Vowel Harmony is local over multi-tiered ARs

Eileen Blum

Rutgers University

NECPhon MIT Nov. 4, 2018

Introduction

- Vowel harmony as a phonotactic constraint rather than a transformation from an underlying form into the surface form (Goldsmith, 1976; Clements, 1976; a.o.)
- A unified theory of phonotactic constraints as forbidden substructure constraints over multi-tiered autosegmental representations captures a variety of vowel harmony patterns
  - neutral vowels: blocking in Akan, transparent vowels in Finnish
- Transparent vowels don't rely on underspecification

Why do we care?

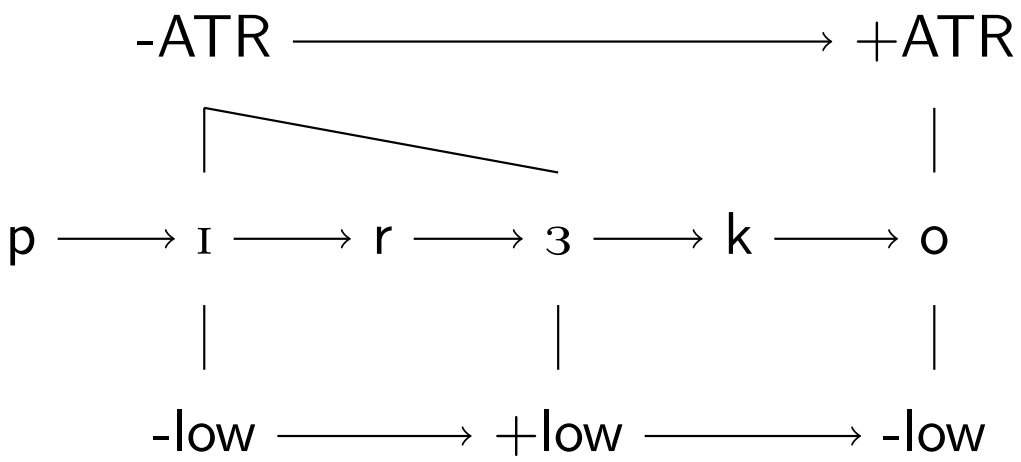
Autosegmental representations (ARs) make vowel harmony strictly local

- Patterns that are complex with one representation can be simpler with a different representation
- ARs provide explanatory power
  - allow for strictly local descriptions with single representation as opposed to multiple distinct representations (Heinz, 2010; Heinz et al, 2011; Aksënova & Deshmukh, 2018)

Locality

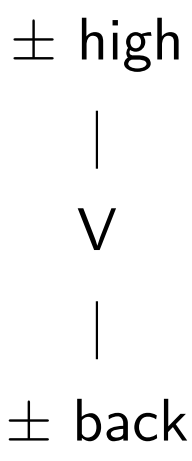
- Attested vowel harmony patterns captured by static surface well-formedness constraints: forbidden substructure constraints (FSCs) (Jardine 2016, 2017)
- FSCs over ARs use two relations: association (|) and successor ($\rightarrow$)

Akan: [pɪrɜko] 'pig'



Autosegmental Representations (ARs)

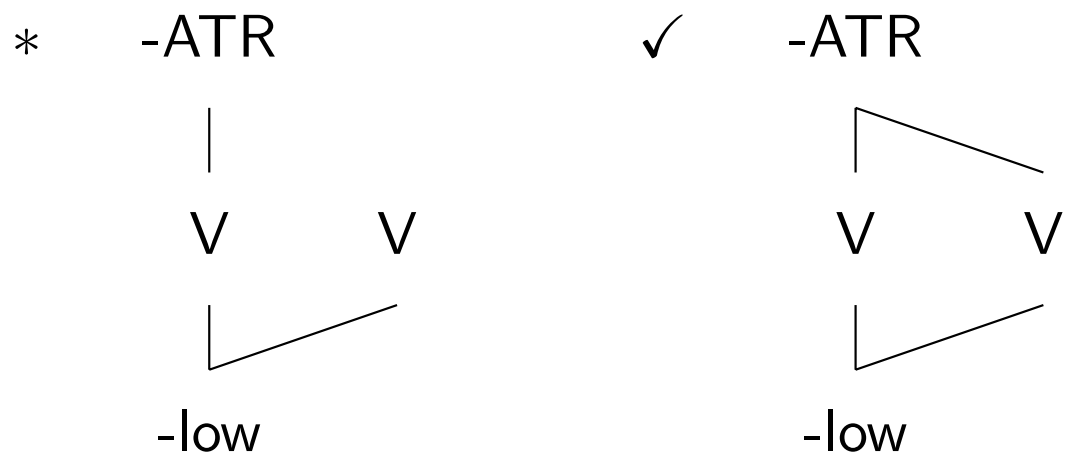
- Tone patterns have been represented with two autosegmental tiers (Goldsmith, 1976; Jardine, 2016, 2017, etc.)
- Vowel harmony can be represented with multiple featural tiers



Representational Assumptions

Full Specification (FS):

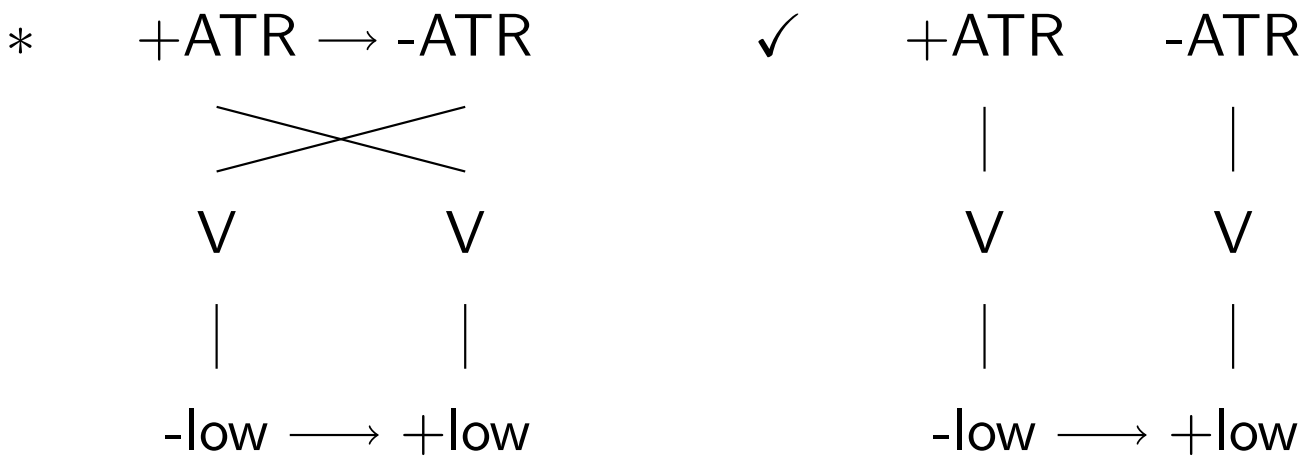
- each featural element must be associated to at least one vowel
- each vowel must be associated to at least one element on each feature tier
- consonants are not associated to vowel features



Representational Assumptions

No Crossing Constraint (NCC):

