule of Vowel Truncation (5a), we turn to a set of vowel/zero alternations in Czech that demonstrate that, as in Russian, the underlying form of a morpheme may contain a yer vowel, yielding minimal pairs.

(20)				
a.	kapsa	kapes	'pocket'	(Nom. sg./Gen. pl.)
	ři:msa	ři:ms	'edge'	(Nom. sg./Gen. pl.)
b.	posel	posla	'envoy'	(Nom. sg./Gen. sg.)
	nesl	nesla	'carried'	(Past part. masc./fem.)
c.	rez	rzi	'rust'	(Nom. sg./Gen. sg.)
	mez	meze	'limit'	(Nom. sg./Gen. sg.)

The examples in (20) show that certain word-final consonant clusters are admitted in some words, yet the same clusters trigger vowel insertion in other words. We assume that, as in Russian, this difference is due to the presence of a yer in the underlying representation. Czech differs from Russian in that all yers become [e] under lowering.

Rule (11) in Russian thus corresponds to (21) in Czech.

(21) *Yer Lowering*

$$\text{Yer} \rightarrow [-\text{high}, -\text{back}] \ / \ __ \ C_0 \ \text{Yer}$$

The postcyclic rule of Yer Deletion (12) is the same in both languages. As in Russian, the exponents of the nominative singular and of the masculine past tense in Czech are yers; these trigger rule (21), which lowers the preceding yer, as illustrated in (20).

As in Russian, we assume that all nouns in Czech (and in other Slavic languages) have three parts: a stem, a theme vowel, and a case-number ending. The character of the theme vowel is determined jointly by several factors: semantic animacy, the

declension class of the noun, the consonant with which the stem ends, and the inflectional features of the case morpheme. An overriding regularity is that after stems ending with one of the palatal consonants [š, č, ž, j, ř, ň]—that is, after [−anterior] coronal consonants—the theme vowel is /e/ for all classes of nouns. There are 12 distinct patterns of nominal inflection in Czech once all the case-number combinations are considered. The 12 classes of nouns are listed in (22).

(22) a. hrad 'castle' (masc.)
b. mEst 'city' (neut.)
c. žen 'woman' (fem.)
d. kost 'bone' (fem.)
e. pi:sUň 'song' (fem.)
f. muž 'man' (masc.)
g. moř 'sea' (neut.)[12]
h. ru:ž 'rose' (fem.)
i. stroj 'machine' (masc.)
j. pa:n 'gentleman' (masc.)
k. soudUc 'judge' (masc.)
l. předsed 'chairman' (masc.)

Certain vowel length alternations in the Czech nominal declension are of special interest to phonological analysis.[13] We begin by considering the plural forms of the feminine noun *žen* + *a* 'woman', with theme vowel -*a*-, in the plural cases.[14]

(23)

	Surface form	*Root + Theme + Case*
Inst. pl.	ženami	žen + a + mi
Dat. pl.	žena:m	žen + a + mU
Loc. pl.	žena:ch	žen + a + xU
Gen. pl.	žen	žen + a + U
Nom. pl	ženy	žen + a + y
(Acc. = Nom.)		

As shown in (23), the theme vowel -*a*- is present in the underlying representation of all cases, but its presence is obscured on the surface by the operation of Vowel Truncation (5a). In particular, the theme vowel is deleted before both the nominative/accusative plural case ending -*y* and the genitive plural -*U* (yer). The deletion of the theme vowel before yer shows that yer behaves like any other vowel with respect to Vowel Truncation (5a). Since in the genitive plural the yer is also word-final, it is subject to the postcyclic rule of Yer Deletion (12).

Of special note is that in the dative and locative plural the theme vowel is long, but in the instrumental plural it is short. We assume that the theme vowel is underlyingly short, and we account for the lengthening by positing that the dative and locative

plural case exponents end with a yer. It is the presence of this yer that induces lengthening in a preceding vowel, thus motivating the rule in (24).[15]

(24) *Pre-Yer Lengthening*
$V_{[-high]} \rightarrow V{:} \ / \ __ \ C_0$ Yer

The operation of Pre-Yer Lengthening (24) is thus responsible for the lengthened theme vowel in the dative and locative in (23). In principle, Pre-Yer Lengthening (24) will lengthen a nonhigh theme vowel whenever one occurs before a yer-containing suffix; thus, we might surmise that even the theme vowel in the genitive plural has the potential of being lengthened (and perhaps is lengthened at an intermediate level of representation though we do not see it because of the operation of Vowel Truncation (5a)).

The genitive plural is of particular interest here since it provides evidence for the ordering of Pre-Yer Lengthening (24) and Vowel Truncation (5a). As shown in (25a), the stem vowel of the noun would be incorrectly lengthened if Vowel Truncation applied before Pre-Yer Lengthening. The correct order of application, shown in (25b), is the counterfeeding order of Pre-Yer Lengthening before Vowel Truncation.

(25) *Rule ordering in genitive plural*

a.	žen + a + U	Vowel Truncation (5a)
	žen + U	Pre-Yer Lengthening (24)
	že:n + U	Yer Deletion (12)
	že:n	*Incorrect output*
b.	žen + a + U	Pre-Yer Lengthening (24)
	žen + a: + U	Vowel Truncation (5a)
	žen + U	Yer Deletion (12)
	žen	*Correct output*

Since Pre-Yer Lengthening (24) precedes Vowel Truncation (5a), as shown in (25b), the model thus far implies that if one could have access to an intermediate level of representation or perhaps a situation in which Vowel Truncation (5a) was not operative, one would find an underlyingly short theme vowel that had been lengthened in the genitive plural (see the intermediate representation *žen + a: + U* in (25b)), in addition to being lengthened in the dative and locative plural.

