Vowel Harmony is Local

Eileen Blum

Rutgers University

NecPhon MIT Nov. 4, 2018

Introduction

- A unified theory of surface markedness constraints captures a variety of vowel harmony patterns

Introduction

- A unified theory of surface markedness constraints captures a variety of vowel harmony patterns
- Vowel harmony analysed as a phonotactic constraint rather than a transformation from an underlying form into the surface form (Goldsmith, 1976; Clements, 1976; a.o.)

Introduction

- A unified theory of surface markedness constraints captures a variety of vowel harmony patterns
- Vowel harmony analysed as a phonotactic constraint rather than a transformation from an underlying form into the surface form (Goldsmith, 1976; Clements, 1976; a.o.)
- Transparent vowels don't rely on underspecification

Locality

- Autosegmental surface representations of vowel harmony patterns need two relations between elements: association ($|$) and adjacency ($\rightarrow$)

Locality

- Autosegmental surface representations of vowel harmony patterns need two relations between elements: association ($|$) and adjacency ($\rightarrow$)
- Attested patterns are captured by static surface well-formedness constraints: forbidden substructure constraints (FSCs) (Jardine 2016, 2017)

Autosegmental Representations (ARs)

- Tone patterns have been represented with two autosegmental tiers (Goldsmith, 1976; Jardine, 2016, 2017, etc.)

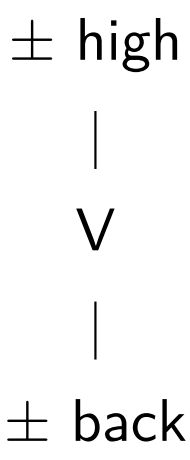
Autosegmental Representations (ARs)

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

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

(3)

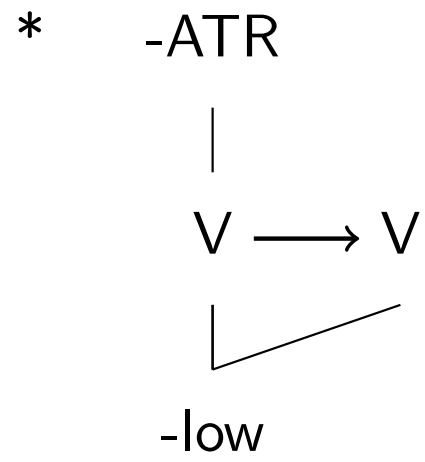


Representational Assumptions

Full Specification (FS):

- each featural element must be associated to at least one vowel

(4) Violates FS

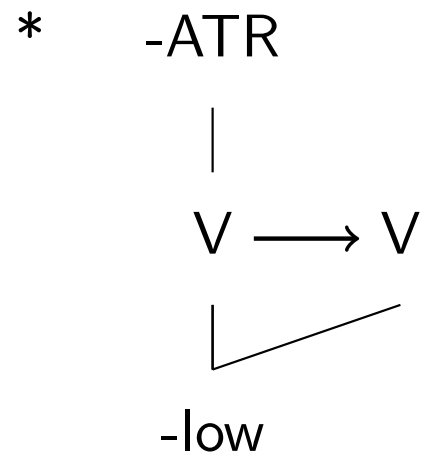


Representational Assumptions

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

(5) Violates FS

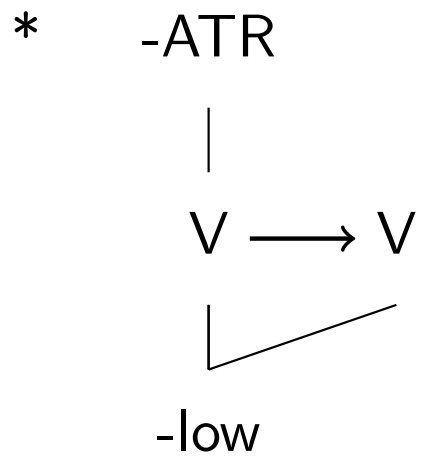


Representational Assumptions

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

(6) Violates FS



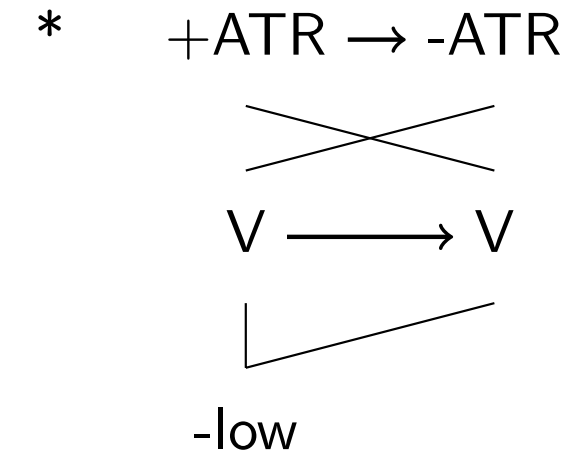
- consonants are not associated to vowel features

