

A formal approach to /v/: Evidence from Czech and Slovak*

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1 Introduction

It has long been noted that the sound /v/ in many Slavic languages exhibits anomalous voicing behaviour. For example, Broch (1911: ¶197) writes, “Für das v ist ein Vorbehalt zu machen: es wird zwar gewöhnlich assimiliert (vt zu ft u.a.), hat aber selbst keine assimilierende Kraft (tv geht nicht in dv über).”¹ Diachronically, the fact that /v/ does not behave entirely as other obstruents do can be attributed to its origins as what might be termed a ‘lapsed sonorant,’ derived from Common Slavic *w.

More contentious is the question of how /v/ should be represented synchronically. Lightner (1965), Hayes (1984), and Kiparsky (1985), among others, have proposed that in Russian, the segment that surfaces as [v] (or, when devoiced, as [f]) is underlyingly a /w/. Its phonological status as a sonorant prevents it from triggering voicing assimilation, but it is subject to a process of strengthening that causes it to surface as an obstruent. Avery (1996) presents an account of Russian /v/ in which the anomalous segment is unspecified for the voicing features that characterize regular sonorants and obstruents. More recently, Padgett (2002) has argued that Russian v is both phonetically and phonologically a

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¹ “For v a proviso must be made: though it is generally subject to assimilation (vt becomes ft and so on), it has no assimilatory power of its own (tv does not become dv).”

“narrow approximant” [ɥ], and that its anomalous phonological patterning follows from the fact that it is phonetically intermediate between a sonorant [ɥ] and an obstruent [ɥ].

In this paper, I examine the phonological behaviour of /v/ in Czech and Slovak, and show how it can be accounted for through formal underspecification of voicing features, along much the same lines as Avery’s (1996) treatment of Russian. I then go on to show that an approach along the lines of Padgett’s treatment of Russian is phonetically untenable in Czech: although Czech /v/ is phonologically ambiguous, it is articulatorily and acoustically very much an obstruent. Under the assumption that a consistent account of the anomalous behaviour of /v/ in the Slavic languages is to be preferred, the phonetic facts in Czech thus indirectly lend support to Avery’s formal account of Russian voicing assimilation, and to similar treatments of related voicing systems.

2 The behaviour of /v/ in Czech

2.1 *The inventory*

The phonemic consonant inventory of Czech is shown below in (1). Orthographic symbols are shown in angle brackets where they differ from the IPA symbols.

(1)

	labial	dental/ alveolar	palatal/ postalveolar	velar/ glottal
stops	p	t	c ⟨t̚⟩	k
	b	d	ɟ ⟨d̚⟩	g
affricates		ts ⟨c⟩	tʃ ⟨č⟩	
fricatives	f	s	ʃ ⟨š⟩	x ⟨ch⟩
	v	z	ʒ ⟨ž⟩	ɦ ⟨h⟩
nasals	m	n	ɲ ⟨ň⟩	
trills		r	ř ⟨ř⟩	
approximants		l	j	

2.2 Ordinary Czech obstruents

2.2.1 *Voicing assimilation.* Most Czech obstruent clusters agree in voicing. This pattern appears to be generated by a rule of regressive assimilation, as (non-final) clusters take on the underlying voicing values of their rightmost members. This can be seen from the data in (2), which show how voicing assimilation applies to the prepositions *s* /s/ ‘with’ and *z* /z/ ‘from’. Before sonorants (2a), the prepositions surface with their underlying voicing values; before voiced obstruents (2b), both are voiced; before voiceless obstruents (2c), both are voiceless.²