Just this scenario actually holds for a large group of Czech nouns. In fact, 10 out of the 12 inflectional classes of nouns in (22)—that is, all of them except for the *žen* and *mEst* classes—are subject to an exceptional marking, operative *only in the genitive plural*, that renders these forms exceptions to Vowel Truncation (5a).

(26) *Czech exceptional marking*
The genitive plural of the 10 inflectional classes in (22a,d–l) is exempt from Vowel Truncation (5a).

The statement in (26) is cast in a very specific way: it mentions that these forms are exceptions to Vowel Truncation (5a). They are not exceptional in any other manner; that is, Pre-Yer Lengthening (24), Yer Lowering (11), Yer Deletion (12), and all other segmental rules of Czech phonology apply to them as would normally be expected.

In (27), we illustrate with plural case forms of the noun *ru:ž-e* 'rose' the consequences of the exceptional marking in (26) as it interacts with the application of otherwise normally operative rules in the Czech declension. (*UR* = underlying representation)

(27)	*UR*	*Surface form*
Inst. pl.	ru:ž + e + mi	ru:žemi
Dat. pl.	ru:ž + e + mU	ru:ži:m
Loc. pl.	ru:ž + e + xU	ru:ži:ch
Nom./Acc. pl.	ru:ž + e + ∅	ru:že
Gen. pl.	ru:ž + e + U	ru:ži:

The case endings in (27) are all the same as the case endings in (23), except for the nominative plural, which is ∅ in the five inflectional classes represented by *mož* + *e*, *ruž* + *e*, *stroj* + *e*, and *pi:sUň* + *e* (but not *muž* + *e*). Pre-Yer Lengthening (24) applies as expected in the dative and locative, yielding a long theme vowel. In Czech, lengthened mid vowels surface as high vowels, owing to a rule of Mid Vowel Raising that turns long [−high, −low] vowels into their [+high] counterparts,[16] thus accounting for the long *i:*/short *e* alternation in the theme vowel.

(28) *Mid Vowel Raising*
[−low] V: → [+high]

This raising rule applies to the [+back] theme vowel /o/ after it has been lengthened in the dative plural forms of the masculine and neuter nouns in classes (22a,b,f,i,j), generating *hradu:m*, *pa:nu:m*, *mužu:m*, *stroju:m*, and *mEstu:m*.

In the genitive plural, only a subset of Czech nouns exhibit the behavior illustrated in (25). In addition to the feminine nouns of the *žen* class, the neuter nouns of the *mEst* class show no surface ending in the genitive plural. The nouns of the other 10 classes of (22) have a long high vowel suffix in the genitive plural, as shown in the surface forms in (29).

(29)		
	hrad + u:	ru:ž + i:
	kost + i:	stroj + u:
	pi:sň + i:	pa:n + u:
	muž + u:	soudUc + u:
	moř + i:	předsed + u:

The distribution of endings in (29) is straightforward: masculine nouns take long /u:/ whereas feminine and neuter nouns ending with a palatal consonant take long /i:/. These are derived from /o:/ and /e:/ by application of Mid Vowel Raising (48).

The forms in (29) differ from those in (25). Because of the exceptional marking (26), the genitive plural ending -*U* in (29) does not induce Vowel Truncation (5a). We illustrate this with the derivations in (30).

(30) a.	ru:ž + e + U	
	ru:ž + e: + U	Pre-Yer Lengthening (24)
	ru:ž + e: + U	Vowel Truncation (5a): *does not apply* because of (26)
	ru:ž + e:	Yer Deletion (12)
	ru:ž + i:	Mid Vowel Raising (48)
b.	hrad + o + U	
	hrad + o: + U	Pre-Yer Lengthening (24)
	hrad + o: + U	Vowel Truncation (5a): *does not apply* because of (26)
	hrad + o:	Yer Deletion (12)
	hrad + u:	Mid Vowel Raising (48)

It is important to note that the ordering solution works without added complexity: *each of the four rules in (30) is independently motivated; and when properly ordered, these rules account for the genitive plural facts*. Other treatments of the genitive plural of the 10 classes that are subject to the exceptional marking in (26) require additional machinery because they view the long suffix vowel as a morphological idiosyncrasy or as the result of a templatic effect (e.g., Scheer 2002). Our proposal for the genitive plural employs the same rules as those for all other inflected forms of the Czech nouns.

(31)	*UR*	*Surface forms*	*Rules applied*
a. Nom. pl.	mEst-o-a	mEsta	Vowel Truncation (5a)
b. Dat. pl.	mEst-o-mU	mEstu:m	Pre-Yer Lengthening (24), Yer Deletion (12)
c. Gen. pl.	mEst-o-U	mEst	Vowel Truncation (5a), Yer Deletion (12)
d. Loc. pl.	mEst-U-xU	mEstech	Theme vowel replacement (32a), Yer Lowering (21), Yer Deletion (12)

In (31), we illustrate the derivations of the different plural forms of the neuter noun *mEst + o* 'city'. We note that the theme vowel in the locative plural is /U/ rather than /o/. We assume that this is due to a readjustment rule, by which the theme vowel that appears in most of the case-number combinations undergoes a change in its phonetic exponent. Readjustment rules, by hypothesis, are locally determined morphological

operations that apply prior to any rules of the cyclic block. In (32), we list the readjustment rules that apply to the theme vowel of Czech nouns.

