Triggers and Targets in Voicing Assimilation: The Inevitability of Russian /v/

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1 Motivation: Russian /v/ patterns anomalously

Russian /v/ patterns with both obstruents and sonorants.

1.1 Obstruent patterning: /v/ ⇒ [f] / {___#, ___**T**}

Like voiced obstruents /b, z/, /v/ is a target of voicing processes:

(1) **Final Devoicing (FD):** Voiced obstruents devoice word-finally

a.	[sleda]	[slet]	'track (gen./nom.sg)'
b.	[mil]	*[mil̥]	'dear'
c.	[prava]	[praf]	'right (fem./masc.)'

(2) **Regressive Voicing Assimilation (RVA):** Voiced obstruents devoice before voiceless obstruents

a.	/pod-nesti/	[podnesti]	'to bring (to)'
b.	/pod-pisat^{j}/	[potpisat^{j}]	'to sign'
c.	/v supe/	[fsupe]	'in the soup'

1.2 Sonorant patterning: /**T**/ ↛ [**D**] / ___v

(3) **RVA:** Voiceless obstruents become voiced before voiced obstruents, *except* /v/

a.	/ot-jexat^{j}/	[otjexat^{j}]	'to ride off'	
b.	/ot-brosit^{j}/	[odbrosit^{j}]	'to throw aside'	
c.	/ot-vesti/	[otvesti]	'lead away'	*[odvesti]

2 Russian /v/ in a (cross-)linguistic context

The anomalous patterning of /v/ is not restricted to Russian, and has been tackled by many different linguists, in many different frameworks.

2.1 Languages with ambiguous patterning of /v/ (non-exhaustive)

	Final Devoicing	RVA	
		Target	Trigger
Russian	✓	✓	✗
Bulgarian	✓	✓	✗
Slovak	/v/ → [w]	✓	✗
Hungarian	N/A	✓	✗
Hebrew	N/A	✓	✗

RVA and /v/: The asymmetric pattering of /v/ with respect to RVA is independent of:

- language family: Slavic vs. non-Slavic
- whether or not the language has FD: Russian vs. Hungarian
- whether or not /v/ participates in FD: Russian vs. Slovak
- ancestry of /v/: Slavic: **w* > /v/ vs. Hebrew: **b* > /v/

2.2 Linguists on /v/ (non-exhaustive)

- Halle (1959)
- Lightner (1965)
- Andersen (1969)
- Coats and Harshenin (1971)
- Daniels (1972)
- Barkai and Horvath (1978)
- Jakobson (1978)
- Vago (1980)
- Hayes (1984)
- Avery (1996)
- Burton and Robblee (1997)
- Kavitskaya (1999)
- Padgett (2002)
- Hall (2003b,a)
- Petrova and Szentgyörgyi (2004)
- Lulich (2004)
- Kiss and Bárkányi (2006)
- *linguists whose work isn't in English ...*
- ...

> *"... the Standard Russian V ... occupies an obviously intermediate position between the obstruents and the sonorants"*
> – Jakobson (1978)

Common thread: Despite (often profound) differences, all accounts assume to a greater or lesser extent, that /v/ is *special*, and of *intermediate sonority*; its patterning is accounted for with a language-specific rule/representation/feature/constraint used to account for its *anomalous/heightened/intermediate* sonority.

Ambiguous /v/ is:

- actually underlying /w/ (Hayes, 1984)
- of sonority 3; triggers ≤ 2; targets ≤ 3 (Barkai and Horvath, 1978)
- actually /v̩/ = [-wide, +sonorant] (Padgett, 2002)
- gets classified with sonorants by Contrastive Hierarchy (SDA) (Hall, 2003a)

3 Is Russian /v/ realized with "intermediate sonority"?

3.1 Padgett (2002) on ambiguous /v/

The patterning of ambiguous /v/ derives from its *intermediate phonetic nature* together with a cue-based approach to phonology.

(4) Prediction (Padgett, 2002): phonological identity ⇔ phonetic realization

obstruent	ambiguous	sonorant
v	v̞	ʋ

Instability of /v̞/: Such a segment is inherently unstable, and as such, it is:

- prone to devoicing
- only realized as [v̞] in positions of perceptual salience (i.e., pre-sonorant)
- not contrastive (but, crucially, is active in the phonology)

3.2 Cross-linguistic acoustic study to test (4)

For a more detailed exposition, see Bjorndahl (2013), as well as my posters from *ICA 2013* and *LabPhon 13*, available on my website (`http://ling.cornell.edu/cbjorndahl/`).