(2) a.	<i>s lesem</i>	[slesem]	‘with a forest’
	<i>z lesa</i>	[zlesa]	‘from a forest’
	<i>s mužem</i>	[smužem]	‘with a man’
	<i>z muže</i>	[zmuže]	‘from a man’
b.	<i>s domem</i>	[zdomem]	‘with a house’
	<i>z domu</i>	[zdomu]	‘from a house’
	<i>s hradem</i>	[zɦradem]	‘with a castle’
	<i>z hradu</i>	[zɦradu]	‘from a castle’
c.	<i>s polem</i>	[spolem]	‘with a field’
	<i>z pole</i>	[spole]	‘from a field’
	<i>s chybou</i>	[sxibou]	‘with a mistake’
	<i>z chyby</i>	[sxibi]	‘from a mistake’

2.2.2 *Final devoicing.* Word-final obstruents and obstruent clusters are consistently voiceless, as shown in (3).

(3) a.	<i>muž</i>	[muʃ]	‘man’ (nom.sg.)
	<i>mužem</i>	[mužem]	‘man’ (inst.sg.)

² The Czech data in this paper are drawn from de Bray (1969), Hála (1962), Kučera (1961), Palková (1994), Townsend (1990), and V. Ambros (p.c.); glosses are based on Poldauf et al. (1994).

<i>myš</i>	[miʃ]	‘mouse’ (nom.sg.)
<i>myši</i>	[miʃi]	‘mouse’ (inst.sg.)
b. <i>hrad</i>	[fɪrat]	‘castle’ (nom.sg.)
<i>hradem</i>	[fɪradem]	‘castle’ (inst.sg.)
<i>robot</i>	[robot]	‘robot’ (nom.sg.)
<i>robotem</i>	[robotem]	‘robot’ (inst.sg.)
c. <i>hvozd</i>	[fɪvost]	‘forest’ (nom.sg.)
<i>hvozdem</i>	[fɪvozdem]	‘forest’ (inst.sg.)
<i>host</i>	[fɪost]	‘guest’ (nom.sg.)
<i>hostem</i>	[fɪostem]	‘guest’ (inst.sg.)

2.3 Czech /v/

2.3.1 /v/ as a target. Czech /v/ is like an obstruent in that it is a target for regressive voicing assimilation, as illustrated in (4) by the behaviour of the preposition *v* /v/ ‘in(to)’:

(4) a. <i>v lese</i>	[vlese]	‘in a forest’
<i>v muži</i>	[vmuʒi]	‘in a man’
b. <i>v domě</i>	[vdompɛ]	‘in a house’
<i>v hradě</i>	[vɦɪrajɛ]	‘in a castle’
c. <i>v pole</i>	[fpole]	‘in a field’
<i>v chybě</i>	[fxibjɛ]	‘in a mistake’

It is also a target for final devoicing:

(5) a. <i>zpěv</i>	[spjɛf]	‘song’ (nom.sg.)
<i>zpěvem</i>	[spjɛvem]	‘song’ (inst.sg.)
b. <i>barev</i>	[baref]	‘colours’ (gen.pl.)
<i>barva</i>	[barva]	‘colour’ (nom.sg.)

2.3.2 /v/ as a non-trigger. However, /v/ is like a sonorant in that it does not trigger assimilatory voicing. In some varieties of Czech, /v/ surfaces as [v] after a voiceless obstruent, resulting in a cluster

that does not agree in voicing; in other dialects, /v/ undergoes progressive assimilatory devoicing:

- (6) a. *s vránou* [svra:nou] ~ [sfra:nou] ‘with a crow’
 b. *tvůj* [tvu:j] ~ [tfu:j] ‘your’
 c. *tvorit se* [tvorit se] ~ [tforit se] ‘to take shape’
 ≠ d. *dvořit se* [dvorit se] ‘to court’

The trilled fricative /ʀ/ follows a similar pattern, which will not be discussed here. See Hall (2003) for a more detailed discussion.

3 The behaviour of /v/ in Slovak

3.1 *The inventory*

The phonemic consonant inventory of Slovak is similar to that of Czech, except for the absence of the trilled fricative /ʀ/ and the presence of voiced affricates /dz, dʒ/ and a palatal lateral /ʎ/. Slovak also makes a quantity distinction in the syllabic liquids: /r/ contrasts with /rː/ and /l/ with /lː/.

