Locality, neutrality, and contrast: A new resolution to the Votic paradox[*]

Daniel Currie Hall

Saint Mary's University

1. Introduction

This paper examines an apparent paradox in Votic identified by Blumenfeld & Toivonen (2016), and proposes a new solution. Votic /i/ behaves as if unspecified for frontness in vowel harmony, but can block velarization and trigger palatalization on certain consonants. Blumenfeld & Toivonen account for this by saying that /i/ is specified with [−back], but that this feature is ignored by harmony because it is non-contrastive; I propose instead that the frontness of /i/ is contrastive, but that it is encoded by a feature other than [−back].

2. The language

Votic (also Vod, Votian; endonym *Vad'd'a tšeeli* or *Vaďďa ceeli*; ISO-639 code vot) is a Finnic language, spoken in western Russia near the Estonian border. Kuznetsova et al. (2015: 135) identify four villages in Leningrad Oblast with Votic speakers; these are shown on the map in (1). Heinsoo & Kuusk (2011: 172) estimated that "the total number of Votic speakers could now be 6 to 10," and Kuznetsova et al. (2015: 137) report that "at present, Votic is almost never used as a means of communication."

(1) *Location of Votic*

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3. The paradox illustrated

As Blumenfeld & Toivonen (2016) point out, Votic /i/ is transparent to vowel harmony, but interacts with /l/ in a way that suggests that it is specified for the harmonizing feature.

3.1 Harmony

Vowel harmony applies to the pairs of vowels shown in (2).

(2)   *Harmonizing vowel pairs*

		FRONT	BACK
HIGH	ROUNDED	y	u
MID	ROUNDED	ø	o
MID	UNROUNDED	e	ɘ
LOW	UNROUNDED	æ	ɑ

Harmony propagates from left to right, typically causing suffix vowels to agree in frontness or backness with the stems to which they attach. The data below illustrate this with the elative case suffix, which surfaces as [-ssæ] after front stems, as in (3), and as [-ssɑ] after back stems, as in (4). All examples in (3)–(8) are drawn from Ahlqvist (1856) and Ariste (1968).

(3)   *Front stem* + EL. /-ssA/   (4)   *Back stem* + EL. /-ssA/

  a. yleː-ssæ   'cream'   a. udu-ssɑ   'fog'
  b. sømæ-ssæ   'eating'   b. vɘrkko-ssɑ   'net'
  c. vævy-ssæ   'son-in-law'   c. roːpɑ-ssɑ   'porridge'
  d. sepæ-ssæ   'smith'   d. vɑsɑrɑ-ssɑ   'hammer'

The high front unrounded vowel /i/, which has no immediate back counterpart in the native inventory, is transparent to harmony. As shown below, /i/ can occur both in front stems, as in (5), and in back stems, as in (6), and it has no effect on the realization of the case suffix.

(5)   */i/ in front stems* + EL. /-ssA/   (6)   */i/ in back stems* + EL. /-ssA/

  a. izæ-ssæ   'father'   a. siłłɑ-ssɑ   'bridge, floor'
  b. tæi-ssæ   'louse'   b. poiɡɑ-ssɑ   'boy, son'
  c. pehmiæ-ssæ   'soft'   c. vɘttimɘ-ssɑ   'key'

The plural suffix /-i/ further demonstrates the transparency of the vowel /i/. As illustrated in (7) and (8), plural /-i/ follows the stem and precedes the case suffix. The frontness or backness of the stem vowels determines the realization of the vowel in the case suffix, but the intervening plural suffix is unaffected, consistently surfacing as [-i].

(7) *Front stem* + PL. /-i/ + EL. /-ssA/ (8) *Back stem* + PL. /-i/ + EL. /-ssA/

a.	ʧivæ-i-ssæ	'stones'	a.	su-i-ssɑ	'mouths'
b.	seːmen-i-ssæ	'seeds'	b.	ɑmpɑ-i-ssɑ	'teeth'
c.	lyhy-i-ssæ	'short'	c.	lintu-i-ssɑ	'birds'

The phonetic frontness of /i/ is systematically ignored by harmony. Given that there is no harmonic partner for /i/ in the native inventory, an obvious way of accounting for this fact would be to say that /i/ is simply phonologically unspecified for frontness, connecting transparency with an absence of contrast as in Jakobson et al.'s (1952: 41) discussion of neutral vowels in Finnish (on which see also Hall 2017).

