Chapter 16

The Phonetics and Phonology of Russian Voicing Assimilation

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The voicing pattern of the Russian consonants has been described quite thoroughly in the phonological and phonetic literature. However, as yet no published analysis accounts for all of the facts in a coherent, explanatory fashion. In this paper, I will propose what I believe to be such an analysis, and will use it as evidence to bear on two issues in phonetic and phonological theory: the definition of the feature [voice] and treatment of unbounded propagating assimilation rules.

The basic pattern of Russian consonant voicing is a familiar one: all members of an obstruent cluster take on the voicing of the last obstruent, as in (1):

(1)

Mcensk # že	[zgž]	'Mcensk, though'
zub-ki	[pk]	'little teeth'

In addition, obstruents in word-final position are devoiced, as in *klub* [p] 'club' (cf. gen. sg. *klub-a* [b]). The Final Devoicing rule feeds Voicing Assimilation, so that underlying *vi*[zg] 'scream' becomes first *vi*[zk] by Final Devoicing, then *vi*[sk] by Assimilation.

In a number of cases, however, the pattern is more complicated. First, the sonorant consonants fail to trigger Voicing Assimilation (cf. *pe*[s'n'] 'song', [tr']*i* 'three'), but they nevertheless may allow Assimilation to propagate across them, as in *iz Mcenska* [smc] 'from Mcensk' or *ot mzdy* [dmzd] 'from the bribe'.[1] In addition, there are several strange facts associated with the labiodental fricative /v/ and its palatalized counterpart. /v/ patterns with the other Russian obstruents in that it devoices finally, as in *zdorov* [f] 'healthy', and before a voiceless obstruent, as in *korov-ka* [fk] 'cow (dimin.)' or *krivd* [ft] 'falsehood (gen. pl.)', where the triggering voiceless obstruent is itself derived by Final Devoicing. However, in all

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other respects /v/ behaves as a sonorant: it fails to trigger Voicing Assimilation, as in *s vami* [sv] 'with you'; and it permits Assimilation to propagate across it, as in *ot vdovy* [dvd] 'from the widow', *bez vpuska* [sfp] 'without admission'. Perhaps strangest of all, the devoiced reflex of word-final /v/ fails to trigger Voicing Assimilation, in cases like *trezf* [zf] 'sober', *xorugv'* [gf'] 'banner'. In general, when /v/ is the target of Voicing Assimilation, it behaves like an obstruent; but for purposes of triggering the rule, it behaves like a sonorant.

Given this split behavior, a reasonable guess is that /v/ should be derived from underlying /w/, a segment that is in fact absent on the surface in most dialects of Russian. However, this in itself is insufficient to handle the facts, as there is no way to order a /w/ → /v/ rule with respect to Voicing Assimilation so that /v/ will undergo, but not trigger, the rule. This is shown below with the two possible derivations of *v skvažine* [fskv] 'in the chink', where both orderings fail:

(2)

/w skvažine/		/w skvažine/	
v skv	/w/ → /v/	—	Voicing Assimilation
*v zgv	Voicing Assimilation	*v skv	/w/ → /v/

Even under a theory that countenances "local ordering" of rules (see Anderson (1974)), it is clear that there is no way for the rules to generate the right output. The remedy is to allow sonorants to *undergo* Final Devoicing, only to be revoiced later in the derivation. If the /w/ → /v/ rule is ordered before the late revoicing of sonorants, the right pattern will result. The rules that are needed are listed in the correct order under (3):

(3)

a. *Final Devoicing*

   $C \rightarrow [-\text{voice}] / \underline{\quad} \#$

b. *Voicing Assimilation*

   In a consonant cluster, assign the voicing of the last obstruent to all consonants on its left.[2]

c. *W Strengthening*

   $$\begin{bmatrix} C \\ -\text{cons} \\ +\text{labial} \end{bmatrix} \rightarrow [-\text{son}]$$

d. *Sonorant Revoicing*

$[+\text{son}] \rightarrow [+\text{voice}]$

The following derivations show how the rules work:

(4)

a. /w skwažine/	b. /tolst # li/	'stout-interr.'
w̦ skw	l̦st l	Voicing Assimilation
f skv	—	W Strengthening
—	lst l	Sonorant Revoicing
c. /s wami/	d. /jazw/	
—	zw̦	Final Devoicing
—	—	Voicing Assimilation
s v	zf	W Strengthening
e. /iz mcenska/	f. /bez wpuska/	
s m̦c	s w̦p	Voicing Assimilation
—	s fp	W Strengthening
s mc	—	Sonorant Revoicing

In *v skvažine*, Voicing Assimilation is triggered by /k/, the last obstruent of the initial cluster, so that the initial /w/ is devoiced. Both the voiceless /w̦/ and the voiced one are then converted to /f/ and /v/, respectively, by W Strengthening. *Tolst li* has a similar derivation, except that both /l/s are allowed to remain as sonorants, so that the /l/ on the left is subject to Sonorant Revoicing. In *s vami* and *jazv*, I have accounted for the fact that /v/ and its devoiced reflex do not trigger Voicing Assimilation by placing Assimilation in counterfeeding order with respect to W Strengthening. *Iz Mcenska* shows that under the new analysis, sonorant consonants are not skipped over by Assimilation, but actually undergo the rule at an intermediate stage of the derivation. The evidence for this is found in cases like *bez vpuska*, where the hypothetical devoicing of a sonorant has effects on the surface, since W Strengthening bleeds Sonorant Revoicing.

This analysis is built on earlier accounts of the Russian voicing rules, particularly those of Coats and Harshenin (1971) and Halle and Vergnaud (1980). The revised account improves on earlier work in two respects: it handles a wider range of data than Coats and Harshenin's analysis; and unlike Halle and Vergnaud's proposal, it does not need an extra ad hoc rule to derive the voicing of /v/. There are at least five independent arguments that support my proposal, the first three of which I cite from earlier work:

I. The rule of W Strengthening is needed independently to handle other rules deeper within the phonology, as both Halle and Vergnaud (1980) and

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II. For many speakers, /w/ and /v/ vary freely on the surface, at least in certain environments, so that some version of W Strengthening is needed simply as a rule of allophony.

III. In more rapid speech, *voiceless sonorants* sometimes appear just where the proposed rules derive them, as in *rta* [r̥t] 'mouth (gen. sg.)', *mysl'* [sl̥'] 'thought', *kontrfors* [r̥for̥s] 'buttress' (Jones and Ward (1969)). This follows straightforwardly if the rule of Sonorant Revoicing is optional in rapid speech.

IV. The segment /v/ differs from other obstruents in that it appears voiced in word-final position if a sonorant-initial clitic follows: compare *zdorov#li* [vl'] 'Is he healthy?' with *grjob#li* [pl'] 'Did he row?'. The proposed analysis could account for this with an additional rule like (5):

(5)
$$\text{w̥} \rightarrow \text{w} / \underline{\hspace{1cm}} \# \, [+\text{son}]$$

But the same pattern holds true of word-final sonorants: they never show up voiceless before a sonorant-initial clitic, even in speech styles where voiceless sonorants typically appear. Rule (5) is therefore just a special case of the more general rule (6):

(6)
$$[+\text{son}] \rightarrow [+\text{voice}] / \underline{\hspace{1cm}} \# \, [+\text{son}]$$

The collapsing of the two cases crucially requires that /v/ be derived from /w/.

V. The final argument concerns forms like *trezv* [zf], *xorugv'* [gf'], with obstruent clusters that disagree in voicing. Since Voicing Assimilation must be allowed to apply after Final Devoicing,[3] the only reasonable way to block Assimilation in these cases without a W Strengthening rule is to say that /f/, as well as /v/, is not an Assimilation trigger. But this cannot be right, since those /f/s that are *not* derived from /v/ do trigger Assimilation, as in *bez forsa* [sf] 'without swagger'. For the /w/ → /v/ analysis, forms like *trezv* are no problem: at the relevant stage of the derivation, the final segment of *trezv* is a voiceless /w̥/, which as a sonorant cannot trigger Assimilation.