3.2 *Ordinary Slovak obstruents*

3.2.1 *Voicing assimilation to obstruents.* As in Czech, Slovak obstruents participate in a process of regressive voicing assimilation. This can be seen applying within derived words in (7) and across the boundary between a preposition and its object in (8). Regressive assimilation results both in voicing (7a, 8a) and in devoicing (7b, 8b).³

- (7) a. *prosit'* [prɔsɪc] ‘to ask’
 prosba [prɔzba] ‘request’

³ The Slovak data are drawn from de Bray (1969), Short (1993b), Rubach (1993), Krajčovič (1975), and Pauliny (1978).

<i>mlatieb</i>	[mlatjɛp]	‘threshing’ (g.pl.)
<i>mlatba</i>	[mladba]	‘threshing’ (n.sg.)
b. <i>srdečný</i>	[sɾdɛtʃni:]	‘cordial’ (adj.)
<i>srdce</i>	[sɾttɕɛ]	‘heart’
<i>muža</i>	[muʒa]	‘man’ (gen.sg.)
<i>mužstvo</i>	[muʃstvɔ]	‘team’

(8) a. <i>k domu</i>	[gdɔmu]	‘to a house’
<i>z domu</i>	[zdɔmu]	‘from a house’
<i>s dievčatkou</i>	[zdjɛftʃatkɔm]	‘with a girl’
b. <i>k tebe</i>	[kɕɛbɛ]	‘to you’
<i>z kina</i>	[skina]	‘from a cinema’

3.2.2 *Voicing assimilation to sonorants.* In Slovak, voicing assimilation can also be triggered by sonorants (including vowels):

(9) a. <i>vlak</i>	[vlak]	‘train’
b. <i>vlak mešká</i>	[vlag mɛʃka:]	‘the train is late’
c. <i>vlak ide</i>	[vlag ijɛ]	‘the train is coming’
d. <i>tak+mer</i>	[tagmɛr]	‘almost’
e. <i>s otcom</i>	[zɔtsɔm]	‘with a father’

However, assimilatory voicing triggered by sonorants occurs only across (some) morpheme boundaries. In (10a), there is no morpheme-internal assimilation of /k/ triggered by /n/ (cf. (9a–c) above). There is no assimilation across the boundary between the stem and the inflectional suffix (nor morpheme-internally between the /x/ and the /l/) in (10b), but the same sequence of segments does result in assimilation across the word boundary in (10c).

(10) a. <i>vlákno</i>	[vla:kno]	‘fibre’
b. <i>chlap+mi</i>	[xlapmi]	‘guys’ (inst.pl.)
c. <i>chlap môže</i>	[xlab mwɔʒɛ]	‘a guy can’

3.2.3 *Final devoicing.* Slovak obstruents are subject to final devoicing, as illustrated in (11).

(11) a.	<i>dub</i>	[dup]	‘oak’ (nom.sg.)
	<i>duby</i>	[dubi]	‘oaks’ (nom.pl.)
	<i>chlap</i>	[xlap]	‘guy’ (nom.sg.)
	<i>chlapi</i>	[xlapɪ]	‘guys’ (nom.pl.)
b.	<i>zväz</i>	[zvæʂ]	‘union’ (nom.sg.)
	<i>zväzu</i>	[zvæʂu]	‘union’ (gen.sg.)
	<i>čas</i>	[tʃas]	‘time’ (nom.sg.)
	<i>času</i>	[tʃasʉ]	‘time’ (dat.sg.)