3.2 Velarization of /l/

However, Blumenfeld & Toivonen (2016) go on to show that the frontness of /i/ must be phonologically specified, based on how it interacts with an allophonic pattern in the realization of /l/. The lateral /l/ normally surfaces as plain [l] in words with front vowels, and as velarized [ɫ] in words with back vowels.[1] This is illustrated in (9) and (10) with examples from Ariste (1968) and Blumenfeld & Toivonen (2016: 1170).

(9) [l] *in front-harmonic words*

a.	elæː	'to live'
b.	ʧylæ-llæ	'village' + ADESSIVE
c.	miltinleːb̥	'some kind of'
d.	veːl	'more'
e.	næltʃ	'hunger'

(10) [ɫ] *in back-harmonic words*

a.	əɫud̥	'beer'
b.	poiɡɑ-ɫɫɑ	'boy, son' + ADESSIVE
c.	miɫtɑ	'from me' (1SG. ABLATIVE pronoun)
d.	kəɫmɑʒ	'third'
e.	nɑːtɫ	'chicken pen'

Before /i/, however, /l/ is consistently plain, even in otherwise back-harmonic words, as shown in (11) with data from Blumenfeld & Toivonen (2016: 1171) and Ariste (1968).

(11) [l] *before /i/ in back-harmonic words*

a.	əlimmɑ	'we were'
b.	tɑppəlikko	'combative person'
c.	tuli-i-səː	'fire' + PL. + ILLATIVE
d.	lintu-i-ɫɫɑ	'bird' + PL. + ALLATIVE

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[1][ɫ] contrasts with palatal(ized) [ʎ] or [lʲ]; see Blumenfeld & Toivonen (2016: 1170) for discussion.

Černjavskij (n.d.: 6) suggests that the trigger for velarization of /l/ is an immediately following back vowel, which would mean that the non-velarized [l]s in (11) could simply be attributed to non-application, rather than requiring that /i/ actively block or reverse velarization. This analysis, however, appears to be ruled out by forms such as (10c)–(10e), in which velarized [ɫ] occurs in pre-consonantal or word-final positions. As Blumenfeld & Toivonen (2016) conclude, then, the frontness of /i/ is phonologically active here, even though it is ignored by vowel harmony.

3.3   Palatalization of /k/

Further evidence of a a phonologically active place specification on [i] comes from a pattern described by Odden (2005: 100–101, citing Ariste 1968 for the data). The unrounded mid vowels /e/ and /ə/ raise (and, in the case of /ə/, front) to [i] word-finally. The alternation is illustrated in (12); the non-alternating forms with [i] in (13) indicate that the alternating vowels are underlyingly mid.

(12)   *Underlying mid vowel: Final raising*

	PARTITIVE	NOMINATIVE	
a.	tʃive-æ	tʃivi	'stone'
b.	jɑrvə-ɑ	jɑrvi	'lake'
c.	mætʃe-æ	mætʃi	'hill'

(13)   *Underlying /i/: No alternation*

	PARTITIVE	NOMINATIVE	
a.	siːli-æ	siːli	'hedgehog'
b.	ɫusti-ɑ	ɫusti	'pretty'

The [i] derived by raising palatalizes an immediately preceding /k/ to [tʃ], as in (14).

(14)   *Palatalization before derived* [i]

	PARTITIVE	NOMINATIVE	
a.	kurkə-ɑ	kurtʃi	'stork'
b.	əɫkə-ɑ	əɫtʃi	'straw'
c.	kahkə-ɑ	kɑhtʃi	'birch'

Non-derived /i/ does not trigger palatalization, as illustrated in (15) with examples from Ariste (1968; not quoted by Odden).

