

# Votic Vowel Harmony in Substance-Free Logical Phonology

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# Substance Free

- Innate set of binary phonological features
- “The motor and perceptual correlates of a feature are not accessible to the phonological computation system”
- ‘Substance free’ ~ ‘markedness free’



# Logical Phonology

- Really really substance free!!
- Using simple mathematico-logical notions: basic set theory
- Only need 2 operations: ~~Merge and Agree~~
  - **Set subtraction** for feature deletion
  - **Set unification** for feature insertion





# Segments and natural classes

- Segments as sets of valued features

$$/m/ = \{+NAS, +LAB, -COR, -CONT, \dots\}$$
$$/n/ = \{+NAS, -LAB, +COR, -CONT, \dots\}$$

- Natural classes

Definition: If  $S = \{s_1, s_2 \dots s_k\}$  is a subset of the segments occurring in a language  $L$ , and  $Q = (s_1 \cap s_2 \cap \dots \cap s_k)$  is the (generalized) intersection of  $S$ , then the **smallest natural class**  $N$  in  $L$  containing the members of  $S$  is the set of all segments that are supersets of  $Q$ . So,  $N = \{x : x \supseteq Q\}$ .<sup>1</sup>

## Natural classes: e.g.

- Natural classes

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- If a rule targets  $S = \{i, o\}$ , then it must target  $N = \{i, e, o, u\}$ . All four of those vowels are supersets of features at  $i \cap o = \{-Lo\}$ . So, an apparent rule targeting just  $i$  and  $o$  must correspond to separate rules.

# Unification

- Unification = regular set union + safeguard in case union is not consistent.
- Consistent = the set doesn't have two oppositely valued features.

If  $A$  and  $B$  are sets, then  $A \sqcup B = A \cup B$  if  $A \cup B$  is consistent. Otherwise,  $A \sqcup B$  is undefined. (Bale and Reiss (2018): 567)

# Unification

Four sets of features:

$$A = \{+Hi, -Rd\}$$

$$B = \{+Hi, -Bk\}$$

$$C = \{-Lo, +Rd\}$$

$$D = \{+Hi\}$$

Unifications:

$$A \sqcup B = \{+Hi, -Rd, -Bk\}$$

$A \sqcup C$  is undefined because  $A \cup C$  is not consistent

$$B \sqcup C = \{+Hi, +Rd, -Bk, -Lo\}$$

$$A \sqcup D = \{+Hi, -Rd\}$$

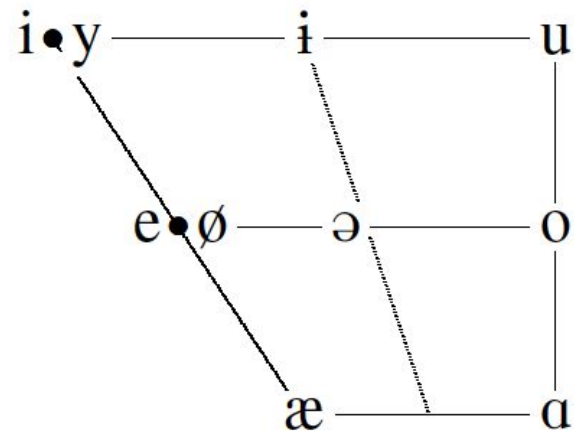


# Votic Language

- Finnic language spoken in Ingria, northern Russia.



## Votic vowel inventory



## Data: Votic Vowel Harmony

- Back harmony: each suffix vowel agrees with the preceding (or last root) vowel

–BACK V in root		+BACK V in root	
a. [vævy-æ]	‘son-in-law.PART.’	[sɑvvə-ɑ]	‘clay.PART.’
b. [ø-he:]	‘night.ILLAT.’	[so-hə:]	‘marsh.ILLAT.’
c. [væsy-nny]	‘tired.PAST.ACT.’	[arvɑ-nnu]	‘guessed.PAST.ACT.’
d. [sətamehe-nnæ]	‘soldier, warrior.ESS.’	[lenno-ɸɸɑ]	‘tree.ADDRESS.PL’

# Data: Votic Vowel Harmony

- /i/ does not trigger harmony

Table 2: Transparency of /i/

-BACK V IN ROOT		+BACK V IN ROOT	
a. [tšæs- <b>i</b> -næ:]	‘hand.COMIT. II.PL’	[pəɫʲv- <b>i</b> -nɑ:]	‘knee.COMIT. II.PL.’
b. [pehmi: <b>i</b> -se:]	‘soft.ILLAT.PL’	[vət <b>i</b> m- <b>i</b> -sə:]	‘key.ILLAT.PL’

- /i/ in suffixes doesn't participate in harmonic alternations

-BACK V IN ROOT		+BACK V IN ROOT	
[ylepæ-ssi]	‘chief.TRANSL.’	[antə-ssi]	‘as forgiveness.TRANSL.’
[teh-ti:]	‘it was done, made’	[tuɫʲ-ti:]	‘one had come’

## Data: Votic Vowel Harmony

- There are non-alternating suffixes.