Having presented what seems to be the best motivated analysis, I would like to suggest a means of improving it further. In particular, I would argue that the rule of Sonorant Revoicing can be eliminated, in that it is not a

phonological rule of Russian, but rather an epiphenomenon resulting from an incorrect interpretation of the phonological feature [voice].

There are two main approaches one might take in defining a phonological feature of voicing. One is simply to define [+ voiced] segments as those in which the vocal cords vibrate, as Gandour (1974) and many others have proposed. The other approach, which I will advocate here, is to define voicing as an articulatory state. This has been suggested, for example, by Halle and Stevens (1971), who argue for a pair of voicing features, [stiff vocal cords] and [slack vocal cords].

I am not prepared to defend Halle and Stevens's features in every detail, but I do believe that the facts of Russian support their claim that phonological voicing should have an articulatory basis. The empirical difference between the two approaches to voicing derives from the fact that a given laryngeal configuration can produce either voicing or voicelessness, depending on a number of factors (see Westbury and Keating (1980)). In particular, it is possible for the same laryngeal configuration to produce voicelessness in obstruents, but voicing in sonorants, owing to the difference between the two cases in the pressure drop across the glottis. The phonological feature system is thus faced with an irreconcilable conflict between a simple acoustic definition and a simple articulatory definition of voicing. Let us suppose, then, that the definition that wins out is an articulatory one, and examine the consequences. It is unfortunately not possible at present to formulate such a definition explicitly, owing to our limited knowledge of how voicing is controlled—see Hirose and Gay (1972), Ewan and Krones (1974), and Bell-Berti (1975), all of whom identify different contributing mechanisms. However, we can still reason on the following basis. If voicing is articulatorily defined, different definitions of voicing will disagree in whether it is the obstruents or the sonorants in which [voice] receives a clear acoustic realization as vocal cord vibration: only one of the two may be selected by the phonological system as the "calibrating" case. It is reasonable to suppose that the obstruents win out, since most languages have a voicing opposition in obstruents, but not in sonorants.

Assume, then, that the correct definition of [voice] is articulatory in nature, calibrated so as to have its clearest acoustic consequences among obstruents. An immediate consequence is that the facts of Russian can be accounted for without postulating a rule of Sonorant Revoicing — the data follow directly from rules (3a–c), with [voice] interpreted as I have suggested. To see why, observe that the rules of Russian that trigger phonological devoicing will guarantee the cessation of vocal cord vibration in

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obstruents, by the very nature of the voicing feature. But no such guarantee applies for sonorants, which permit vibration under a wider range of conditions. The loss of vibration in sonorants will be possible only under special circumstances, such as particularly low subglottal pressure. We therefore predict a surface pattern in which sonorants in devoicing environments appear to devoice only sporadically. As noted above, this is just what we find in the data.

Acoustic measurements provide further arguments that phonological voicing in Russian should not be identified with vocal cord vibration. The first such argument derives from the existence of segments having *contour voicing*—that is, segments that begin voiced and end voiceless or vice versa. At first blush, these segments pose a challenge in phonological description, suggesting perhaps an autosegmental representation for voicing. However, closer inspection shows that the contour-voiced segments are quite limited in their distribution: the voiceless-to-voiced variety occurs utterance-initially, while the opposite type occurs utterance-finally and -medially in obstruents. From what is known about the physiology of voicing (Westbury and Keating (1980)), this is just what would be expected from laryngeal articulations that remained more or less constant throughout a segment: the buildup and falloff of subglottal pressure that occur initially and finally give rise to crescendo and decrescendo voiced segments in these positions. Utterance-medially, the buildup of *supra*glottal pressure behind an obstruent constriction often leads to loss of vibration. These facts are just what would be expected given an articulatory voicing feature: apparently the articulatory gestures for voicing fail to compensate for the various changes in transglottal pressure drop that occur across an utterance. A feature system in which voicing was strictly equated with vibration could provide no comparable explanation of the facts.