(15)   *No palatalization before underlying /i/*

a.	prɑkizəb̥	'it is cracking'
b.	kəkiː	'everyone'
c.	ɑɫki	'he began, started'

d.	tɑki	'still, nevertheless, yet'
e.	piki	'pitch, cobbler's wax'

The implications of the raising and palatalization pattern for the representation of Votic /i/ are not entirely clear. Because palatalization is triggered only by derived [i], it could be that raising involves the insertion of a [−back] feature not present on underlying /i/; alternatively, the restriction could be a derived-environment effect (Kiparsky 1973, Burzio 2011) that does not entail a difference in featural representations. Furthermore, because the environment for raising is word-final, it is impossible to tell whether raised [i] is treated as a front vowel by harmony, which would be the obvious way of testing whether raising introduces a [−back] specification. Still, /k/ palatalization shows that some place specification on at least some tokens of [i] is phonologically active, and, as with /l/ allophony, this activity is manifest in interactions with consonants.

4. Theoretical questions

The immediate question raised by the patterns described in the previous section is why the frontness of /i/ is phonologically inert in the case of harmony, but phonologically active in interactions with /l/ and /k/. More broadly, these patterns raise questions about the role of contrast in determining phonological feature specifications, and about what makes a segment visible or invisible to long-distance operations such as vowel harmony.

4.1 Blumenfeld & Toivonen's account

Blumenfeld & Toivonen (2016) present a solution based on Rhodes's (2010) proposal that non-contrastive feature specifications are 'weak,' which is similar to the approach to contrast taken by Calabrese (1995), Halle et al. (2000), and Nevins (2010). In their account, /i/ is specified as [−back], like other front vowels in Votic. This feature is visible to a high-ranking constraint that requires /l/ to agree in [±back] with an immediately following vowel.[2] However, because /i/ has no native phonemic [+back] counterpart, its [−back] specification is invisible to the constraints responsible for harmony, which see only 'strong' feature specifications.

Because an /i/ that shares its [−back] feature with a preceding /l/ can intervene between a [+back] stem vowel and a suffix vowel that harmonizes with it, as in (11c) [tuli-i-səː], Blumenfeld & Toivonen argue that Span Theory (McCarthy 2004, O'Keefe 2007) cannot account for Votic harmony. Their analysis is formulated in Agreement By Correspondence (Hansson 2001, Rose & Walker 2004), though they note (Blumenfeld & Toivonen 2016: 1175) that other frameworks could also offer satisfactory accounts of the Votic patterns.

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[2]When /l/ is not immediately followed by a vowel, a lower-ranking constraint forces it to agree in [±back] with the 'strong' specifications of vowels elsewhere in the word.

4.2   How should locality be relativized?

In arguing against Span Theory, Blumenfeld & Toivonen (2016: 1168) write that "Votic harmony is incompatible with strictly local theories." Feature strength (Rhodes 2010), like other implementations of the idea that the phonological computation can distinguish between contrastive and non-contrastive features (Calabrese 1995, Halle et al. 2000, Nevins 2010), makes it possible to distinguish two degrees of relativized locality, (16b) and (16c), where (16a) represents strict locality:

(16)   *Strict and relativized locality conditions for harmony*
      a.   Harmony applies to segments within a contiguous domain.
      b.   Harmony applies to segments *specified for the harmonizing feature* within a contiguous domain.
      c.   Harmony applies to segments *contrastively* specified for the harmonizing feature within a contiguous domain.

In this approach, both contrastive and non-contrastive features are specified, but they do not have equal status. Some patterns (like harmony) are sensitive only to contrastive feature values; others (like /l/ allophony) are sensitive to all feature values.

4.3   What is the role of contrast?

An alternative view, which Nevins (2015) refers to as the Contrastivity-Only Hypothesis, posits that only contrastive features are specified at all (Steriade 1987, Mackenzie & Dresher 2004, Dresher 2009, Hall 2007, 2011, among others). Under this hypothesis, conditions (16b) and (16c) are by definition identical.