(32) *Czech theme vowel replacement*
   a. Theme vowel → yer in locative plural of *hrad*, *mEst*, *pa:n*, *předsed* classes (22a,b,j,l)
   b. Theme vowel → /o/ in dative plural and genitive plural of *stroj* class (22i)
   c. Theme vowel → /e/ in genitive plural of *kost* class (22d)
   d. Theme vowel → yer in instrumental singular of *hrad*, *mEst*, *muž*, *moř*, *stroj*, *pa:n*, and *soudUc* classes (22a,b,f,g,i,j,k)

As a consequence of the readjustment rule of "yer replacement" in (32a), the theme vowel in these locative plural forms exhibits special behavior.[17] Specifically, as Pre-Yer Lengthening (24) does not apply to high vowels, it will not affect the yer theme vowel in (31d), since yer is a high vowel at that point in the derivation.

Rule (32a) applies to the locative plural of the noun stems of the *hrad* class. Consider next the plural forms of the nouns of the *kost* class (22d), shown in (33).

(33)

	UR	*Surface form*	*Rules applied*
Inst. pl.	kost + I + mi	kostmi	Yer Deletion (12)
Dat. pl.	kost + I + mU	kostem	Yer Lowering (21), Yer Deletion (12)
Loc. pl.	kost + I + xU	kostech	Yer Lowering (21), Yer Deletion (12)
Nom./Acc. pl.	kost + I + i	kosti	Yer Deletion (12)
Gen. pl.	kost + e + U	kosti:	Theme vowel replacement (32c), Pre-Yer Lengthening (24), Yer Deletion (12)

As a result of the change in the theme vowel induced by (32c), the theme vowel in the genitive plural is subject to Pre-Yer Lengthening (24) and subsequently raises to become the long high vowel /i:/.

Of additional interest is the fact that in none of these forms does Pre-Yer Lengthening (24) apply on the stem cycle. If Pre-Yer Lengthening, a cyclic rule, were to apply to the constituent [root + theme], it would apply to the root vowel in *kost*, incorrectly yielding **ku:stmi* for the instrumental plural. The fact that this does not occur provides evidence, by way of the diagnostic established in section 18.2, that theme vowels are postcyclic.[18] As a postcyclic constituent, then, the [root + theme] constituent does not undergo the cyclic rule of Pre-Yer Lengthening (24).

This completes the inventory of the rules involved in the computation of underlying-to-surface forms in the declension of Czech nouns. The case-number

forms of the 12 nouns in table 18.1 exhibit the range of variation that is actually encountered. In the table, we indicate the theme vowel by a hyphen next to the nominal root (*-o-* is the theme vowel for the root *hrad*, *-a-* is the theme vowel for the root *žen*, etc.). In each cell, we supply the underlying form of the case-number suffix. The surface forms of course diverge from the underlying forms as a result of both the readjustment rules and the phonological rules reviewed above.

As noted throughout the chapter, *U* and *I* indicate yers. Accusative cells marked *Nom* or *Gen* are those in which the accusative is syncretic with either the nominative or genitive form (depending on animacy and gender).[19] The neuter noun *kuř-e*, not included in the table, inflects like *moř-e* in the singular and like *mEst-o* in the plural.

A parenthesized form in a cell (e.g., the locative plural of *mEst*) indicates a theme vowel that undergoes readjustment, as described above (see (32)). Each shaded cell marks a form that is an exception to Vowel Truncation (5a) (see (26)). As the reader can verify, only the genitive plural is an exception to that rule. Importantly, genitive plural forms that are exceptions to Vowel Truncation (5a) do not constitute exceptions to Pre-Yer Lengthening (24).

18.4 Cyclic and Postcyclic Rule Interaction in the Serbo-Croatian Genitive Plural

The Serbo-Croatian genitive plural resembles that of Czech. In particular, as in a subset of Czech nouns (e.g., *ru:ži:* and *hradu:*), the genitive plural form of the majority of Serbo-Croatian nouns ends with a long vowel: for example, *ora:la:* 'eagle, gen. pl.'.[20] On the plausible assumption that the lengthened vowel in the genitive plural is to be accounted for in the same way in Serbo-Croatian as in Czech, we posit (1) that the exponent of the Serbo-Croatian genitive plural is also yer and (2) that, as in Czech (see (26)), genitive plural forms constitute marked exceptions to Vowel Truncation (5a).

(34) *Serbo-Croatian exceptional marking*
The genitive plural is exempt from Vowel Truncation (5a).

Since the case ending is a yer, the long vowel of the genitive plural in Serbo-Croatian is the theme vowel, and its length is due to Pre-Yer Lengthening (24), which is triggered by the case ending. The derivation thus proceeds exactly as in Czech (see (30)).