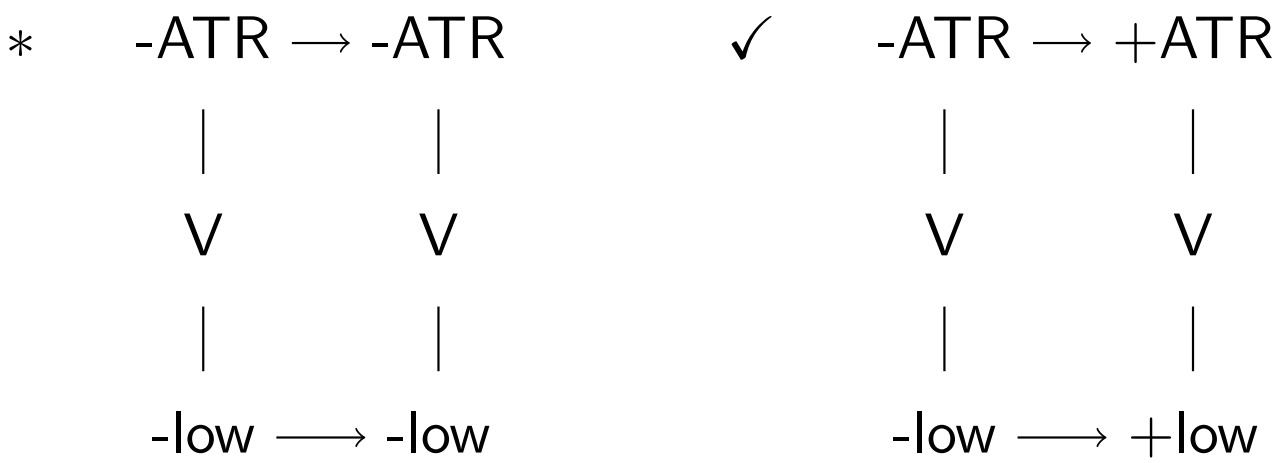
- association lines between the segmental tier and a feature tier never cross
- FS and NCC prevent gapped structures (Archangeli & Pulleyblank, 1994; Ringen & Vago, 1998)



Representational Assumptions

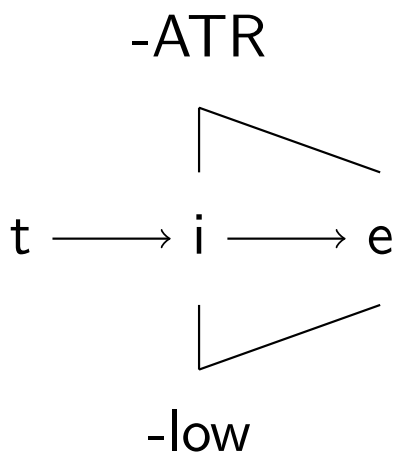
Obligatory Contour Principle (OCP):

- adjacent featural elements must be distinct



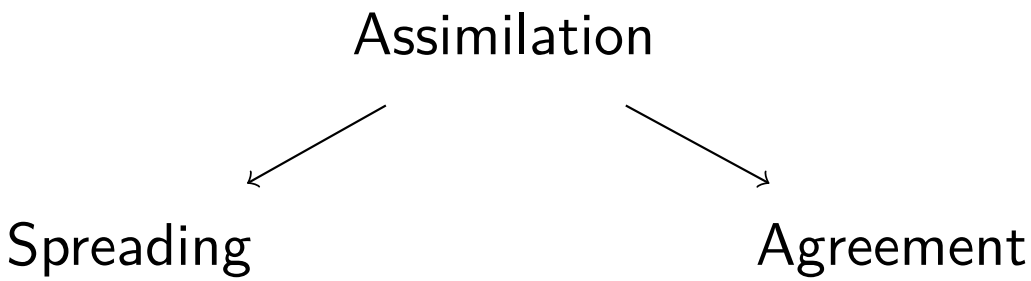
Representational Assumptions

- A well-formed AR obeys FS, the NCC, and the OCP



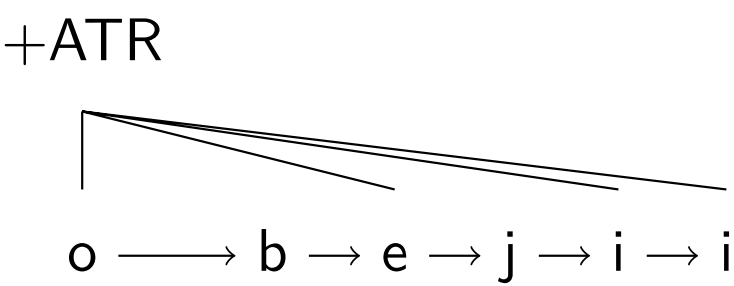
Terminology

- Assimilation: vowels have the same feature

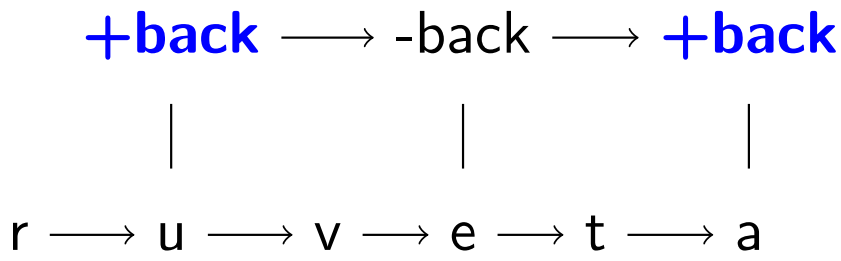


Terminology

Spreading: multiple association



Agreement: different vowels associated to different iterations of the same feature



Forbidden Substructure Grammar

- Previous work applied logical descriptions of formal languages to phonological well formedness constraints (Heinz et al., 2011; Rogers et al., 2013)
- Forbidden substructure grammar is a conjunction of negative literals
  - literals = substructures
  - describes a set of well-formed structures by ruling out ill formed substructures, r_1 through r_n

$\neg r_1 \wedge \neg r_2 \wedge \neg r_3 \wedge \ldots \wedge \neg r_n$

- FSCs define locality because they refer to elements in a structure connected by successor or association

Neutral Vowels

Blocking Vowels: Akan

Akan ATR harmony:

- If a word contains a sequence of -low vowels they will be associated to a single ATR feature (Clements, 1976)
- The vowels on either side of a +low vowel can be associated to different ATR features

Blocking Vowels: Akan

Table 1: Akan Vowels

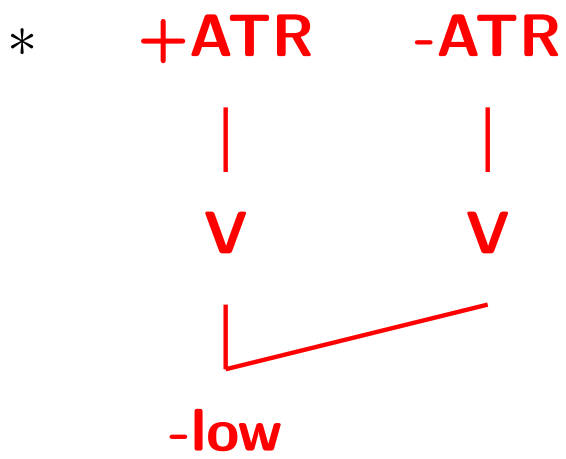
	+ATR	-ATR
-low	i	ɪ
	u	ʊ
	e	ɛ
	o	ɔ
+low	ɜ	a

- -low vowels in sequence are associated to a single ATR feature: [obejii] 'he came and removed it'
- -low vowels on either side of a +low vowel can be associated to different ATR features: [pɪrɜko] 'pig'