3.3 *Slovak /v/*

3.3.1 *Assimilation.* Like Czech /v/, Slovak /v/ is a target (12), but not a trigger (13), for obstruent voicing assimilation:

(12) a.	<i>vták</i>	[fta:k]	‘bird’
b.	<i>vtip</i>	[fcip]	‘joke’
c.	<i>v tom</i>	[ftɔm]	‘in that’
d.	<i>vši</i>	[fʃi]	‘lice’ (nom.pl.)
e.	<i>voš</i>	[vɔʃ]	‘louse’ (nom.sg.)
(13) a.	<i>tvoj</i>	[tvɔj]	‘your’
b.	<i>tvár</i>	[tva:r]	‘face’

The sources on Slovak do not mention /v/ as a trigger for assimilatory voicing of the sort illustrated in (9).

3.3.2 *Lenition.* Unlike Czech /v/, Slovak /v/ is not subject to final devoicing. In Slovak, all syllable-final instances of /v/, including word-final ones, are realized as [w]:

(14) a.	<i>pravý</i>	[pra.vi:]	‘true’
	<i>pravda</i>	[praw.da]	‘truth’

b. <i>stav</i>	[staw]	‘position’
<i>stavba</i>	[staw.ba]	‘building’
c. <i>krv</i>	[krw]	‘blood’

4 A formal approach

4.1 Theoretical assumptions

The anomalous behaviour of /v/ in Czech and in Slovak can be elegantly accounted for in a formal system that allows for underspecification of phonological features. The account presented here is based on a theory of contrastive specification defined by the Continuous Dichotomy Hypothesis of Dresher, Piggott, and Rice (1994), and elaborated in subsequent work by Dresher (1998a, 1998b, 2003). This approach to underspecification is based on an algorithm for assigning features based on contrasts in the phonemic inventory (the Successive Division Algorithm). Unlike various other approaches to contrastive specification, such as the algorithm described by Archangeli (1988), the Successive Division Algorithm consistently produces minimal sets of feature specifications that fully distinguish the members of an inventory, while allowing for restricted variation in feature assignments among languages with phonetically similar inventories. (See Dresher (2003) for discussion.)

In this paper, I will assume that phonological features are privative (monovalent), and that the phonological computation is a derivation consisting of (partially) ordered rules that operate on non-linear representations. Although much of the elegance of the account proposed here follows from the logical consequences of underspecification in this theoretical framework, these assumptions are not necessarily crucial. For example, some version of the present treatment of /v/ should in principle be tenable within a version of Optimality Theory (Prince and Smolensky 2002) that allows for underspecification.

4.2 *Featural representations*

Given the assumptions stated above, the attested patterns in Czech and Slovak can be accounted for using laryngeal feature specifications proposed for Russian by Avery (1996). Each of these languages has a system of voicing features that combines properties of what Avery refers to as Laryngeal Voice and Contextual Voice systems. In a Laryngeal Voice (LV) system, all obstruents bear a Laryngeal node, the voiced obstruents being distinguished from the voiceless ones by the further presence of the dependent feature Voice. In a Contextual Voice (CV) system, voiceless obstruents again are characterized by a bare Laryngeal node, but their voiced counterparts are entirely unspecified for voicing features. Sonorants in both systems bear the feature SV (an abbreviation for ‘sonorant voice’ or ‘spontaneous voicing’; see Avery and Rice (1989), Piggott (1992), Rice (1993)). In the Czech and Slovak systems, most obstruents are specified as in a Laryngeal Voice system, but the anomalous /v/ is unspecified, as in a Contextual Voice system.⁴ This mixing of the two systems is schematized in (15).