The next question concerns the nature of the theme vowel: as its surface appearance is [a:], one might suppose that it is underlyingly /a/, lengthened by Pre-Yer Lengthening (24). This analysis, while closer to the surface, falls short in an important way, to be described below. Instead, our solution takes advantage of the fact that Yer Lowering in Serbo-Croatian generates the low back vowel /a/, formally

Table 18.1
Czech nominal declensions

	hrad-o sg.	hrad-o pl.	mEst-o sg.	mEst-o pl.	žen-a sg.	žen-a pl.
Nom.	U	y	null	a	null	y
Acc.	nom.	nom.	nom.	nom.	u	nom.
Gen.	u	U	a	U	y	U
Dat.	u	mU	u	mU	E	mU
Loc.	u	(U) + xU	u	(U) + xU	E	xU
Inst.	(U) + mU	y	(U) + mU	y	-ou	mi

	muž-e sg.	muž-e pl.	moř-e sg.	moř-e pl.	ru:ž-e sg.	ru:ž-e pl.
Nom.	U	i	null	null	null	null
Acc.	null	null	null	nom.	i	nom.
Gen.	null	(o) + U	null	U	null	U
Dat.	i	(o) + mU	i	mU	i	mU
Loc.	i	xU	i	xU	i	xU
Inst.	(U) + mU	y	(U) + mU	y	i:	mi

	stroj-e sg.	stroj-e pl.	pa:n-o sg.	pa:n-o pl.	soudUc-e sg.	soudUc-e pl.
Nom.	U	null	U	i	null	i
Acc.	nom.	null	gen.	y	null	null
Gen.	null	(o) + U	a	U	null	(o) + U
Dat.	i	(o) + mU	u	mU	i	(o) + mU
Loc.	i	xU	u	(U) + xU	i	xU
Inst.	(U) + mU	y	(U) + mU	y	(U) + mU	y

Table 18.1
(continued)

	předsed-o sg.	předsed-o pl.	pi:sUň-e sg.	pi:sUň-e pl.	kost-I sg.	kost-I pl.
Nom.	a	we:	U	null	U	i
Acc.	u	y	nom.	nom.	U	nom.
Gen.	y	U	null	U	i	(e) + U
Dat.	wi	mU	i	mU	i	mU
Loc.	wi	(U) + xU	i	xU	i	xU
Inst.	w	y	i:	mi	i:	mi

represented in (35) as the Serbo-Croatian counterpart of the Czech rule (21) and the Russian rule (11).

(35) *Yer Lowering (Serbo-Croatian)*
Yer → [+low, +back] / __ C_0 Yer

We propose that the theme vowel yielding the surface ending [a:] in the genitive plural is an underlying yer. Like its Czech counterpart (21), rule (35) feeds Pre-Yer Lengthening (24); thus, an underlying yer surfaces as [i:] in Czech and as [a:] in Serbo-Croatian.

Perhaps the most interesting fact about the Serbo-Croatian genitive plural is that the final vowel of the noun stem is always lengthened. This fact has puzzled linguists for well over a century. For example, Leskien (1914:416) remarked that there was in his day already an entire literature on the Serbo-Croatian genitive plural, none of which he found convincing. Leskien was especially puzzled by the treatment of stem-final vowels preceding the genitive plural suffix. He asked "why an old sestUrU surfaces not as *sestra: but as sestára: (= sesta:ra:)" (p. 416).[21]

Since the stem vowel in question precedes the yer theme vowel, the length of the stem-final vowel follows automatically from the operation of Pre-Yer Lengthening (24). We thus propose that the theme vowel of the genitive plural of Serbo-Croatian nouns becomes a yer as the result of a readjustment rule, like that proposed for Czech (see (32)). The readjustment rule for Serbo-Croatian that yields a yer as the theme vowel in the genitive plural, and its effect of lengthening the stem-final vowel, are shown in (36) and (37).

(36) *Serbo-Croatian theme vowel replacement*
Theme vowel → yer in genitive plural

(37) *Partial derivation of Serbo-Croatian genitive plural*

[sestUr + U]	[root + theme] constituent
sestar + U	Yer Lowering (35)
sesta:r + U	Pre-Yer Lengthening (24)

However, the suggestion that the theme vowel of the genitive plural is a yer that induces Pre-Yer Lengthening (24) of the stem-final vowel is incompatible with our proposal above that theme vowels are generally postcyclic. The partial derivation in (37) tacitly assumes that theme vowels are cyclic. If the genitive plural theme vowel were postcyclic, Pre-Yer Lengthening (24) would not be applicable to the innermost [root + theme] constituent. After application of Yer Lowering (35) and Pre-Yer Lengthening (24) in the next constituent, the result would be as shown in (38), where brackets denote immediate constituents.

(38) *Incorrect derivation of Serbo-Croatian genitive plural*

[sestUr + U] + U	No cyclic rules apply if [root + theme] constituent is postcyclic
[sestUrU + U]	Next constituent
[sestUra + U]	Yer Lowering (35)
[sestUra: + U]	Pre-Yer Lengthening (24)
[sestUra: + U]	Marked exception to Vowel Truncation (5a); see (34)
sestUra:U	End of cyclic block
sestra:	Postcyclic Yer Deletion applies; *incorrect output*

The incorrect output in (38) is what one would expect if the [root + theme] constituent were postcyclic, and it is this expectation that led to Leskien's question cited above.

An answer appears once it is assumed that in the genitive plural the theme vowel constituent is cyclic. In other words, in Serbo-Croatian a special readjustment rule assigns cyclic status to the innermost constituent of genitive plural words. This rule is included in a general summary of the cyclic status of constituents in (39).