Blocking Vowels: Akan

- Akan ATR harmony pattern captured by a single FSC
  - forbids two -low vowels from being associated to different ATR features

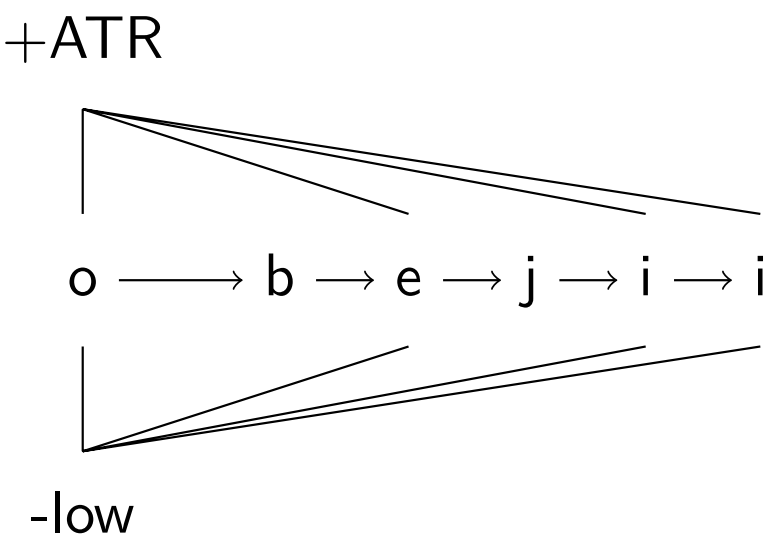
(1)



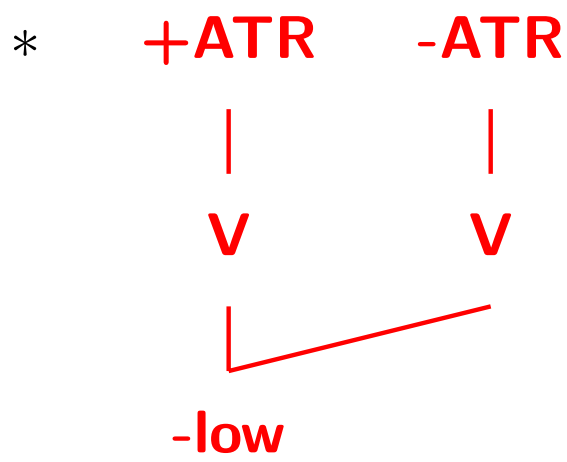
Blocking Vowels: Akan

- Akan FSC in (1) allows grammatical spreading AR

[obejii] 'he came and removed it'



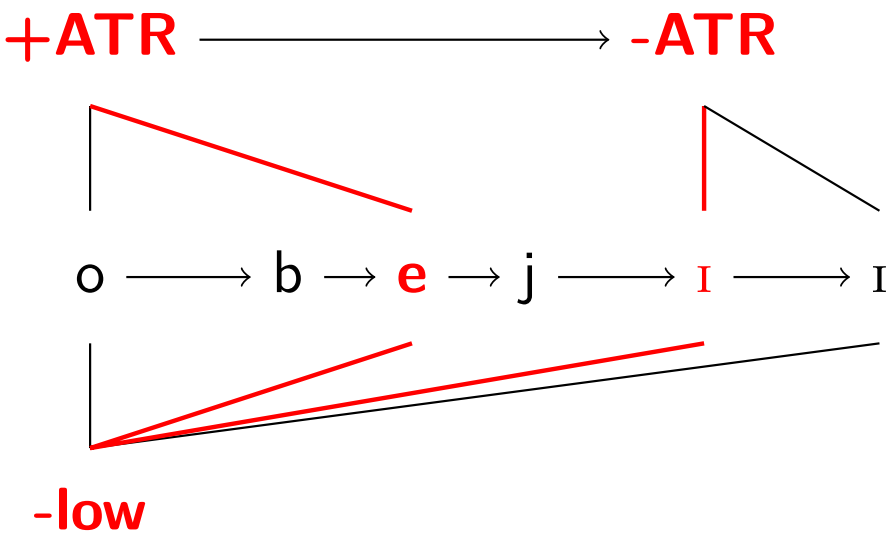
Akan FSC



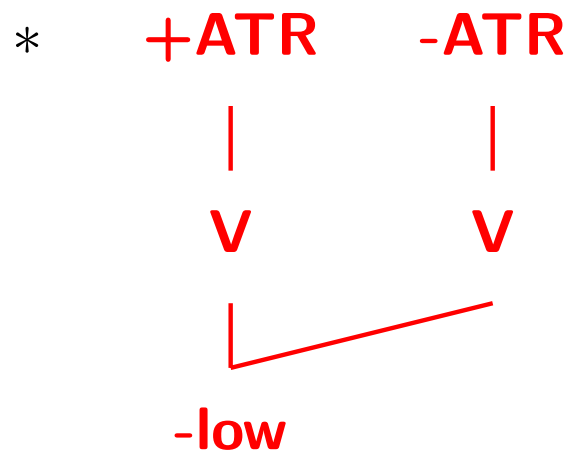
Blocking Vowels: Akan

- and (1) rules out an ungrammatical disharmonic AR because it contains the forbidden substructure

Ungrammatical Akan AR



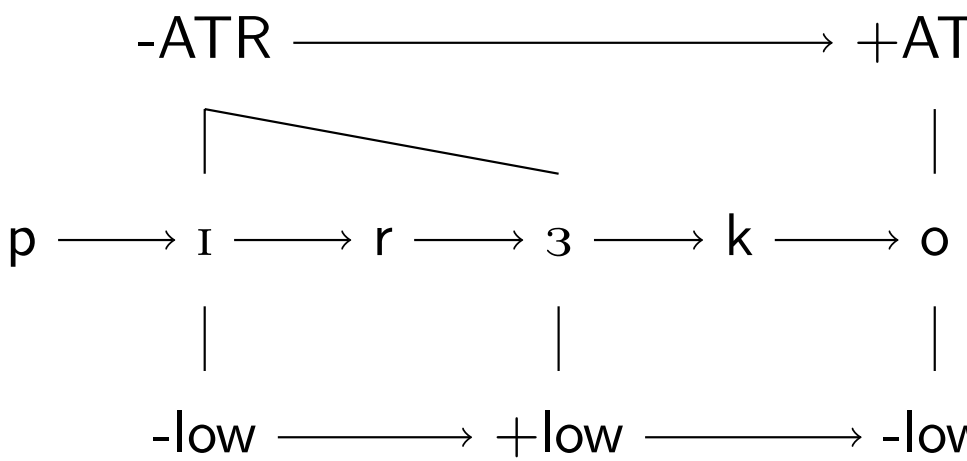
Akan FSC



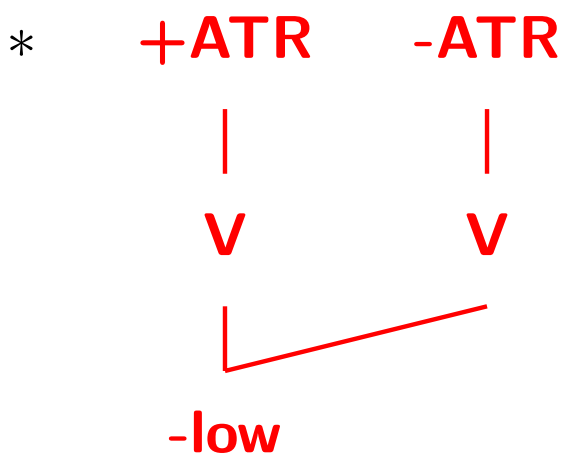
Blocking Vowels: Akan

- The same FSC in (1) also allows a grammatical disharmonic AR with a +low vowel

[pɪrɜko] 'pig'