A second argument against equating voicing and vibration concerns an additional rule in Russian of regressive voicing assimilation, which applies only in fast speech:

(7)
Fast Speech Devoicing

$$C \rightarrow [-\text{voice}] / \underline{} \begin{bmatrix} C \\ -\text{voice} \end{bmatrix}$$

Rule (7) is triggered just by voiceless segments, but these may include voiceless sonorants. By virtue of the rule, forms like *jazv* [zf] and *bobr* [br] ~ [br̥] 'beaver' surface as *ja*[sf] and *bo*[pr̥] in fast speech. In addition, however, we find forms like *žizn'* [s'n'], where acoustic measurements show
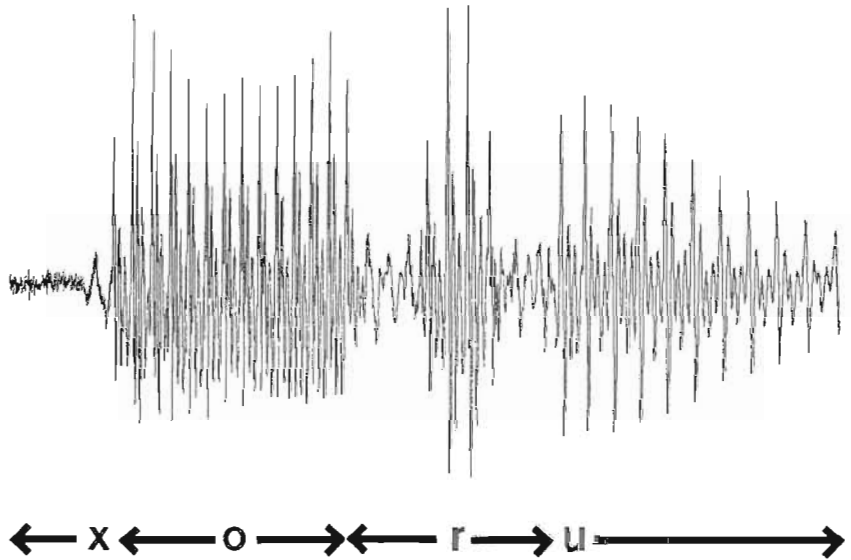
Voicing during closure of Russian /r/

←⟶ x ⟵ o ⟶ ← r ⟶ u ⟶

Figure 1
xorugv' (/r/ is phonologically [+ voice])
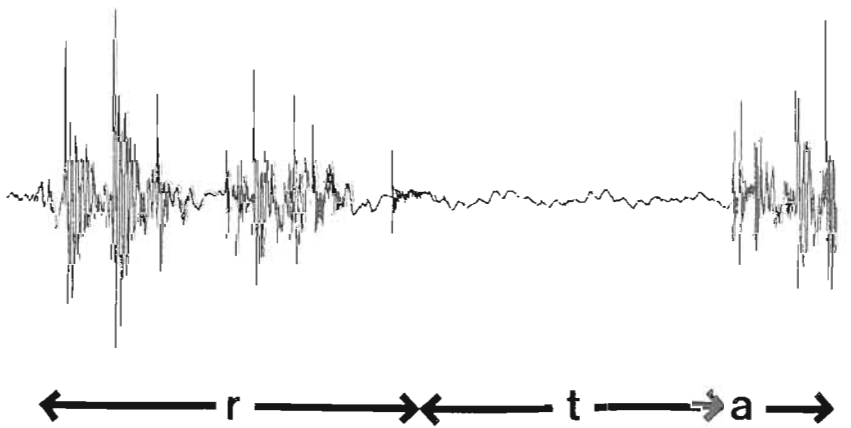