(15) a. Laryngeal Voice system

Voiced obs.	Voiceless obs.	Sonorants
/d/	/t/	/n/
Laryngeal	Laryngeal	SV
Voice		

⁴ Czech /ɽ/, which is also exceptional, and also historically a sonorant, has a similar representation. In some Czech dialects, /v/ and /ɽ/ exhibit the same voicing behaviour, and are both unspecified for voicing features; in others, a more complicated set of representations is required (see Hall 2003).

b. Contextual Voice system

Voiceless obs.	Voiced obs.	Sonorants
/t/	/d/	/n/
Laryngeal		SV

c. Mixed system (Czech and Slovak)

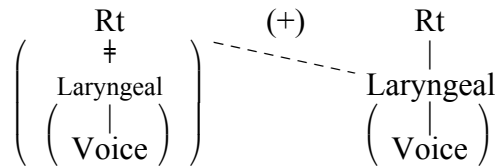
Voiced obs.	Voiceless obs.	/v/	Sonorants
/d/	/t/	/v/	/n/
Laryngeal	Laryngeal		SV
Voice			

Historically, this mixed system seems to have developed from a straightforward LV system as /*w/ became phonologically and phonetically less sonorant, losing the feature SV without gaining a Laryngeal node in its place.

4.3 Rules

Regressive voicing assimilation can be formalized as the leftward spreading of a Laryngeal node, replacing any existing Laryngeal node on the target, as shown in (16).

(16) Regressive Voicing Assimilation (Czech and Slovak)



True sonorants are protected from devoicing by the presence of SV, but /v/, which lacks SV, is subject to assimilation. However, since /v/ itself has no Laryngeal node to spread, it does not trigger

sonorant segment available for it to target.⁵ In Slovak, final devoicing is blocked by Coda *v*-Lenition; in Czech, /*v*/ is a target for final devoicing.

5 A functional approach to Russian *v*...

The formal, feature-based account of Czech and Slovak voicing patterns presented here contrasts with the functionalist approach taken by some recent work in Optimality Theory. For example, Steriade (1999) presents a theory of laryngeal neutralization based on the generalization that environments in which laryngeal contrasts are neutralized are precisely those in which the contrasts are phonetically most difficult to perceive.

Within this framework, Padgett (2002) offers a functional, phonetically driven account of the voicing behaviour of *v* in Russian, which is very similar to that of /*v*/ in Czech. Russian *v* is a target, but not a trigger, for regressive voicing assimilation. Padgett argues that this is because Russian *v* is a ‘narrow approximant’ /*ʋ*/, linking this phonetic fact to Jakobson’s (1978) phonological observation that *v* “occupies an obviously intermediate position between the obstruents and the sonorants.” Its voicing behaviour results from the way in which it is treated by the constraints shown in (19)–(22). Padgett introduces the articulatory feature [–wide] as a means of distinguishing the ‘narrow’ approximant /*ʋ*/ from its more open counterparts: “Vowels, glides, and at least some liquids are [+wide], while obstruents and narrow approximants are [–wide]” (Padgett 2002: 18).

⁵ This bare Laryngeal node appears to mark the edge of the phonological word in much the same way in which boundary tones (Pierrehumbert 1987) mark the edges of intonational phrases. An intriguing alternative to the insertion rule would be to posit that the Laryngeal node is associated with the word boundary itself. The difficulty with this approach is that in combination with the rule in (18), it would incorrectly predict word-initial devoicing of /*v*/.

- (19) IDENT_{PS}(VOICE): An output segment in pre-sonorant position has the same value for [voice] as its input correspondent.
- (20) AGREE(VOICE): Within a clitic group, all contiguous [-wide, -nasal] segments share any [voice] specification.
- (21) *D/ɸ: [-wide, -nasal] segments should not be [+voice].⁶
- (22) IDENT(VOICE): An output segment has the same value for [voice] as its input correspondent.

The relevant feature specifications Padgett posits for /ɸ/ are shown in (23).

- (23) /ɸ/
- | |
|---------------|
| + continuant |
| + approximant |
| - wide |
| - nasal |
| + sonorant |

Because /ɸ/ is [-wide, -nasal], it is subject to regressive voicing assimilation driven by AGREE(VOICE), as shown in the tableau in (24).

⁶ Padgett's somewhat elliptical label for this constraint can be glossed as 'disallow the voicing feature of [d] on segments that are no more sonorous than [ɸ]'; it is based on Steriade's (1999) more general constraint (*D) against voiced obstruents.