Akan FSC



Spreading is local

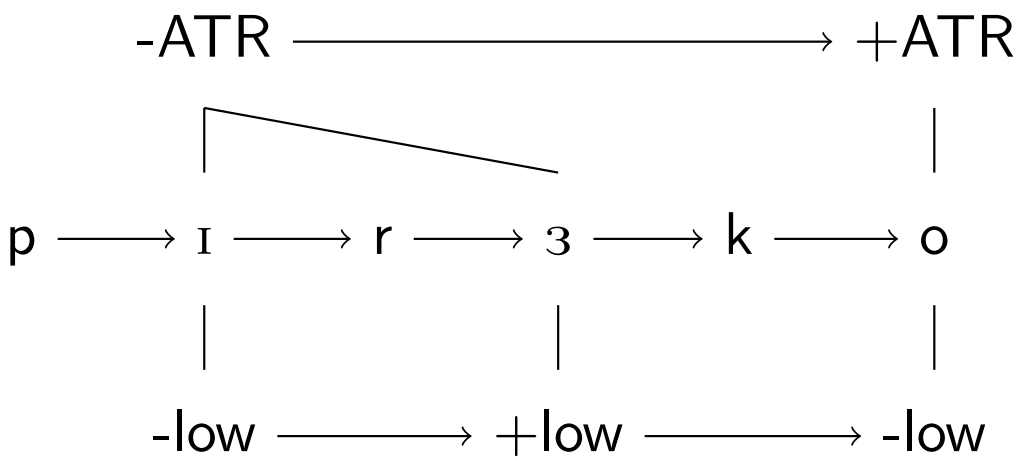
Spreading ARs consist of. . .

- an unbounded span of contiguous vowels associated to a single feature
- successor relation between two different features on the same tier

Spreading is local

- Spreading patterns are local over multi-tiered ARs
  - multiple association
  - distinct successor relations on each tier

[pɪrɜko] ‘pig’



Transparent Vowels: Finnish

Finnish Back harmony:

- Harmonizing vowels in a root are associated to a single back feature
- Harmonizing suffix vowels are associated to the same back feature as the harmonizing root-final vowel (Nevins, 2010; Ringen & Heinamaki, 1999; van der Hulst, 2017; Välimaa-Blum, 1986)
- Back harmony appears to skip over [-back, -round, -low] vowels

Transparent Vowels: Finnish

Table 2: Finnish Vowels

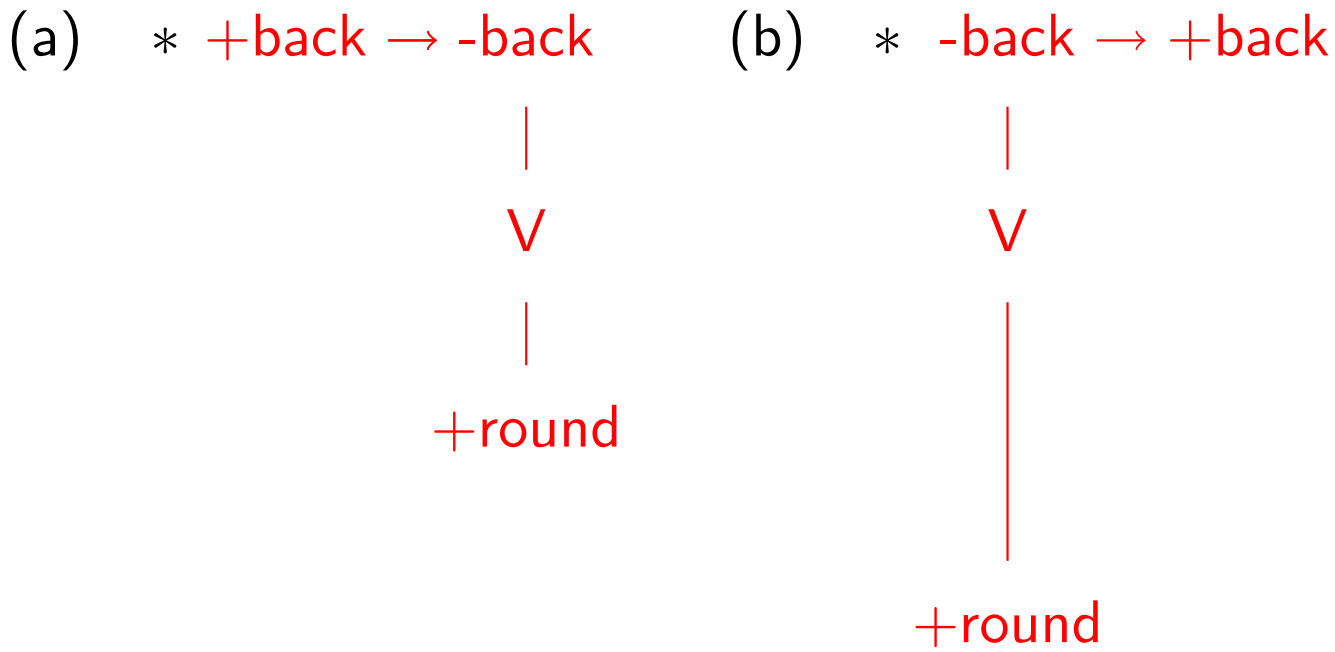
	-round	+round		
-low	i, iː	y, yː	u, uː	
	e, eː	ø, øː	o, oː	
+low		æ, æː	ɑ, ɑː	-round
	-back		+back	

- Two harmonizing vowels in sequence are associated to a single back feature: [poutɑ] 'fine weather'
- Harmonizing vowels on either side of a transparent vowel are associated to the same back feature: [ruvetɑ] 'start'
- The transparent vowel is associated to a different back feature **on the same tier**

Transparent Vowels: Finnish

- Set of Finnish FSCs forbid +round vowels from being associated to a -back feature that succeeds a +back feature