3.2.1 Experimental controls

Phonological controls: To adequately test whether ambiguous /v/ is intermediate (1) across languages and (2) within inventory, must use control cases:

1. Control languages:
   - Greek: obstruent distribution; triggers RVA
     /tis varvaras/ → [tiz varvaras] 'Barbara's'
   - Serbian: sonorant distribution; neither triggers nor targets RVA
     [ovca] 'sheep' [svariti] 'digest'
2. Control segments:
   - /f/ ⇐ voiceless member of "pair"
   - /s, z/ ⇐ uncontroversial obstruent fricative pair
   - /m/ ⇐ sonorant (sanity check)
3. Control for local inventory structure: all three languages lack labial approximant (e.g., /w, ʋ/)

Phonetic controls Given the instability of [v̞], need to look in favourable positions:

- word-initial stressed (WIS)
- word-medial unstressed (WMU)
- flanking vowels /a, o/ (no palatalization, spirantization)
- $C_1VC_2V(C)$

3.2.2 Assessing ~~*phonetic intermediacy*~~ *degree of frication* of [v] tokens

The problem with trying to assess "phonetic intermediacy" is that it is not well defined. Moreover, the literature on the acoustic correlates of sonority (Parker, 2002) has found that while sonority correlates fairly well with major classes (e.g., obstruents vs. nasals vs. vowels), it is less robust for rankings within classes. Rather than attempt to assess sonority directly, I assessed whether tokens were realized as a fricative (i.e., obstruent) or approximant (i.e., sonorant), by measuring the degree of frication.

Question: Modulo the effect of voicing, are tokens of voiced and voiceless fricatives realized with similar degree of frication?

Spectral Centroid: Measure of how high frequencies in spectrum are on average (Boersma and Weenink, 2011).

- Voicing introduces low frequency energy and "multimodal" distribution of frequency
  ⇒ can't interpret centroid of voiced fricative!
- **solution:** high-pass filtered at 1500Hz
  ⇒ remove effect of voicing

Assessing frication relationally In order to compensate for idiosyncracies of languages and speakers, I consider frication relationally, both within the speaker and within the language. Thus, for each speaker s, the following *normalization* was done:

- $\mu_{[f],s}$ = mean centroid value for utterances of [f], averaged across words and repetitions of that speaker
- For each centroid c_i of speaker s, the *relative* measure $\tilde{c}_i$ is $c_i - \mu_{[f],s}$

(5) Prediction (Padgett, 2002) (revised):
Note that $\tilde{c}_i$ denotes *relative* difference of centroids of [v, s, z, m] to [f]

	Greek	Russian	Serbian
	v − f	v̪ − f	ʋ − f
$\tilde{c}_i$:	small	medium	large

3.2.3 Results

Relativized spectral centroid Modulo the effect of voicing, tokens of [s, z] are realized with the same degree of frication. This suggests that /s, z/ are a voicing pair both phonologically and phonetically. The relationship between /f, v/ differs in all three languages, but not in the way suggested by Padgett (2002).[1]

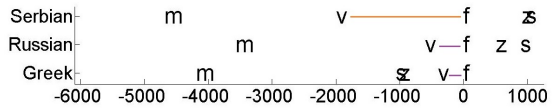

Figure 1: WIS condition

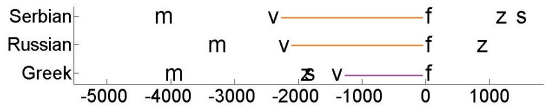

Figure 2: WMU condition

Conclusion: Russian /v/ is not intermediate.

[1] Note that no tokens of /v/ exhibited significant devoicing in any language.

4 Is ambiguous /v/ "special"?

4.1 Questioning assumptions

Why do linguists think that ambiguous /v/ is special? It seems obvious that Russian /v/ requires special treatment, because:

1. There is a symmetry in the relationship between other voicing pairs and RVA:
   /b, z/ → [p, s]; /p, s/ → [b, z]
2. /v/ is a fricative, so it ought to pattern with other fricatives

BUT: this rests on a crucial assumption:

> **Unity of (voiced) obstruents hypothesis:**
> Relationship of voicing in /v, f/ parallels the other obstruents:
>
> /v/ : /f/ :: /b/ : /p/ :: /z/ : /s/.
>
> All segments produced with significant constriction are [−sonorant]; voiceless members are specified as [−voice], voiced members are specified as [+voice]. Thus the pairs /p, b/, /s, z/ and /f, v/ differ by the valuation of the [voice] feature.