Unlike the approach described in the preceding subsection, the Contrastivity-Only Hypothesis is incompatible with relying on minimal pairs of phonemes to identify which features are contrastive (Archangeli 1988; Dresher 2009: ch. 2). The existence of a minimally different segment (e.g., /ɨ/ as a minimal [+back] counterpart to /i/) is a sufficient condition for a feature to be contrastive, but not a necessary one. If there is only one feature that can distinguish two phonemically distinct segments, then that feature must be specified. However, as shown by Archangeli (1988), relying on minimal pairs will not consistently produce an adequate set of specifications. In phonetically dispersed inventories such as the common three-vowel system /i a u/, a phoneme may not have any counterpart that differs from it on only one phonetic dimension: /i/ and /u/ differ in both place and rounding, /u/ and /a/ in both rounding and height, and /a/ and /i/ in both height and place. But it is not viable to say that in such cases, no features can be specified.
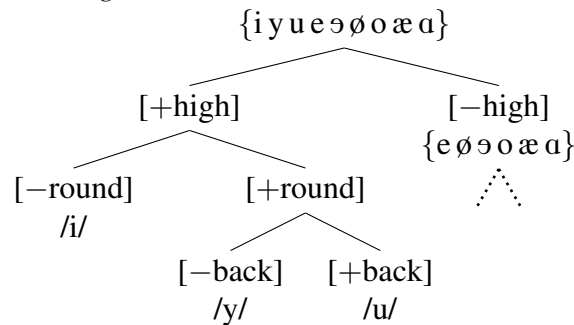
Dresher (2009) argues that contrastive features should instead be identified by successive division of the inventory, creating a contrastive hierarchy of the sort used by Cherry et al. (1953), Halle (1959), and Postal (1968), among others. When multiple features potentially distinguish two segments, the features' relative scope in the hierarchy determines which one(s) will actually be specified.
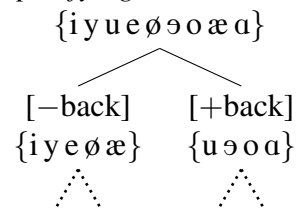
This means that in an inventory that includes /i/ but not /ɨ/, the presence or absence of a [−back] specification on /i/ will depend on the position of [±back] in the contrastive feature hierarchy. If the scope of [−back] is relatively narrow, so that it enters into the picture only after other features (e.g., [±high] and [±round]) have already distinguished /i/ from all back vowels, then /i/ will not receive a [−back] specification, as in (17a). However, if [±back] takes wider scope, as in (17b), then [−back] can be specified on /i/, because it distinguishes /i/ from (at least some) vowels that are [+back], even if there are other features that could have done so.

(17)   *Two partial contrastive hierarchies for the inventory* /i y u e ø ɜ o æ ɑ/

     a.   *Omitting* [−back] *on* /i/

{i y u e ɜ ø o æ ɑ}

[+high]   [−high]
                 {e ø ɜ o æ ɑ}

[−round]   [+round]
/i/

       [−back]   [+back]
       /y/   /u/

     b.   *Specifying* [−back] *on* /i/

{i y u e ø ɜ o æ ɑ}

[−back]   [+back]
{i y e ø æ}   {u ɜ o ɑ}

The challenge for this approach is that Votic seems to provide contradictory evidence about which hierarchy is the right one. Giving [±back] narrow scope, as in (17a), would correctly predict the transparency of /i/ to harmony, but, as Nevins (2015: 59–60, 63) points out, appears to lead to an "Oops, I Need That" problem: if /i/ is not specified for [±back], how can it block or override velarization of /l/? Alternatively, if [±back] takes wide enough scope to be specified on /i/, why is /i/ transparent to harmony? The dual patterning of /i/, Nevins (2015) argues, indicates the need for parametric visibility of redundant features, as in Blumenfeld & Toivonen (2016), Calabrese (1995), Halle et al. (2000), Rhodes (2010), Nevins (2010).