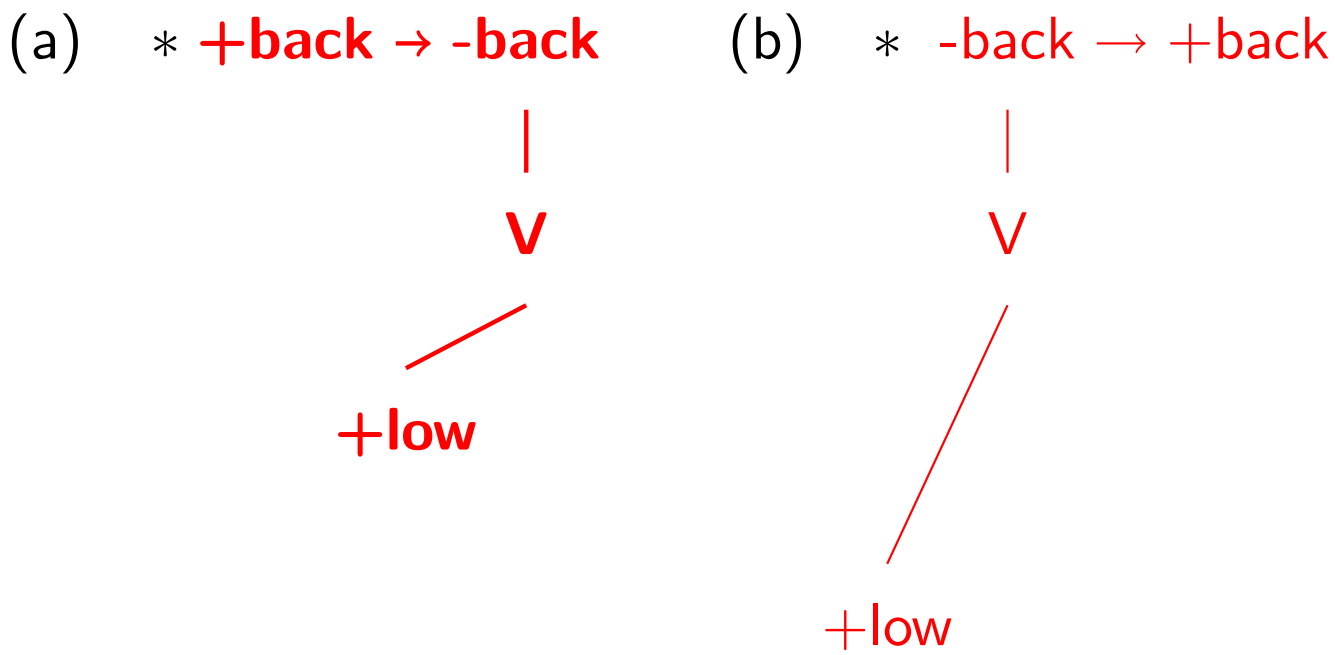
(2) Finnish FSCs



Transparent Vowels: Finnish

- and forbid +low vowels from being associated to a -back feature that precedes a +back feature

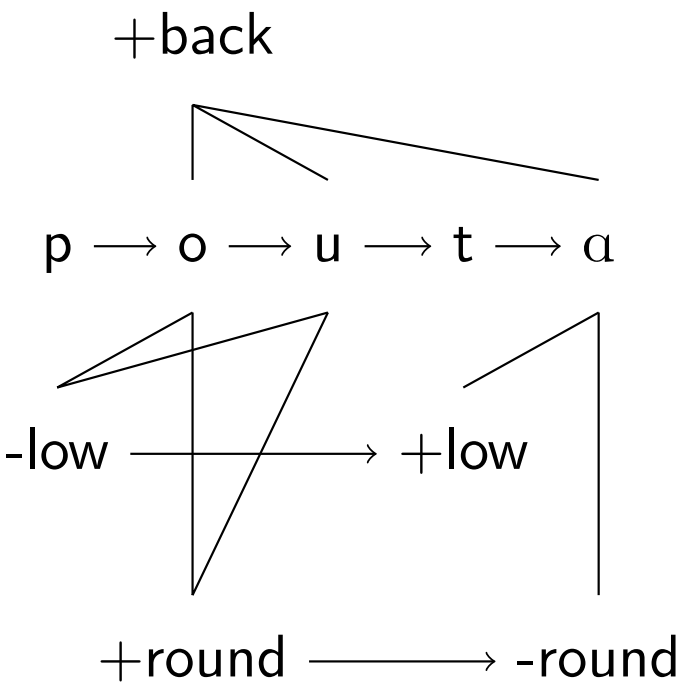
(3) Finnish FSCs



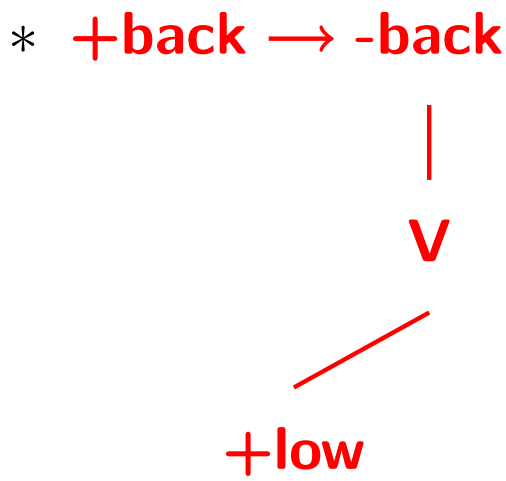
Transparent Vowels: Finnish

- A fully harmonic word does not violate any Finnish FSCs

[pouta] 'fine weather'



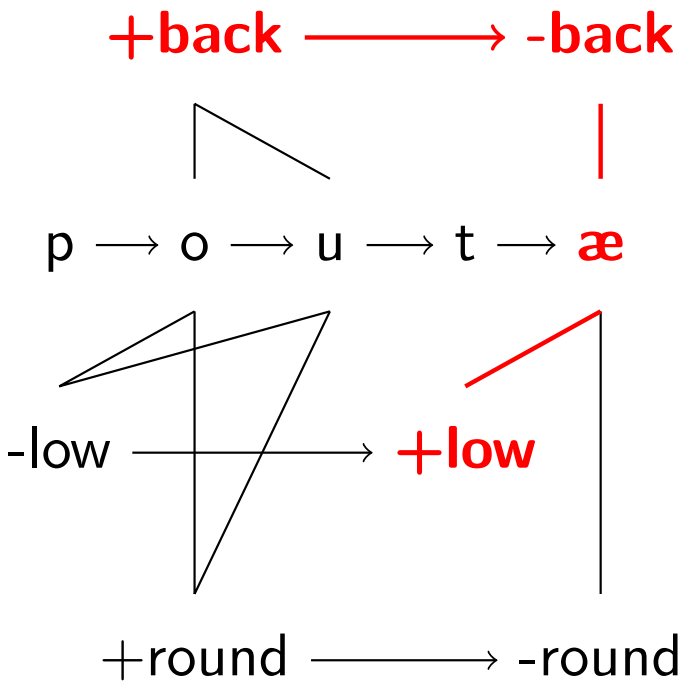
Finnish FSC



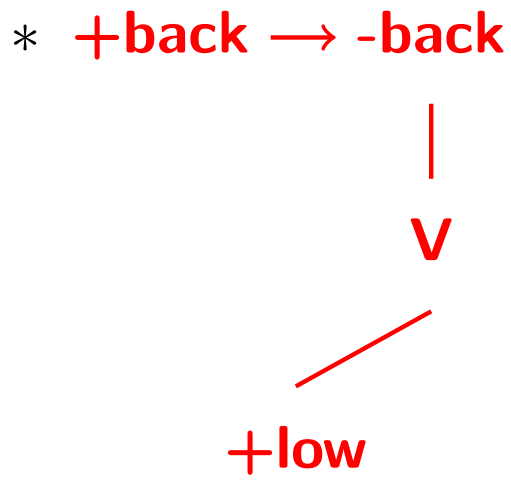
Transparent Vowels: Finnish

- A disharmonic word is ungrammatical because it contains the forbidden substructure of (3a)