Question: Do we have *phonological evidence* that the voicing relationships between the stops, sibilants and non-sibilant fricatives are the same?

> **Definition (Spirants)**: non-sibilant fricatives; e.g., /ɸ, f, θ, x/ vs. /β, v, ð, ɣ/

4.2 Extending the "disunity of voice" principle to obstruents

The relationship between the voiced and voiceless members of the stops, sibilants and spirants is not the same: grounded phonetically, manifested phonologically.

4.2.1 The disunity of voice

Unity of voice: All voiced segments are [+voice] (or equivalent), irrespective of segment type.

Against the unity of voice:

1. Phonetics: spontaneous vs. non-spontaneous voicing (Halle and Stevens, 1971); maintenance of voicing and constriction Ohala (1983), Ohala (1997), Ohala and Solé (2008) in obstruents vs. unobstructed vocal tract in sonorants
2. Phonology: sonorant voicing often phonologically inert (see Rice and Avery (1989), Rice (1993) and references therein) ⇒ S(onorant) V(oice) node

4.2.2 Casting doubt on the unity of voiced obstruents

Lack of robust evidence for unified class behaviour Various phenomena that seem to be sensitive to sonority / obstruence (e.g., syllable structure, consonant gradation, nasal harmony) are best thought of as a scale (sometimes multiple scales!) and require distinctions within the (voiced) obstruents.

The phonetics of obstruent voicing Maintaining voicing and constriction has different implications for stops, sibilants, spirants:

- **Stops:** Supraglottal pressure increases through duration of closure leading to cessation of voicing.
  - Strategies to maintain voicing and occlusion: shortening duration, implosion, nasal venting
  - Strategies to maintain voicing at expense of occlusion: spirantization
- **Fricatives (Sibilants and Spirants):** Difficult to maintain adequate airflow for voicing and frication; typically shorter and partially devoiced.

  Sibilants: Voicing does not affect frication as drastically for sibilants as it does for spirants, since two sources of noise generation (at locus of constriction and downstream).

  Spirants: Insofar as well voiced, poorly fricated, insofar as well fricated, poorly voiced (Ohala, 1983). Since only one source of noise generation, when frication is lost tokens are essentially frictionless.

Voiced spirants often pattern with sonorants The sonorant patterning of voiced spirants /β, v, ð, ɣ/ litters the footnotes of phonology, but the non-obstruent patterning is frequently attributed to them being misclassified (i.e., what the grammar indicates is /β, ð, ɣ/ really should be /β̞, ð̞, ɣ̞); this is the conclusion of Botma and van't Veer (2013) and Botma and van't Veer (2014).

4.2.3 Voicing assimilation and voiced stops, sibilants, spirants and sonorants

What is the relationship between the triggers of voicing assimilation and the classes of voiced consonants?

(6) Triggers of voicing assimilation
  a. All voiced segments – Greek
  b. Stops – Dutch
  c. Stops and sibilants – Russian
  d. Stops, sibilants and spirants – ???

Question: Is there a language in which /v/ patterns as an obstruent with respect to voicing assimilation, to the exclusion of the sonorants?

		O(bstruent) VA	
Manner	Segments	Target	Trigger
Stops	p, t, k b, d, ɡ	✓	✓
Sibilants	s, ʃ, ɕ z, ʒ, ʑ	✓	✓
Spirants (voiceless)	ɸ, f, θ, x	✓	✓
Spirants (voiced)	β, v, ð, ɣ	✓	?

Languages that are (mostly) not counterexamples:

- **Czech?** In some dialects, ambiguous /v/; in others, /tv/ → [tf] (Hall, 2003a)
- **Yiddish?** Lombardi (1999) cites /kɔp+veytik/ → [kɔbveytik], but Albright (2008) notes that "regressive voicing is weaker and less frequent than regressive devoicing", and provides examples where voiced obstruents (including /v/) do not trigger voicing
- **Polish?** In Krakow dialect, sonorants also trigger voicing; in Warsaw dialect?

Given that the default assumption is that /v/ is an obstruent, why is it so difficult to find languages in which /v/ patterns unambiguously as a voiced obstruent? That is, as the voiced counterpart to /f/, parallel to how /b, z/ pattern as the voiced counterparts to /p, s/, with respect to voicing processes, to the exclusion of sonorants.

Conjecture (*OCP 12*, Jan. 2015):

➢ Voiced spirants cannot trigger obstruent voicing assimilation.

➢ If voiced spirants trigger voicing assimilation, sonorants do too.