(24) /laʏka/ → [lafka] ‘bench’ (Padgett 2002: 20)

/laʏka/	ID _{PS} (VOI)	AGREE(VOI)	*D/ʏ	ID(VOI)
[laʏka]		*!	*	
☞ [lafka]				*
[laʏga]	*!		**	*

However, because /ʏ/ is [+sonorant], obstruents to its immediate left are required by IDENT_{PS}(VOICE) to retain their underlying voicing values, as shown in (25).

(25) /sʏerx/ → [sʏerx] ‘above’ (Padgett 2002: 26)

/sʏerx/	ID _{PS} (VOI)	AGREE(VOI)	*D/ʏ	ID(VOI)
☞ [sʏerx]		*	*	
[zʏerx]	*!		**	*
[sferx]	*!			*

In (25), the /ʏ/ must retain its underlying voicing value because it is immediately followed by the [+sonorant] segment /e/, and the /s/ must retain its underlying value because it is followed by the [+sonorant] /ʏ/. This results in a surface cluster that violates AGREE(VOICE).

Final devoicing of obstruents and /ʏ/ is driven by the constraint *D/ʏ, as in (26).

(26) /trezʏ/ → [tresf] ‘sober’ (Padgett 2002: 26)

/trezʏ/	ID _{PS} (VOI)	AGREE(VOI)	*D/ʏ	ID(VOI)
[trezʏ]			*!*	
[trezf]		*!	*	*
☞ [tresf]				**
[tresʏ]	*!	*	*	*

Although *D/ʏ makes no reference to position, its effects emerge only word-finally. If a [-wide, -nasal] segment is followed

by a sonorant, IDENT_{PS}(VOICE) dictates that it must keep its underlying voicing value; if it is followed by an obstruent, its voicing is determined by AGREE(VOICE).

6 ... is non-functional in Czech

Although Czech /v/ and Russian /ʋ/ are phonologically very similar, it would be difficult to extend Padgett's analysis to Czech. Czech /v/ is phonetically nothing like an approximant; on the contrary, it is generally described as being more like a stop than like a fricative, especially at the beginning of a syllable (Kučera 1961; Palková 1994). From a phonetic point of view, there is no reason to classify it as a sonorant *a priori*.

Figure 1 shows two spectrograms illustrating the acoustic realization of Czech /v/. The spectrograms were produced from sound files accompanying the IPA *Handbook* (International Phonetic Association 1999), using the speech analysis program Praat (Boersma and Weenink 2002).

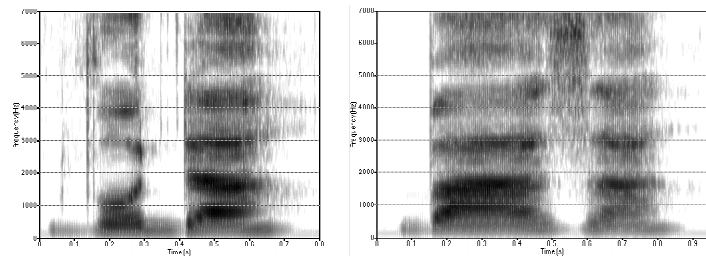


Figure 1: Spectrograms of Czech *voda* /voda/ 'water' and *váza* /va:za/ 'vase'

Although [v] in these examples is quite visibly voiced, it is not particularly sonorous. The [v] in *váza* is difficult to distinguish from the [b] in *bota*, shown in Figure 2; if anything, the [v] is less sonorous than the [b].

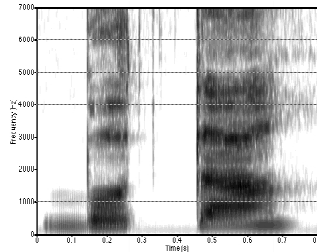


Figure 2: Spectrogram of Czech *bota* /bota/ ‘shoe’

There is, however, one very sonorous Czech obstruent: the breathy voiced glottal fricative /ɦ/. Articulatorily, this sound is maximally open; in Padgett’s feature system, it would presumably be [+wide]. Acoustically, as shown in Figure 3, it is characterized by significant voicing and a clear formant pattern.