Ungrammatical disharmonic word



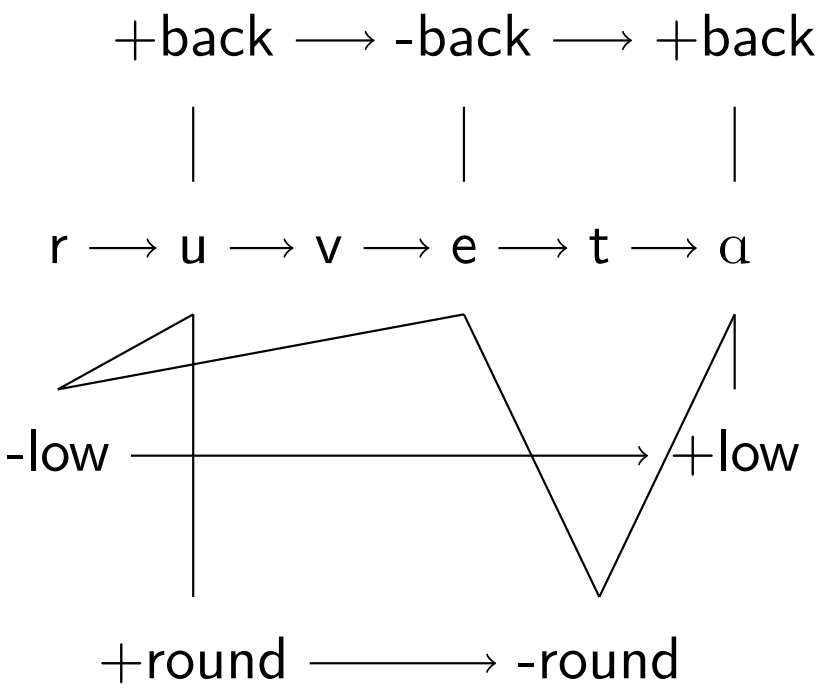
Finnish FSC



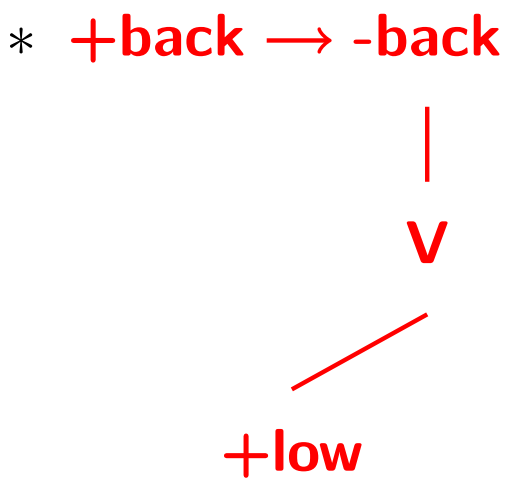
Transparent Vowels: Finnish

- Transparent vowels [i, iː, e, eː] are associated to a feature *on each feature tier*

[ruveta] 'start'



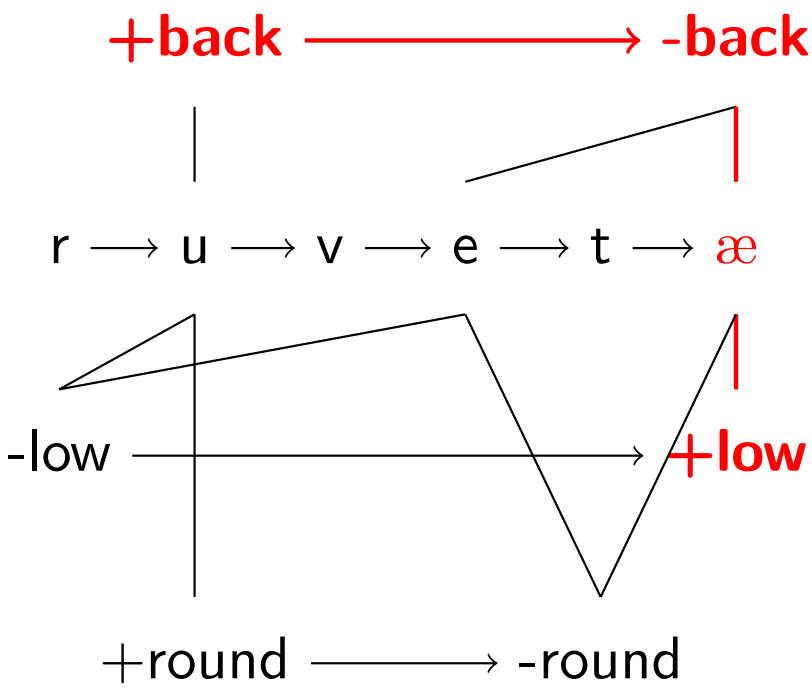
Finnish FSC



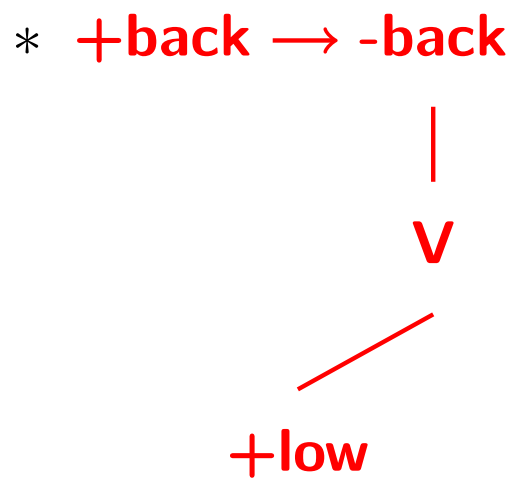
Transparent Vowels: Finnish

- A disharmonic word with a transparent vowel is ungrammatical because it contains the forbidden substructure of (3a)

Ungrammatical disharmonic word



Finnish FSC



Agreement is local

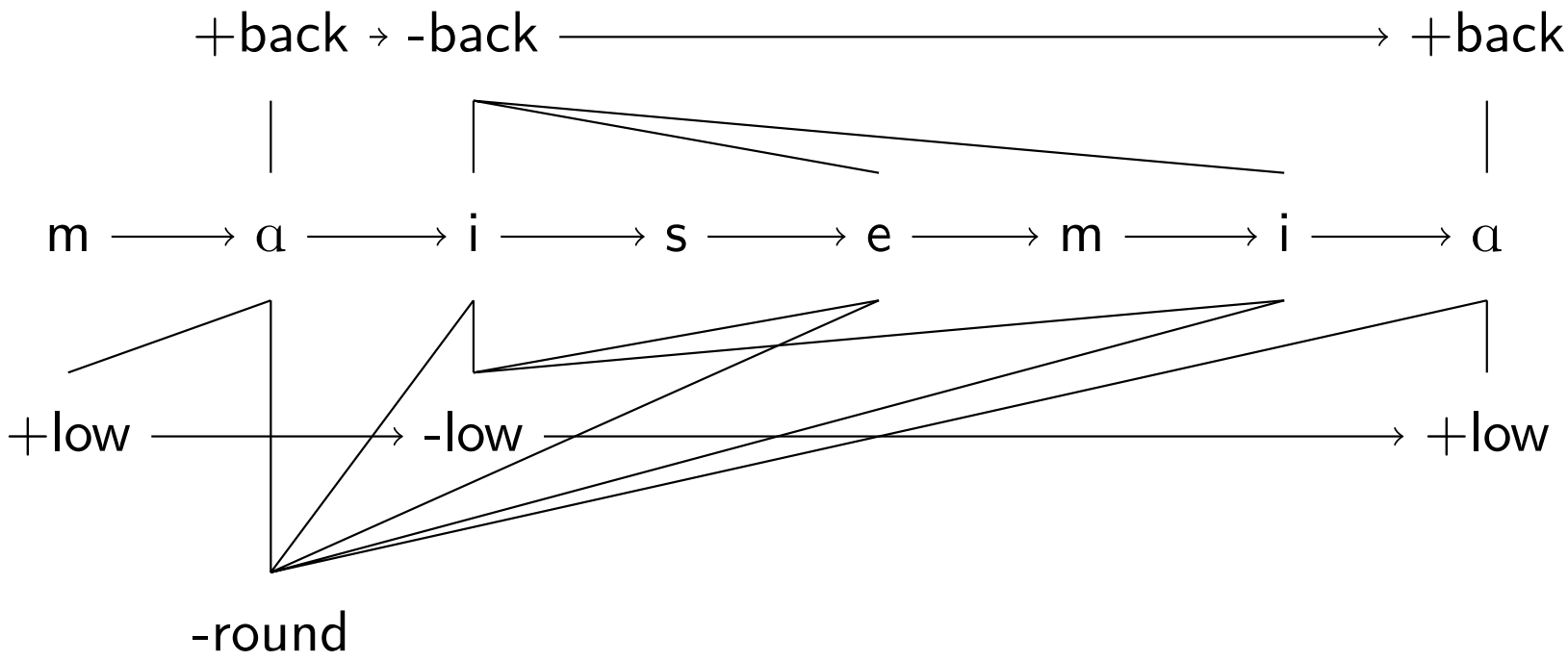
Agreement ARs consist of. . .