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Figure 2
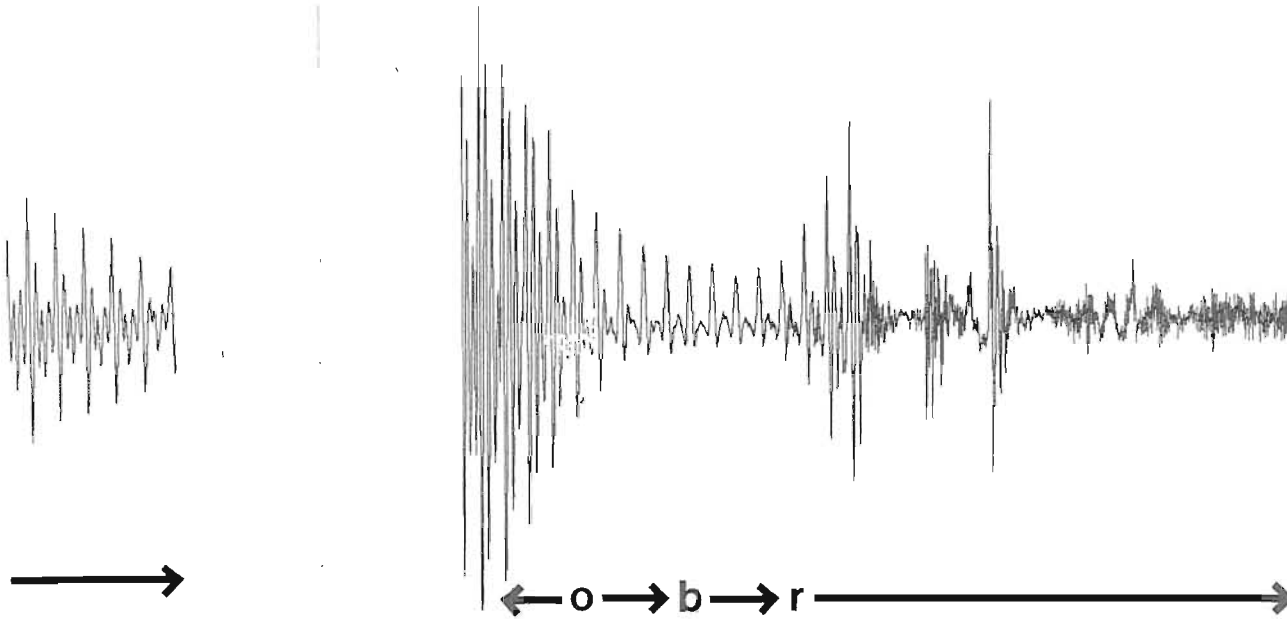*rta* (/r/ is phonologically [− voice])

Figure 3
bobr (/r/ is phonologically [−voice])

that vibration ceases for the /z/, but starts up again for the /n'/. The existence of these cases follows straightforwardly if we adopt the view of voicing features argued for here: phonologically, both of the final consonants of *žizn'* are devoiced, but the physics of the matter are such that vibration ceases only for the /z/. It would seem here that a sonorant that is phonetically vibrating can nonetheless induce phonological devoicing.

A final argument for this view of voicing features, as well as for the claim that sonorants always undergo the voicing rules, concerns the voicing of the Russian trilled /r/. Generally, in those contexts where the proposed rules mark /r/ as [−voice], the portions of the /r/ in which there is tongue closure are indeed phonetically voiceless, although the open portions are voiced (figures 1–3). This pattern is precisely what the analysis predicts, since it is only when an obstruction cuts off the airflow that a phonologically [−voice] segment will always be realized as nonvibrating. Notice that an analysis that equated voicing with vibration would be led here to the absurd claim that the phonological feature [voice] was oscillating synchronously with the aerodynamically controlled movements of the tongue.

The Russian facts are also relevant to a current controversy concerning

segments that undergo the rule are also potential triggers, whereas under a prosodic analysis, only the rightmost or leftmost relevant segment triggers the rule. In most cases, the difference in approach has no empirical consequences. In the case of Russian, however, the iterative approach fails, precisely because of the inherent claim it makes about propagating assimilations.

To summarize: I have presented here what I believe to be an adequate analysis of the Russian voicing rules. From the analysis, I have drawn evidence for two claims in phonetic and phonological theory: first, that the features for voicing should reflect articulatory states rather than vocal cord vibration, and second, that unbounded propagating assimilations should be handled with prosodic devices rather than with segmental iterative rules.