(39) a. Affixal morphemes are marked as cyclic by default.
b. Slavic prefixes and theme vowels are marked as postcyclic.
c. The theme vowel of the Serbo-Croatian genitive plural is marked as cyclic.

As the derivation in (40) shows, (39c) allows the correct output to be generated.

(40) *Correct derivation of Serbo-Croatian genitive plural*

[sestUr + U] + U	*Innermost constituent is cyclic*
[sestar + U] + U	Yer Lowering (35)
[sesta:r + U] + U	Pre-Yer Lengthening (24)

[sesta:rU + U]	Next constituent
[sesta:ra + U]	Yer Lowering (35)
[sesta:ra: + U]	Pre-Yer Lengthening (24)
[sesta:ra: + U]	Marked exception to Vowel Truncation (5a); see (34)
sesta:ra:U	End of cyclic block
sesta:ra:	Postcyclic Yer Deletion applies; *correct output*

A yer theme vowel that is cyclic triggers the cyclic rule of Pre-Yer Lengthening (24). In other words, the rules and the ordering in (38) did not capture the facts correctly because they did not incorporate (39c). The correct derivation in (40) requires no new idiosyncratic rule of stem-vowel lengthening in order to derive the lengthened stems.

An aspect of the architecture of cyclic and postcyclic rule application that has not yet been discussed is described in (41).

(41) A phonological rule *R* may be assigned to *both* the cyclic and the postcyclic blocks.

We explore the consequences of (41) for Serbo-Croatian with the orderings and the assignment to blocks shown in (42). Notice that one rule is assigned only to the cyclic block, one rule is assigned only to the postcyclic block, and two rules are assigned to both blocks.

(42) *Cyclic block rule application order*
Yer Lowering (35)
Pre-Yer Lengthening (24)
Vowel Truncation (5a)

Postcyclic block rule application order
Yer Lowering (35)
Pre-Yer Lengthening (24)
Yer Deletion (12)

The assignment of rules to the two blocks in (42) has consequences for stems that have yer in their last syllable. In a number of such stems, the vowel preceding the yer is lengthened in case forms where the yer is deleted, but not in case forms where the yer is subject to Yer Lowering (35), as illustrated in (43).

(43)

	Surface form	*UR*
Nom. sg.	jarac	jarUc + o + U
Gen. sg.	ja:rca	jarUc + o + a
	'male goat'	

This postcyclic lengthening is distinct from the lengthening in *sesta:ra:*, which is cyclic. As shown in (42), we assume that Pre-Yer Lengthening (24) is assigned to the

postcyclic block as well as the cyclic block. As a result of the ordering, Yer Lowering (35) bleeds Pre-Yer Lengthening (24), and hence any yer that lowers (such as a stem yer in the nominative singular of masculine *o*-stem nouns) will not induce lengthening of the preceding vowel. Unlike the cyclic variant of Pre-Yer Lengthening, the postcyclic variant does not apply when the triggering yer is word-final; if it did, the nominative singular (and genitive plural) forms would surface with an incorrect long vowel in the last syllable. We state the noncyclic rule of Pre-Yer Lengthening in (44), and in (45) we illustrate the application of both the cyclic and the noncyclic rules to the nominative and genitive singular of *jarUc*.

(44) *Nonfinal Pre-Yer Lengthening (postcyclic)*
$V_{[-high]} \rightarrow V{:} \ / \ __ \ C_0 \text{ Yer } C_0 \ V$

(45)	jarUc + o + U	jarUc + o + a
Cyclic block		
Yer Lowering (35)	inapplicable	inapplicable
Pre-Yer Lengthening (24)	jarUc + o: + U	inapplicable
Vowel Truncation (5a)	jarUc + U	jarUc + a
Postcyclic block	jarUcU	jarUca
Yer Lowering (35)	jaracU	inapplicable
Nonfinal Pre-Yer Lengthening (44)	inapplicable	ja:rUca
Yer Deletion (12)	jarac	ja:rca

Many additional examples of this pattern can be found in Matešić 1970. There appear to be lexically marked exceptions to postcyclic Nonfinal Pre-Yer Lengthening (44), such as *prosac* 'suitor, nom. sg.', *prosca* 'gen. sg.', in which the genitive singular does not show lengthening.

In (46), we show derivations of the surface forms of the nominative singular, genitive singular, and genitive plural of the Serbo-Croatian masculine noun *orao* 'eagle'. (*PYL* = Pre-Yer Lengthening; *IR* = intermediate representation)

(46)	*Nom. sg.*	*Gen. sg.*	*Gen. pl.*
First cycle			
UR	[orUl + o] + U	[orUl + o] + a	[orUl + U] + U
Yer Lowering (35)	inapplicable	inapplicable	[oral + U] + U
PYL (24)	inapplicable	inapplicable	[ora:l + U] + U
Vowel Truncation (5a)	inapplicable	inapplicable	inapplicable
Second cycle			
IR	[orUl + o + U]	[orUl + o + a]	[ora:l + U + U]
Yer Lowering (35)	inapplicable	inapplicable	[ora:l + a + U]
PYL (24)	inapplicable	inapplicable	[ora:l + a: + U]

Vowel Truncation (5a)	[orUl + ∅ + U]	[orUl + ∅ + a]	exception (see (39a))
Postcyclic block			
IR	orUlU	orUla	ora:la:U
Yer Lowering (35)	oralU	inapplicable	inapplicable
Nonfinal PYL (44)	inapplicable	o:rUla	inapplicable
Yer Deletion (12)	oral	o:rla	ora:la:
Coda *l*-vocalization	orao	inapplicable	inapplicable
	[orao]	[o:rla]	[ora:la:]

As a result of (41), the same rules yield lengthening of the stem-initial vowel in the genitive singular, lengthening of the stem-final vowel in the genitive plural, and lengthening of neither stem-internal vowel in the nominative singular. (46) shows the result that root-internal interactions occur only in the postcyclic block (as in the genitive singular).