–BACK V IN ROOT		+BACK V IN ROOT	
[tø-ka:]	‘work.COMIT.’	[ja <sup>ɫ</sup> ga:-ka:]	‘foot.COMIT.’
[tyttær-ikko]	‘girl’	[kot-ikko]	‘little bag’
[seipæ-dde:]	‘stake, pole.GEN.PL’	[pu-dde:]	‘tree.GEN.PL.’
[ø:-nikka:]	‘night lodger’	[pu <sup>ɫ</sup> ma-nikka:]	‘wedding guest’

## Data: Votic Vowel Harmony

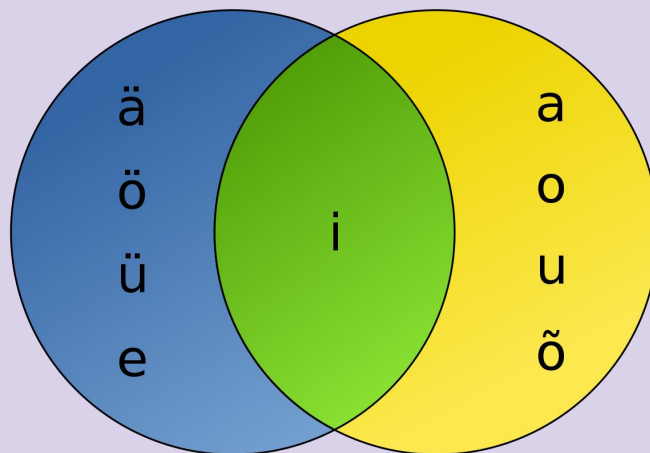
- Roots with just /i/: harmonizing vowels surface as -BACK.

‘hedgehog.PART.’

[si:li-æ]

## Data: Votic Vowel Harmony Overview

- Backness harmony controlled by the last root vowel.
- /i/ is transparent and doesn't participate.
- If /i/ is the only environment, harmony yields -BACK.
- /ø/ and /o/ only trigger harmony but don't participate (no [ø] in suffixes).



## Analysis: Vowel Specifications

- 10 fully-specified vowels that appear in roots and non-alternating suffixes, like so:

$$\begin{array}{cccc} /e/: & \left\{ \begin{array}{l} -\text{HIGH} \\ -\text{LOW} \\ -\text{ROUND} \\ -\text{BACK} \end{array} \right\} & /ə/: & \left\{ \begin{array}{l} -\text{HIGH} \\ -\text{LOW} \\ -\text{ROUND} \\ +\text{BACK} \end{array} \right\} & /æ/: & \left\{ \begin{array}{l} -\text{HIGH} \\ +\text{LOW} \\ -\text{ROUND} \\ -\text{BACK} \end{array} \right\} & /a/: & \left\{ \begin{array}{l} -\text{HIGH} \\ +\text{LOW} \\ -\text{ROUND} \\ +\text{BACK} \end{array} \right\} \end{array}$$

- 3 vowels unspecified for BACK that appear in alternating suffixes:

$$\begin{array}{ccc} /ʊ/: & \left\{ \begin{array}{l} +\text{HIGH} \\ -\text{LOW} \\ +\text{ROUND} \end{array} \right\} & /ɛ/: & \left\{ \begin{array}{l} -\text{HIGH} \\ -\text{LOW} \\ -\text{ROUND} \end{array} \right\} & /ʌ/: & \left\{ \begin{array}{l} -\text{HIGH} \\ +\text{LOW} \\ -\text{ROUND} \end{array} \right\} \end{array}$$

- These form natural classes that cannot be realized as [i], [o], or [ø], regardless of backness specification – those are always fully specified in suffixes or don't appear

# Analysis: A Preliminary Rule

- [+SYL] as natural class of vowels
- Search & Unify approach to rules, based on Search & Copy (Shen 2016):
  - Derivation searches for first segment that meets a featural specification, then unifies with that set of features
- Initial rule:

**BACK harmony (first try):**

**[+SYL]  $\sqcup$  { $\alpha$ BK} / when the first vowel to the left is in [ $\alpha$ BK]**

- Applies plenarily, but vacuously for all other vowels: either they gain a feature they already have, or attempt to unify with a feature set that would render their union inconsistent, so they remain unchanged
  - Underscores importance of feature binary



## Analysis: Reckoning with /i/

- The previous rule is too general, as it would trigger vowel harmony with /i/ in all cases, rather than passing to the preceding vowel
- LP cannot appeal to markedness, only natural classes, so we cannot specify “unify with the first vowel that is not /i/” – must be a natural class
- No such class exists, but we can capture it in two classes, with a rule for each:

(13) **Harmony with Non-High Vowel (NHVH):**

[+SYL]  $\sqcup$  { $\alpha$ BK} of the first vowel to the left that is in [–HI,  $\alpha$ BK]

(14) **Harmony with High Round Vowel (HRVH):**

[+SYL]  $\sqcup$  { $\alpha$ BK} of the first vowel to the left that is in [+HI, +RD,  $\alpha$ BK]

## Analysis: Reckoning with /i/

- Assuming /i/ never transmits a BACK feature, then, we can add one final rule to cover roots with only /i/, which applies after the first two: all vowels unify with {-BACK}
  - Vacuous in all instances except when vowel unspecified for backness still remains

**(15) Default –BK (DF):**  
**[+SYL] ⊔ {-BK}**

# Analysis: Rule Ordering

- Which applies first?

(13) Harmony with Non-High Vowel (NHVH):

[+SYL]  $\sqcup$  { $\alpha$ BACK} of the first vowel to the left that is in [−HI,  $\alpha$ BACK]

(14) Harmony with High Round Vowel (HRVH):

[+SYL]  $\sqcup$  { $\alpha$ BACK} of the first vowel to the left that is in [+HI, +RD,  $\alpha$ BACK]

- In a word like /toky/, (14) would have to apply first to achieve the attested pattern; in /tyko/, (13) would need apply first, due to specifications of Search
- However, /toky/-type roots are unattested: no {−HI,  $\alpha$ BACK} {+HI, +RD,  $\beta$ BACK} in Votic
- Therefore, we order (13) before (14), to match needs of attested /tyko/-type roots

# Analysis: Sample Derivations

- Using these three rules, we can derive the attested forms of alternating suffixes:

UR	'key.ILLAT.PL' /vøttim-i:-sE:/	'tree.ILLAT.' /pu-hE:/	'hedgehog.PART' /si:li-A/	'girl.PART' /tyttær-ikko-A/
NHVH	[vøttimi:sø:]	—	—	[tyttærikkoə]
HRVH	—	[puhø:]	—	—
DF	—	—	[si:liæ]	—
SR	[vøttimi:sø:]	[puhø:]	[si:liæ]	[tyttærikkoə]
comments	$\alpha$ Bk spreads from ə	$\alpha$ Bk spreads from u	Default –Bk	NHVH bleeds HRVH

## Previous Analyses

- Blumenfeld and Toivonen (2010) assert that /i/ is [+BACK, -BACK] – featurally inconsistent; what does this mean for phonetic interpretation?
- Hall (2017, 2018) specifies /i/ as [CORONAL] rather than [±BACK] – needlessly abstract when no distinction is based on /i/, as opposed to abstractions based on y/u/U, e/ə/E, æ/ɑ/A

# Conclusions

- Logical Phonology:
  - Segments as consistent sets of binary features; not necessarily complete
  - Rule environments as natural classes wherein all segments are a superset of given features
  - Does not make use of phonetic notions such as markedness
- Votic vowel harmony analyzed as three rules that appeal to different natural vowel classes to unify featurally and specify backness on alternating suffixes
  - Draws on vacuous rule application to avoid crashes
  - As the third rule doesn't harmonize with any preceding backness feature, overall “vowel harmony” is a conspiracy of other phenomena
- Surface well-formedness not encoded in phonologic grammar ([o-e] as ill-formed alternating suffix vs. well-formed non-alternating suffix depending on underlying process); computations free of phonetic substance

# References

- Leduc, M., Reiss, C., & Volenec, V. 2020. Votic vowel harmony in Substance Free Logical Phonology. To appear in *The Oxford Handbook of Vowel Harmony*, ed. H. Van der Hulst, Oxford: Oxford University Press.
- All other references cited therein.