Notes

1. Voicing Assimilation is sometimes bled by an optional rule, motivated in Reformatskij (1971), which syllabifies sonorant liquids and nasals that are not adjacent to a vowel—the syllabic resonants behave just like vowels in blocking the assimilation.

2. I have provisionally expressed this rule in words rather than notation. The formulation of the rule raises an interesting problem for phonological theory, discussed below.

3. It is not just forms like *vizg* [sk], discussed above, that motivate this ordering. Voicing Assimilation also must follow Final Devoicing in order to override it when it applies across word boundaries: compare *grjob # li* [pl'] 'Did he row?' with *grjob # že* [bž] 'But he did row', where the derivation must be /b # ž/ → /p # ž/ → [b # ž].

4. For the arguments supporting directional iterative rules, see Johnson (1972), Howard (1971), Anderson (1974), and Kenstowicz and Kisseberth (1977).

5. Other nonprosodic formulations are available: for example, one might employ the parenthesis-star notation of Chomsky and Halle (1968), as in (i):

(i)
$$C \rightarrow [\alpha \text{voice}] / \underline{\hspace{1cm}} (C)^* \begin{bmatrix} -\text{son} \\ \alpha\text{voice} \end{bmatrix}$$

However, the parenthesis-star device has been fairly well discredited in the literature on other grounds; see the references cited in note 4. Another alternative is to place an optional sonorant in the environment of the rule, as in (ii):

the treatment of assimilation rules that propagate over unbounded distances. Halle and Vergnaud (1980) have proposed that the currently standard treatment, directional iterative rules,[4] should be abandoned in favor of prosodic analyses in which feature values spread autosegmentally or are percolated through metrical tree structures. The Voicing Assimilation rule (3b) provides some support for Halle and Vergnaud's claim, as no iterative formulation of the rule successfully describes the data. If only obstruents are allowed to trigger the rule, as in (8), then propagation will be blocked at the /w/ of /bez wpuska/:

(8)

$$C \rightarrow [\alpha voice] / \underline{\quad\quad} \begin{bmatrix} -son \\ \alpha voice \end{bmatrix} \quad \text{(iterative, right to left)}$$

/bez wpuska/ $\rightarrow$ be[z w̥p]uska $\rightarrow$ *be[z fp]uska

The alternative of allowing *all* consonants to trigger Voicing Assimilation is of course even worse, as it derives *pe[z'n'] from *pesn'*, *[dr']i from *tri*, and so on. The problem lies in the fact that a sonorant consonant may be allowed to trigger Assimilation only if it has undergone Assimilation itself, a condition that is impossible to state without global devices.[5]

The absence of good segmental formulations leads us to Halle and Vergnaud's hypothesis that propagating assimilation rules are prosodic. As a concrete suggestion for Russian, I offer the autosegmental rule (9):

(9)

In the configuration [$-$son], reassociate [αvoice] with the maximal string of
$$\quad\quad\quad\quad\quad\quad |$$
$$\quad\quad\quad [\alpha voice]$$
consonants to the left, deleting any autosegments stranded in the process.

Rule (9) would apply to *bez vpuska* as in (10):

(10)

Notice how rule (9) avoids the problem of globality: assimilation is never triggered by a sonorant, but only by the rightmost obstruent in a cluster.

The fundamental difference between a segmental iterative analysis and a prosodic analysis lies in what segments are regarded as being triggers for a propagating assimilation: an iterative analysis necessarily claims that all

(ii)

$$C \rightarrow [\alpha\text{voice}] / \underline{\hspace{1cm}} \left(\begin{bmatrix} C \\ +\text{son} \end{bmatrix} \right) \begin{bmatrix} -\text{son} \\ \alpha\text{voice} \end{bmatrix} \quad \text{(right to left iterative)}$$

But standard assumptions about parenthesis notation (Chomsky and Halle (1968, 30)) as well as the Elsewhere Condition (Kiparsky (1973), Anderson (1974)) would predict that the two expansions of (ii) would apply disjunctively, deriving *be*[s vp]*uska* from /*bez wpuska*/.

LANGUAGE
SOUND
STRUCTURE

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