In the above account of genitive plural forms, the fact that these forms are systematic exceptions to Vowel Truncation (5a) plays a crucial role. By a coincidence that is close to miraculous, the historical record of this development has been preserved. In discussing the evolution of the Serbo-Croatian genitive plural, Leskien reports that the genitive plural form with long /a:/ became dominant in the sixteenth century, but can be documented already in the fourteenth century. In his words: "The traditional Church Slavonic orthography of the older records writes all genitive forms with -*I*, [single yer] even where *a* was already likely to have been pronounced. *In the fourteenth century, people began to write in place of the single* -I, *the double* -II; e.g., pastirII, človekII, selII, rabotII" (Leskien 1914:434; emphasis added). On the plausible assumption that these spellings represent the pronunciation of an archaic (or archaizing) dialect without Yer Lowering and Yer Deletion, we have here a written record of the fact that in the fourteenth century, Serbo-Croatian genitive plural forms became exceptions to the rule of Vowel Truncation (5a) (see (34)), and these forms surfaced with sequences of two yers.

This was not Leskien's view. Since Leskien's theory of phonology and morphology did not view the phonetic surface form as the result of the application of ordered rules to abstract underlying representations, it would have been all but impossible for Leskien to analyze these forms as special exceptions to Vowel Truncation (5a). He therefore assumed that the spellings with two yers did not reflect the actual phonetics of these forms, but were a roundabout way of representing a long [a:]. He wrote, "That in fact -a was pronounced here is shown by spellings of that time such as *župa*, *zemalja*, which are already found regularly in the fifteenth century. The phonetic output form [Gesamtlautgestalt] of the genitive plural is here already that of present-day Štokavian" (Leskien 1914:434).

We see no reason to suppose that the two different spellings—the yer sequence ⟨II⟩ and ⟨a⟩—reflect the same phonetic event. If the genitive plural ending had been pronounced as [a] in the fourteenth century, this would have been so recorded by the scribes, since both *a* and yer were letters in their alphabet. The fact that the letter *a* does not appear in genitive plural endings until a century later indicates that [a] was not pronounced here in the fourteenth century and that the written sequence of two yers represents the actual pronunciation of as a sequence of two central vowels.

Our account of the intricate facts of both Czech and Serbo-Croatian is based on our assumption that rules are not only subject to ordering, but also assigned to different blocks (cyclic vs. noncyclic), and that particular constituents of the word may be systematic exceptions to the rules of the cyclic block. Our account of the phonology of Russian, Czech, and Serbo-Croatian has relied on aspects of ordering to account for facts that would otherwise require complications of the rules. We believe this exploitation of various aspects of rule ordering afforded by our theory is a general property of the phonology of all languages. To the extent that we have succeeded in presenting a correct account of the facts, we have also provided empirical evidence to support the theory that underpins our account. We have developed a theory that sticks to well-motivated phonological rules and derives divergent surface results through different ways of applying these rules: namely, by their order of application.

An important question that deserves further thought and study concerns the nature and function of theme vowels. Oltra-Massuet (1999) proposes that in Catalan, every functional head requires that a theme vowel adjoin to it postsyntactically. She cites examples such as *agudidzari∅az* 'sharpen, cond.', with three theme vowels: between stem and mood, between mood and tense, and between tense and agreement. Theme vowels have no syntactic or semantic function, as they occur not only in verbs and nouns but also in adjectives. We would like to tentatively suggest that theme vowels serve a parsing purpose, functioning as boundary markers between contentful morphemes that assist the hearer in recovering the constituency of the linear phonetic string.

A point worth emphasis concerns the positing of underlying representations containing yers. The inclusion of a yer in the memorized form of a morpheme or word attributes considerable theoretical sophistication to each fluent speaker of the languages discussed here. As we have shown, however, this abstract nature of the underlying representations allows simple accounts of a great variety of surface facts. For example, the obvious fact that the yer is a vowel leads to the correct conclusion that it triggers Vowel Truncation. It also implies correctly that this vowel will trigger or undergo Yer Lowering, and, in Czech and Serbo-Croatian, that it will trigger Pre-Yer Lengthening. Traditional and recent accounts of these facts that have excluded

yers on a priori grounds have been forced to employ considerably more complex and less perspicuous solutions than the handful of rules presented above.

Notes

We thank Pavel Caha, Chuck Cairns, Markéta Ceplová, Bill Idsardi, Jay Jasanoff, Ivona Kučerová, Horace Lunt, Nikola Predolac, Eric Raimy, Tobias Scheer, Donca Steriade, and Markéta Ziková for helpful discussions during the course of this research.

1. Bermúdez-Otero (2007) has recently argued for a synchronic rule of heteromorphemic vowel deletion in Spanish that is strikingly similar and perhaps suggestive of a broader phenomenon at hand.