Counterexamples:

1. Polish (Warsaw dialect only)
2. "Hungarian grandmother": some dialects of Hungarian; apparently unstable, and in some regions /v/ is devoiced following voiceless obstruents[2]

There do exist examples of "obstruent /v/", but they are surprisingly difficult to find, and the data suggest that this patterning is perhaps unstable. In other words, the "assimilatory force" (to use the terminology of Broch (1911)) of /v/ seems fundamentally different from the voiced stops and sibilants.

Conclusion: It's not *ambiguous* /v/ that's special, it's /v/ that's special.

4.3 Triggers of RVA

A typology of triggers? In systems that distinguish obstruent voicing from sonorant voicing with respect to voicing assimilation, there appear to be three types, as in the table below. It is unclear if all the gaps in the typology are meaningful, but it nevertheless seems that voiced spirants are less prone to triggering obstruent voicing than the stops and sibilants.

Language	Partitions of voiced segments	Triggers of RVA
Greek	{/m, b, z, v/} (vs. {/p, s, f/})	All voiced segments
Dutch	{/m/} vs. {/b/} vs. {v, z}	Voiced stops (voiced fricatives devoice)
Russian	{/m/} vs. {/b, z/} vs. {/v/}	Voiced stops, voiced sibilants
Hungarian (dialect)	{/m/} vs. {/b, z, v/}	All non-sonorant voiced segments

Regressive vs. progressive voicing assimilation The default (i.e., not further conditioned by morphological factors) directionality for voicing assimilation is regressive voicing assimilation, where the rightmost consonant determines the voicing value of the cluster (Lombardi, 1996). Investigations so far indicate that all the exceptions to this generalization occur when the rightmost consonant is a fricative. In cases where fricatives undergo progressive devoicing (or condition devoicing on the entire cluster, as in Dutch), /v/ and /z/ pattern together.

[2]Many thanks to Peter Rebrus for providing me with information on this dialect

Why does Russian /v/ appear to be anomalous? The default for /v/ is that it is a non-trigger for RVA, and hence its patterning in Russian is to be expected. It appears anomalous as an artefact of the fact that in languages like Russian, sibilants happen to also be triggers of voicing assimilation.

5 The inevitability of Russian /v/

The preceding typology and the patterning of various segment classes with respect to voicing phenomena (not all of which have been dealt with here) are suggestive of how the classes of voiced obstruents considered here are differentially categorized. Below are some preliminary conjectures: feedback, examples, counterexamples welcome!

Laryngeal voice /v/: Among languages that distinguish between obstruents and sonorants as triggers for RVA, there appears to be an implicational relation, schematized in (7): if voiced spirants are triggers, then voiced sibilants are triggers; if voiced sibilants are triggers, then voiced stops are triggers.

(7) /v/ » /z/ » /b/

In the terminology of Avery (1996), obstruent voicing assimilation is represented as a L(aryngeal) V(oice) system, shown in Figure 3.

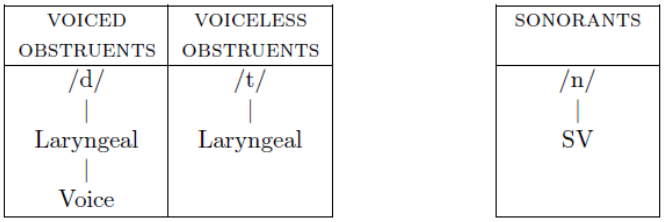

Figure 3: Laryngeal Voice System Avery (1996)

One way to capture the typology of triggers is in light of how readily a segment is represented as part of a laryngeal voiced system: if /v/ is part of an LV system, then /z/ is; if /z/ is part of an LV system, then /b/ is. In other words, voiced spirants are the worst laryngeally voiced obstruents.

Sonorant voice /v/: In contrast, voiced spirants make very good sonorants, a conclusion that various others have already come to for language specific treatment of /β, v, ð, ɣ/ with respect to various phenomena. In such cases, we expect that voiced spirants are most readily represented with an SV node. The fact that /v/ in Russian fails to be a trigger for voicing assimilation has been accounted for in this way already (Avery (1996), Hall (2003b) and Hall (2007)). The goal of the present work is to show why this is expected, not only as a consequence of the formal mechanisms, but also as a consequence of the inherent properties of the class of voiced spirants.[3]

[3]Note that the representation of /v/ as being part of a C(ontextually) V(oiced) system in certain dialects of Czech where /v/ undergoes progressive devoicing is fully compatible with these claims.

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