Representational Assumptions

No Crossing Constraint (NCC):

- association lines between the segmental tier and a feature tier never cross

(7) Violates NCC

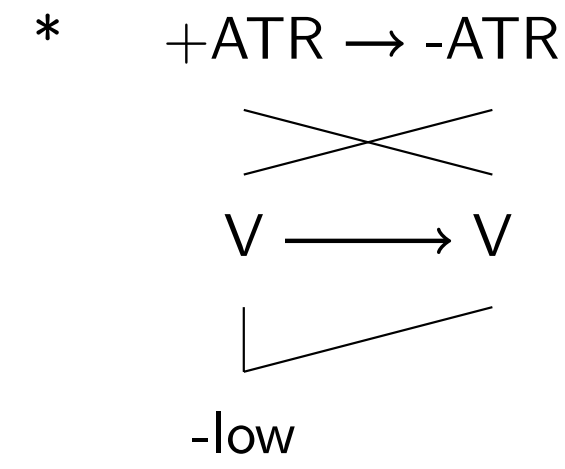


Representational Assumptions

No Crossing Constraint (NCC):

- association lines between the segmental tier and a feature tier never cross

(8) Violates NCC



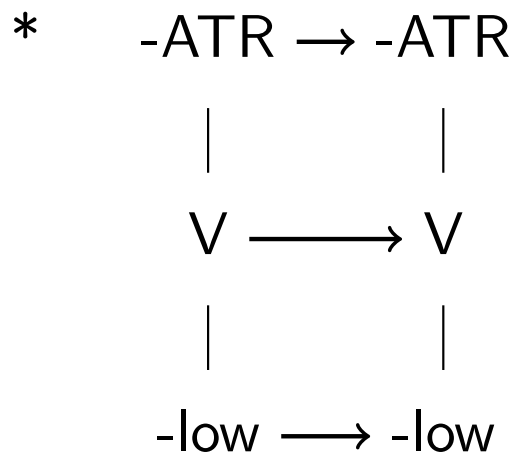
- FS and NCC prevent gapped structures (Archangeli & Pulleyblank, 1994; Ringen & Vago, 1998)

Representational Assumptions

Obligatory Contour Principle (OCP):

- adjacent featural elements must be distinct

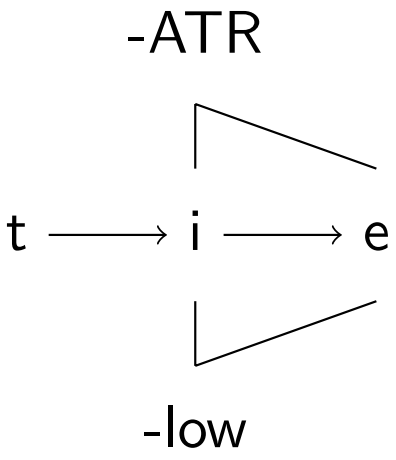
(9) Violates OCP



Representational Assumptions

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

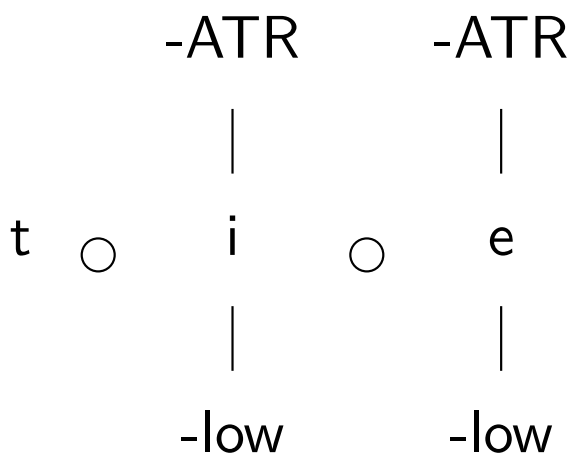
(10)



Concatenation

- NCC and OCP derived by concatenation operation ($\circ$) (Jardine & Heinz, 2015)
  - Concatenation merges autosegmental graph primitives, like (1)