2. One possible explanation might be that /u/ is a complex morpheme that signals both present tense and first person singular agreement. The /-z/ suffix in English verb forms such as *plays* has such composite structure: it simultaneously signals present tense and third person singular agreement. But in English it is common for a suffix to signal both tense and agreement. For Russian, this analysis would be attributing composite structure to some suffixes and not to others, and this would require special stipulations in the syntax-morphology interface of Russian. A second explanation might posit two phonetic realizations of the present tense: /-e-/ in some (most) person forms of the verb, and zero elsewhere. Again, a parallel could be cited from English, where the present tense forms of all verbs other than those of the third person singular take such a zero suffix. (This is shown by the fact that *Do* Support is triggered by the negative verb forms, both those that take the suffix /-z/, as in *she doe + s not play*, and those that take the zero suffix, as in *we do + ∅ not play*.) If this proposal were to be adopted for Russian, it would again require some complications in the morphology; at a minimum, we would have to posit a ∅ present tense morpheme, which appears only in first person singular forms, while /-e-/ appears elsewhere.

Neither of these accounts is to be rejected on a priori grounds; as noted above, the proposals are very similar to what is actually found in English. But in Russian they are essentially ad hoc accounts, with nothing to support them beyond their limited descriptive adequacy, and in missing the generalization about vowel deletion, they are to be dispreferred to an account like the one in the text.

3. The distinction between underlying and surface representations was explicitly made also in a celebrated paper by Edward Sapir, "The Psychological Reality of Phonemes," which first appeared in 1933, the same year as Bloomfield's *Language*, in a French translation in *Journal de Psychologie Normale et Pathologique* (30:247–265). Trubetzkoy drew Jakobson's attention to Sapir's paper in a letter of 10 July 1933; see Jakobson 1975:279.

4. In Jakobson's formulation, morphemes ending with nasals were included in (5b), however, Jakobson was mistaken about nasals deleting before consonants, as noted first in Kayne 1967.

5. The stem *laja* is composed of /laj + a/, that is, a verbal root plus theme vowel, while *lez* is "athematic," having a zero theme vowel. We omit zero morphemes here for expository ease.

6. For instructive discussions of the yer facts in Polish, which differ only little from those considered below, see Gussmann 1980 and Szpyra 1995.

7. Both nouns in (13) contain the underlying theme vowel -*o*-, as can be seen in the instrumental singulars *parkom* and *turkom.* This theme vowel deletes in (13) because of Vowel Truncation

(5a); we omit it in the example to maintain focus on the application of Yer Lowering (11) and Yer Deletion (12).

8. Additional rules of Russian phonology also apply to this form, including a rule that turns stressed *e* into *o* before an unpatalalized consonant. We omit the theme vowels in (16) as they will be deleted by Vowel Truncation (5a) and our focus in (16) is on cyclic Yer Lowering (11).

9. The change of *k* to *č* in the first of two diminutive suffixes is due to a rule that we leave aside here.

10. Further research may reveal that the postcyclic character of Slavic prefixes is related to their syntactic status. For recent discussion, see Arsenijević 2005 and Svenonius 2005.

11. That the prefix /sU/ contains a yer may be shown by examining the feminine past tense *sožgla*, where the yer of the prefix lowers because of the application of a postcyclic version of Yer Lowering. We motivate the existence of this application of Yer Lowering in section 18.4. As (18) shows, /sU/ is part of a postcyclic constituent and hence does not undergo cyclic lowering on the [prefix + root] cycle.

12. An additional class represented by *kuř* 'chicken' (neut.) behaves identically to *moř* in the singular and *mEst* in the plural; we omit explicit mention of this class from further discussion. Everything said about the singular forms of *moř* applies to the singular forms of *kuř*, and everything said about the plural forms of *mEst* applies to the plural forms of *kuř*.

13. The relevance of Czech vowel length alternations for a phonological model employing underlying yers and rule ordering was first brought to our attention by Ivona Kučerová. Kučerová 2004 provided inspiration for the current analysis.

14. We do not treat the vocative case in this chapter.

15. For discussion of Pre-Yer Lengthening in Slovak, which is similar in many respects to the rule in Czech, see Rubach 1993:168ff. The formulation in (24) is shorthand for a representation in which vowel length is the result of an extra timing slot, and thus for a representation in which length is reflected by skeletal structure and not a subsegmental feature. See Clements and Keyser 1983 for an extended discussion of such a model.

16. This rule is fully regular in inflectional suffixes but subject to some variation with respect to stem-internal vowels when they are [−back, −round]; thus, *mli:ko* and *mle:ko* 'milk, nom. sg.' are in variation for many speakers.

17. Ivona Kučerová suggests that this readjustment rule is due to a phonotactic constraint against the sequence *ux* in Czech, a sequence that is apparently unattested.

18. Additional evidence that the [root + theme] constituent is postcyclic may be found in the behavior of roots ending in a vowel, such as *kaka-o* 'cocoa', whose genitive plural *kaki:*, based on the underlying form [[kaka + e] + U], parallels the derivation of *ru:ži:*, but crucially does not show application of Vowel Truncation (5a) on the postcyclic innermost constituent [kaka + e]. We thank Pavel Caha and Markéta Ziková for pointing out the relevance of this example.