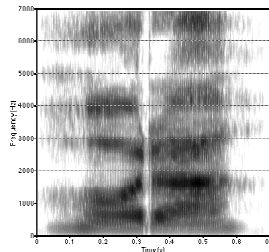


Figure 3: Spectrogram of Czech *hora* /hora/ ‘mountain’

If phonetic characteristics were a reliable determinant of phonological behaviour, then we should expect /ɦ/ to be the first Czech obstruent to show sonorant-like patterning. Yet /ɦ/ patterns phonologically as if it were /ɣ/: it is both a target and, as shown in (27) (=2b), a trigger for regressive voicing assimilation.⁷

- | | | | |
|---------|-----------------|-----------|-----------------|
| (27) a. | <i>s hradem</i> | [zɦradem] | ‘with a castle’ |
| b. | <i>z hradu</i> | [zɦradu] | ‘from a castle’ |

⁷ Short (1993a) indicates that in Bohemian varieties of Czech, /ɦ/ is subject to progressive assimilatory devoicing. However, progressive devoicing is not characteristic of Czech sonorants, so this pattern too is unexpected in Padgett’s phonetic approach.

Short (1993b:535–6) notes that /fi/ in Slovak also patterns as a regular voiced obstruent, and gives the example shown in (28) of /fi/ devoicing to [x] before a voiceless consonant.

(28) *vrah pil* [vraxpil] ‘murderer drank’

Czech and Slovak thus present two distinct challenges to the phonetically based functionalist approach: Czech /v/, though phonetically clearly an obstruent, patterns with sonorants in not triggering voicing assimilation, while Czech and Slovak /fi/, though articulatorily very open and, if the example in Figure 3 is typical, acoustically highly sonorous, patterns with the obstruents.⁸

7 Conclusions

Padgett’s approach, although it neatly accounts for the Russian data, appears to be untenable in Czech. Furthermore, despite its phonetic naturalness, it is formally arbitrary. Padgett’s account of Russian depends on constraints that refer to a class of segments defined by the features [–wide, –nasal], but nothing in the formal structure of the representations or the constraints explains why these features should be more relevant to each other, or to the feature [±voice], than to any other properties of segments.

The formal approach to /v/ presented in section 4 lacks the phonetic naturalness of Padgett’s approach. To the extent that the behaviour of /v/ in modern Czech and Slovak can be linked to

⁸ The assimilation of obstruents to sonorants in Slovak is problematic for both the functional and the formal approach, partly because of the difficulty of characterizing the environment in which it applies, and partly because sonorants are unexpected triggers in either theory. Under the formal approach, the process might be accomplished by leftward spreading of SV, combined with appropriate rules for the phonetic realization of segments with conflicting feature specifications. For the functional approach, the phenomenon is, if anything, more problematic, as Padgett’s constraints explicitly predict the preservation of underlying voicing contrasts in pre-sonorant position.

phonetics within the underspecified approach, the connection is purely diachronic: present-day /v/ lacks the features of a regular obstruent because it is historically descended from *w.

The advantages of the underspecified approach, however, are its formal naturalness and its cross-linguistic extensibility. Under this approach, /v/ cannot trigger voicing assimilation for the simple reason that it has no voicing features to spread. Because this phonological pattern is derived from featural representations rather than from phonetic properties, this account works both for cases such as Russian, in which the pattern appears phonetically natural, and cases such as Czech, in which it does not. The fact that such similar patterns appear in languages with and without phonetic motivation for them suggests that a more abstract, phonological explanation is required. Phonetics alone cannot determine whether a segment is phonologically an obstruent, a sonorant, or something in between.

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