5.   The contrastive status of /ɨ/

If the frontness of /i/ is phonologically active, as it seems it must be in /l/ allophony and /k/ palatalization, the Contrastivity-Only Hypothesis predicts that it must be contrastive. This

prediction is correct. The table in (18), adapted from Ariste (1968: 1), shows the complete vowel inventory, which includes /ɨ/.

(18)   *All the vowels of Votic*

	FRONT		BACK	
	UNRD	RD	UNRD	RD
HIGH	i	y	ɨ	u
MID	e	ø	ə	o
LOW	æ		ɑ	

As Blumenfeld & Toivonen (2016: 1169 fn. 2) and Ariste (1968: 1) point out, /ɨ/ occurs only in Russian loanwords; this is why Blumenfeld & Toivonen exclude it from their inventory. However, Harms (1987: 382) reports that these borrowings are "well assimilated to Votic phonological and morphological patterns." Although Harms does not specify what this means for the status of /ɨ/, he does offer the examples in (19) to illustrate the productive application of Votic morphological and phonological processes to loans from Russian. (19a) is a compound formed in Votic from Russian roots, and in (19b), a Russian loanword containing /ɨ/ conditions back harmony on a native suffix, though the root also contains another back vowel, /o/, which would likely cause the suffix vowel to be back in any event.

(19)   *Russian loanwords and Votic morphology*

   a.   kit-rɨːbɑ   'whale'
         < Russian /kit/ [kʲit] 'whale' + /ˈrɨba/ [ˈrɨbə] 'fish'

   b.   rɨnko-i-łłɑ 'marketplace'+PL.+ADESSIVE
         < Russian /ˈrɨnok/ [ˈrɨnək] 'marketplace'

Although it is possible to say that borrowings from Russian are in some sense exceptional, and that the native Votic lexicon bars unrounded high back vowels, the grammar still needs to be able to distinguish /i/ from /ɨ/. The two can co-occur within a loanword, as in (20), from Ariste (1968: 1), so the difference between them cannot be reduced to a difference between two classes of words; they must have distinct phonological representations.

(20)   *Co-occurrence of /i/ and /ɨ/*
        [vɨʃifkɑ] 'embroidery' < Russian /ˈvɨṣivka/ [ˈvɨṣifkə] 'embroidery'

This means that if the specification of frontness on /ɨ/ is 'weak' in Votic, then its weakness follows from something less straightforward than a categorical lack of contrast between /i/ and /ɨ/. Blumenfeld & Toivonen (2016: 1176) "loosely" identify feature strength with functional load, but they go on to offer a formal definition in terms of minimally contrasting segments, following Rhodes (2010: 17). Because /i/ differs from /ɨ/ only in place, the place feature that distinguishes them would be a strong feature by this criterion.

One might look to Hall's (2009, 2013) proposal that contrast is not an all-or-nothing property as a basis for an alternative definition of feature strength. Under this approach, one might say that features that do not serve to mark any contrast at all are unspecified, ones that mark marginal contrasts (like the contrast between /i/ and /ɨ/ in Votic) are weakly specified, and ones that distinguish fully contrastive segments are strongly specified. However, while Hall (2009) proposes a way of quantifying contrastiveness based on the information-theoretic property of entropy (Shannon & Weaver 1949), she also points out that there are no clear criteria for drawing a line between marginal and non-marginal contrasts. As Hall & Hall (2016) point out, a gradient view of contrast is compatible with a system of phonological representations that makes a categorical binary distinction between zero and non-zero entropy—that is, between wholly non-contrastive pairs and pairs that contrast to at least some degree. But it is much less obvious how the continuous property of entropy might map to a ternary system of non-contrastive, weakly contrastive, and strongly contrastive features.

6.   Proposal: A new resolution to the paradox

Given that the frontness of Votic /i/ must be specified not only in order to account for its interactions with /l/ and /k/, but also to distinguish it from /ɨ/, the question that remains is why this contrastive property is ignored by vowel harmony. I propose that the feature that identifies /i/ as front is different from the harmonizing feature [±back].