- Multiple iterations of the same feature, with a different intervening feature on the same tier
- Transparent vowels associated to a feature **on each feature tier**

Agreement is local

- Multi-tiered ARs make agreement patterns local
  - multiple association
  - successor relations on distinct tiers

[maisemia] 'scenery.plural.partitive'



Discussion

Well-formed multi-tiered surface ARs make vowel harmony strictly local

- ARs of vowel harmony utilize successor and association relations
- FSCs capture attested vowel harmony patterns that use neutral vowels: Akan, Finnish
- Transparent vowels do not require underspecification on the surface

Discussion

Multi-tiered ARs can also represent boundaries

- FSCs can capture morphologically-conditioned harmony: morpheme boundaries on feature tiers in Turkish
- FSCs over multi-tiered ARs can also capture an unattested pattern: sour grapes

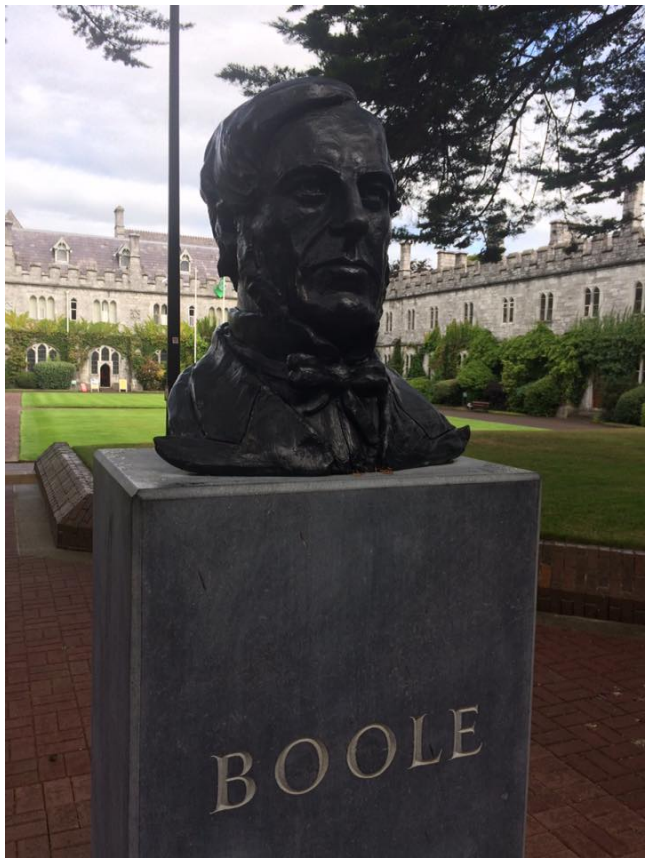
Future Work

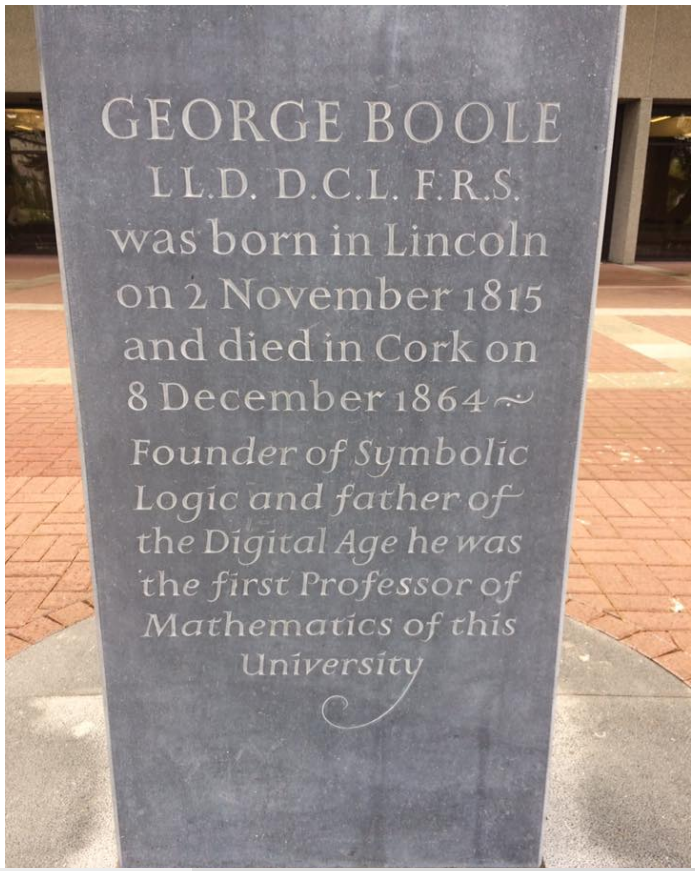
- Are multi-tiered ARs too powerful?
- Can multi-tiered ARs be restricted further to exclude unattested patterns?

Thank You

- QP committee: chair- Adam Jardine, Bruce Tesar, Simon Charlow
- Attendees of PhonX reading group and the 2nd Rutgers Computational Phonology Workshop

email: eileen.blum@rutgers.edu





References

- Aksënova, A. and Deshmukh, S. (2018). Formal restrictions on multiple tiers. Proceedings of the Society for Computation in Linguistics, 1(8).
- Archangeli, D., & Pulleyblank, D. (1994). Grounded phonology (Vol. 25). MIT Press.
- Clements, G. (1976). Vowel harmony in non-linear generative phonology: An autosegmental model.
- Goldsmith, J. (1976). Autosegmental phonology (PhD thesis). Massachusetts Institute of Technology.
- Heinz, J. (2010). Learning long-distance phonotactics. Linguistic Inquiry, 4(4), 623-661.
- Heinz, J., Rawal, C., & Tanner, H. G. (2011). Tier-based strictly local constraints for phonology. In Proceedings of the 49th annual meeting of the association for computational linguistics: Human language technologies: Short papers (Vol. 2). Association for Computational Linguistics.