19. Among the case endings, the reader will notice the extremely widespread distribution of *-u* and *-i*, whose appearance may be reduced to an underspecified [+high] elsewhere item. A full morphological analysis of Czech syncretism should capture the regularities of their appearance; see Caha and Ziková 2005 for discussion.

20. In the orthography of Serbo-Croatian, the stress-bearing syllable is marked with an accent only in words with initial stress. In such words, the initial syllable is marked with a "falling"

accent, of which there are two: the "long falling" accent in words of the form $\#C_0\hat{V}$: ... and the "short falling" accent in words of the form $\#C_0\grave{\grave{V}}$.... Words with stress on a noninitial syllable mark the syllable before the stress, and the marked syllables are said to have "rising" accent. There are two "rising" accents: a "long rising" accent in words of the form ... $C_0\acute{V}$:C_0'V ... and a "short rising" accent in words of the form ... $C_0\grave{V}C_0$'V....

21. In Leskien's notation, an acute accent marks a long vowel with a rising tone.

References

Arsenijević, Boban. 2005. Slavic verb prefixes are resultative. To appear in *Cahiers Chronos*, a selection of papers from Chronos 6, Geneva 2004.

Bailyn, John, and Andrew Nevins. 2008. Russian genitive plurals are impostors. In *Inflectional identity*, ed. by Asaf Bachrach and Andrew Nevins, 237–270. Oxford: Oxford University Press.

Bermúdez-Otero, Ricardo. 2007. Morphological structure and phonological domains in Spanish denominal derivation. In *Optimality-theoretic studies in Spanish phonology*, ed. by Sonia Colina and Fernando Martínez-Gil, 278–311. Amsterdam: John Benjamins.

Bloomfield, Leonard. 1933. *Language*. New York: Henry Holt.

Caha, Pavel, and Markéta Ziková. 2005. Czech syncretism. Paper presented at Formal Description of Slavic Languages, 2005.

Chomsky, Noam, Morris Halle, and Fred Lukoff. 1956. On accent and juncture in English. In *For Roman Jakobson*, ed. by Morris Halle, Horace G. Lunt, and Hugh McLean, 65–80. The Hague: Mouton.

Clements, G. N., and Samuel Jay Keyser. 1983. *CV phonology: A generative theory of the syllable*. Cambridge, Mass.: MIT Press.

Gussmann, Edward. 1980. *Studies in abstract phonology*. Cambridge, Mass.: MIT Press.

Halle, Morris. 1994. The Russian declension: An illustration of the theory of Distributed Morphology. In *Perspectives in phonology*, ed. by Jennifer Cole and Charles Kisseberth, 29–60. Stanford, Calif.: CSLI Publications.

Halle, Morris, and Ora Matushanky. 2006. The morphophonology of Russian adjectival inflection. *Linguistic Inquiry* 37:351–404.

Halle, Morris, and K. P. Mohanan. 1985. Segmental phonology of Modern English. *Linguistic Inquiry* 16:57–116.

Halle, Morris, and Jean-Roger Vergnaud. 1987. *An essay on stress.* Cambridge, Mass.: MIT Press.

Havránek, Bohuslav, and Alois Jedlička. 1981. *Česká mluvnice*. Prague: Státní pedagogické nakladatelství.

Jakobson, Roman. 1948. Russian conjugation. *Word* 4:155–167.

Jakobson, Roman. 1975. *N. S. Trubetzkoy's letters and notes*. The Hague: Mouton.

Kayne, Richard. 1967. Against a cyclic analysis of Russian segmental phonology. Generals paper, MIT.

Kenstowicz, Michael. 1994. *Phonology in generative grammar*. Oxford: Blackwell.

Kučerová, Ivona. 2004. On the Czech declension. Ms., MIT.

Leskien, August. 1914. *Grammatik der serbo-kroatischen Sprache*. Heidelberg: Universitätsverlag C. Winter.

Lightner, Theodore. 1972. *Problems in theory of phonology*. Vol. 1, *Russian phonology and Turkish phonology*. Edmonton-Champaign: Linguistic Research, Inc.

Mascaró, Joan. 1976. Catalan phonology and the phonological cycle. Doctoral dissertation, MIT.

Matešić, Josip. 1970. *Der Wortakzent in der serbokroatischen Schriftsprache*. Heidelberg: Universitätsverlag C. Winter.

Oltra-Massuet, Isabel. 1999. On the notion of theme vowel: A new approach to Catalan verbal morphology. Master's thesis, MIT.

Rubach, Jerzy. 1993. *The Lexical Phonology of Slovak*. Oxford: Oxford University Press.

Sapir, Edward. 1933. The psychological reality of phonemes. In *Edward Sapir: Selected writings in language, culture and personality*, ed. by David G. Mandelbaum, 46–60. Berkeley and Los Angeles: University of California Press, 1949.

Scheer, Tobias. 2002. How yers made Lightner, Gussmann, Rubach, and Spencer & Co invent CVCV. Paper presented at Generative Linguistics in Poland 3.

Svenonius, Peter. 2005. Russian prefixes are phrasal. Paper presented at Formal Description of Slavic Languages 5.

Szpyra, Jolanta. 1995. *Three tiers in Polish and English phonology*. Lublin: Wydawnictwo Uniwersytetu Marii Curie-Skłodowskiej.

Townsend, Charles, and Laura Janda. 1996. *Common and comparative Slavic: Phonology and inflection*. Columbus, Ohio: Slavica.