6.1   Feature specifications

In partial contrastive hierarchy in (21), the frontness of /i/ is encoded by the place feature CORONAL.[3] This feature takes scope over [±back], so that it distinguishes /i/ from the rest of the vowel inventory before the harmonizing feature is assigned; /i/ thus receives no specification for [−back].

(21)   *Partial contrastive hierarchy for Votic*
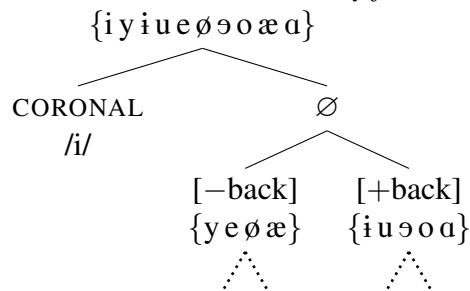
Apart from distinguishing the feature from [±back], the choice of the name CORONAL reflects the fact that the place specification on /i/ appears to interact only with consonants

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[3]Following Clements & Hume (1995: 252), among others, I assume here that CORONAL is monovalent, but this is not crucial.

and not with other vowels. The phonetic plausibility of assigning /i/ a distinct, and possibly consonantal, place feature is discussed below in §6.3.

6.2   Processes

This set of representations allows for relatively straightforward accounts of all the phonological patterns described above, which may be formulated in either rule- or constraint-based frameworks.

At a first approximation, harmony spreads [±back] rightward to all vowels specified with this feature, or, in constraint-based terms, harmony requires vowels specified for [±back] to agree, with preferential faithfulness to root vowels.[4] Consonants and /i/, having no underlying specification for [±back], neither initiate nor block harmony, and except for /l/, they are unaffected by it.

In fact, it may be that only [+back] spreads. Roots whose only vowel is /i/ are followed by front versions of suffixes, as in (13a) [siːli-æ]. If /i/ itself is not a possible source for [−back], as predicted by the specifications in (21), this suggests that [−back] is the default value for alternating suffix vowels. Furthermore, all non-alternating suffix vowels mentioned by Ariste (1968), other than neutral /i/, are back vowels: these include the comitative /-kɑː/ (diachronically a relatively recent development from a postposition; Ariste 1968: 33–34), the terminative /-ssɑː/ (Ariste 1968: 34–35), and the imperatives /-kɑː/, /-koː/ (Ariste 1968: 73–74), as well as various derivational suffixes (Ariste 1968: 5). Front /ø/ rarely occurs in non-initial syllables, and so there are many instances of disharmonic non-initial /o/, which can then condition back vowels in subsequent suffixes. This is illustrated in (22) with two stems meaning 'girl'. In (22a), the root with an unusual non-initial /ø/ is followed by the front-harmonic form of the partitive case suffix. In (22b), a stem formed by the addition of a derivational suffix with disharmonic /o/ conditions the back-harmonic form of the partitive.[5]

(22)   *The partitive suffix after front-harmonic and disharmonic stems*

    a.   tyttø-æ   'girl'+PARTITIVE (Ariste 1968: 4)
    b.   tyttærikko-ɑ   'girl'+PARTITIVE (Ariste 1968: 20)

The positive value of [±back] is also the only one that needs to spread in order to account for the velarization of /l/. Unlike harmony, velarization appears to apply in both directions, as either a preceding or a following back vowel is sufficient to condition velarized [ɫ]; compare (10e) [nɑːtɫ] and (10c) [miɫtɑ]. I posit that when [+back] spreads to /l/, it docks as a secondary articulation dependent on the primary CORONAL place of the lateral.

Velarization is overridden by an immediately following /i/. Given the representations in (21), this can be implemented through spreading of CORONAL from /i/ leftward to an adjacent /l/, replacing its existing primary place feature, and thereby also delinking any sec-

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[4]As in many harmony systems, Votic has some disharmonic roots; I set these aside here.