References

- Jardine, A., & Heinz, J. (2015a). A concatenation operation to derive autosegmental graphs. In Proceedings of the 14th annual meeting on the mathematics of language (mol 2015) (pp. 139–151). Chicago, USA: Association for Computational Linguistics.
- Jardine, A. (2016). Locality and non-linear representations in tonal phonology (PhD thesis). University of Delaware.
- Jardine, A. (2017). The local nature of tone association patterns. Phonology, 34(2), 385–405.
- Nevins, A. (2010). Locality in vowel harmony. Linguistic Inquiry Monographs (Vol. 55). MIT Press.
- Prince, A., & Smolensky, P. (1993). Optimality theory: Constraint interaction in generative grammar (No. 2). Rutgers University Center for Cognitive Science.
- Ringen, C., & Heinamaki, O. (1999). Variation in finnish vowel harmony: An ot account. Natural Languge and Linguistic Theory, 17, 303–337.

References

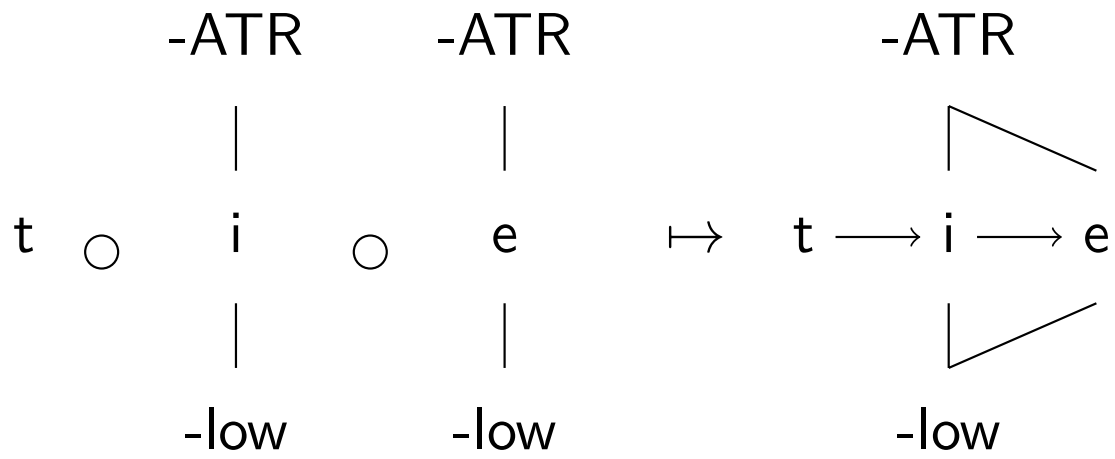
- Ringen, C., & Vago, R. (1998). Hungarian vowel harmony in optimality. Phonology, 15, 393–416.
- Rogers, J., Heinz, J., Fero, M., Hurst, J., Lambert, D., & Wibel, S. (2013). Cognitive and sub-regular complexity. Formal Grammar, 90–108.
- Välimaa-Blum, R. (1986). Finnish vowel harmony as a prescriptive and descriptive rule: An autosegmental account. In F. Marshall (Ed.), Proceedings of the third eastern states conference on linguistics. University of Pittsburgh.
- van der Hulst, H. (2017). A representational account of vowel harmony in terms of variable elements and licensing. In Approaches to hungarian (Vol. 15). John Benjamins Publishing Company.

Appendix

Concatenation

- NCC and OCP derived by concatenation operation ($\circ$) (Jardine & Heinz, 2015)
  - Concatenation merges autosegmental graph primitives

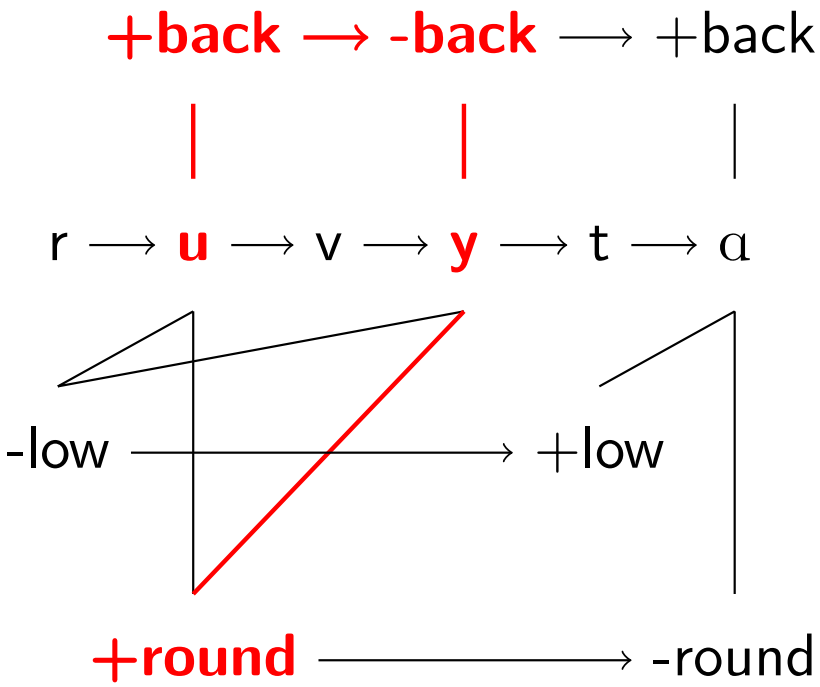
(4) Concatenation of adjacent autosegmental graph primitives



Transparent Vowels: Finnish

- This disharmonic word with a transparent vowel is ungrammatical because it contains the forbidden structure of (2a)

Ungrammatical disharmonic word



Finnish FSC

* +back → -back

V

+round

Morphologically-conditioned harmony: Turkish

Turkish back harmony:

- Suffix vowels are associated to the same back feature as the root-final vowel
- Multiple suffix vowels are associated to the same back feature
- Disharmonic roots

Morphologically-conditioned harmony: Turkish

Table 3: Turkish Vowels

	-back		+back	
+high	i	ü	ɨ	u
-high	e	ö	a	o
	-round	+round	-round	+round

- Suffix vowels are associated to the same back feature as the root-final vowel: [ip+ler] 'rope (Nom.pl)'
- All suffix vowels are associated to the same back feature: [kɨz+lar+ɨn] 'girls (gen.)'
- Disharmonic roots are also grammatical: [tatil] 'vacation'

Morphologically-conditioned harmony: Turkish

- Turkish FSCs forbid two back features in a successor relation with a morpheme boundary from having different values

(5)

(a) $*$ +back $\longrightarrow$ + $\longrightarrow$ -back

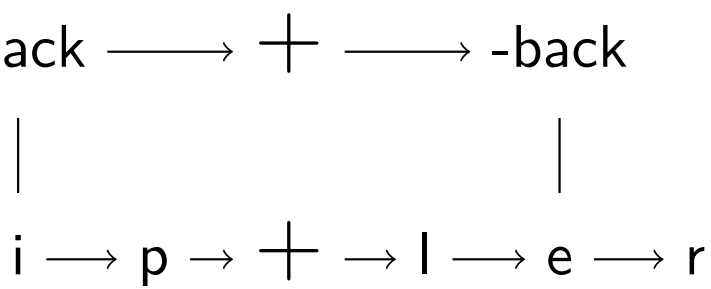
(b) $*$ **-back $\rightarrow$ + $\rightarrow$ +back**

Morphologically-conditioned harmony: Turkish

- FSC in (5b) allows a grammatical Turkish word

[ip+ler] 'rope (Nom.pl)

(a)



Turkish FSC

* **-back → + → +back**

Morphologically-conditioned harmony: Turkish

- and (5b) rules out an ungrammatical word that contains the forbidden substructure