[5]The derivational suffix in (22b) is not glossed by Ariste, but Ahlqvist (1856: 83) identifies it as historically a diminutive suffix that has lost its diminutive interpretation.

ondary [+back] specification the /l/ may have received. In derivational terms, spreading of CORONAL from /i/ to /l/ follows velarization; in constraint-based terms, place agreement in /li/ sequences outranks the constraints that would otherwise cause /l/ to agree with [+back] vowels. This sharing of CORONAL between /i/ and /l/ is exclusively a vowel-to-consonant (or nucleus-to-onset) interaction; a following coronal consonant does not override velarization of /l/, as can be seen in (10c) [miłtɑ].

As for the alternations described in §3.3, non-low unrounded vowels become CORONAL word-finally. Derived [i] spreads its CORONAL feature leftward to palatalize an immediately preceding /k/. Assuming for the sake of representational parsimony that the CORONAL feature involved in these alternations is non-distinct from the one specified on underlying tokens of /i/, the fact that only [i] derived by raising triggers palatalization must be a derived-environment effect.

6.3   Phonetic corroboration

Phonologically, the motivation for representing CORONAL /i/ differently from [−back] /y e ø æ/ is that the frontness of /i/ interacts only with consonants, while [±back] is the feature that harmonizes on vowels. But is it phonetically plausible to say that /i/ is CORONAL and other front vowels are not?

This question, which I take to be a valid one, presupposes a view of phonological features that can be characterized as 'substance use in moderation' (Hall 2014; see also Dresher 2014), and which represents an intermediate position between the wholly abstract features of radically substance-free phonology (Blaho 2008) and features with rigidly defined universal phonetic boundaries. A system of features with cross-linguistically uniform phonetic content would most likely rule out the proposed analysis altogether; at the opposite end of the spectrum, radically substance-free features do not require phonetic justification at all. But in the range of intermediate theories in which features are expected to be phonetically interpretable but are permitted to vary from language to language, it makes sense to ask whether the representations proposed above are compatible with the phonetic facts of Votic.

Not much phonetic work on Votic is available. Both Ahlqvist (1856) and Ariste (1968) describe the vowels as being similar to their Estonian counterparts (except for /ɨ/, which does not have one). The Estonian vowel chart presented by Asu & Teras (2009: 368) suggests that /i/ is articulated farther forward than the other front vowels, including its nearest rounded counterpart /y/; if this is also true in Votic, then it is plausible (though by no means inevitable) that /i/ bears a feature marking a degree of coronal constriction that other vowels lack.

More strikingly, Černjavskij (n.d.: 8) indicates that intervocalic /i/ in Votic can be realized as [dʲː]. Although Černjavskij does not provide further details, this would certainly be consistent with the proposal that /i/ has a place feature that otherwise occurs only on consonants.

7. Consequences

If the featural representations of Votic vowels must be able to distinguish /i/ from /ɨ/, as argued in §5, then the transparency of /i/ to Votic vowel harmony cannot be attributed to an absence of contrast, contra Blumenfeld & Toivonen (2016).

The alternative proposal in §6 resolves the apparent paradox of Votic /i/ in a manner consistent with the strong claim that a feature must be contrastive to be phonologically active: the ability of /i/ to palatalize /k/ and override velarization of /l/ depends on the fact that the feature CORONAL distinguishes it from the other Votic vowels, while the transparency of /i/ to harmony follows from the fact that [−back] is redundant if /i/ is already specified as CORONAL. While this analysis requires that frontness on vowels be marked by two different features, it eliminates the need for a meta-feature of strength to distinguish between contrastive and redundant specifications; all specified features are contrastive.

Finally, although the analysis presented here is motivated in part by the presence of /ɨ/ in the Votic inventory, it does not depend on it. A hypothetical Votic speaker with no Russian loanwords in their lexicon could still assign CORONAL to /i/ and [±back] to the other eight vowels of their inventory according to the contrastive hierarchy in (21), and thus produce the same patterns of vowel harmony, /l/ allophony, and /k/ palatalization described here.

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Daniel Currie Hall
daniel.hall@utoronto.ca