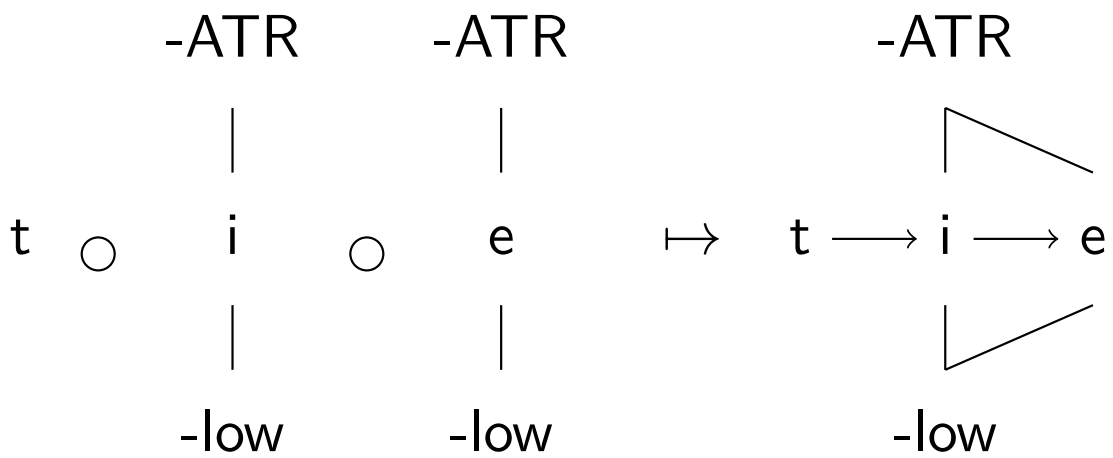
(11) Concatenation of adjacent autosegmental graph primitives



Concatenation

- NCC and OCP derived by concatenation operation ($\circ$) (Jardine & Heinz, 2015)
  - Concatenation merges autosegmental graph primitives, like (1)

(12) Concatenation of adjacent autosegmental graph primitives



Terminology

- Assimilation: vowels have the same feature

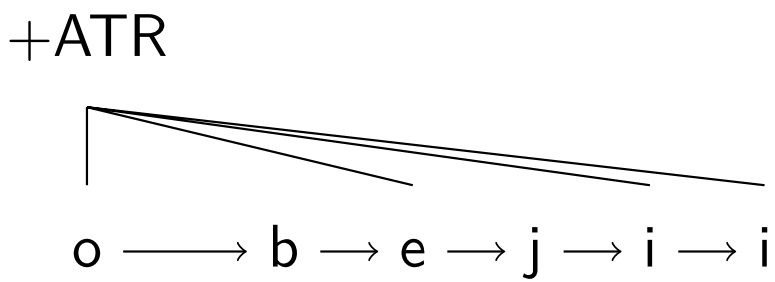
Terminology

- Assimilation: vowels have the same feature
- Spreading: multiple association

Terminology

- Assimilation: vowels have the same feature
- Spreading: multiple association

(15) Spreading



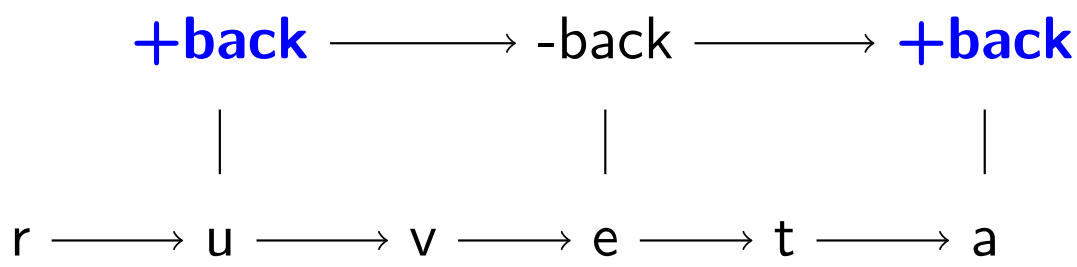
Terminology

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

Terminology

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

(17) Agreement



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

- Previous work applied logical descriptions of formal languages to phonological well formedness constraints (Heinz et al., 2011; Rogers et al., 2013)
- Forbidden substructure grammar generates a set of well-formed structures and rules out ill formed substructures, r_1 through r_n

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 generates a set of well-formed structures and rules out ill formed substructures, r_1 through r_n

(20) Forbidden substructure grammar (Jardine, 2017)
$\neg r_1 \wedge \neg r_2 \wedge \neg r_3 \wedge \ldots \wedge \neg r_n$

Forbidden Substructure Constraints (FSCs)

- Phonotactic restriction that combines the OT (Prince & Smolensky, 1993, 2004) representation of surface markedness (*) with forbidden substructures, like r_1

Forbidden Substructure Constraints (FSCs)

- Phonotactic restriction that combines the OT (Prince & Smolensky, 1993, 2004) representation of surface markedness (*) with forbidden substructures, like r_1
- FSCs can define locality because they refer to elements in a structure connected by an ordering or association relation

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)

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'

Blocking Vowels: Akan

Table 1: Akan Vowels

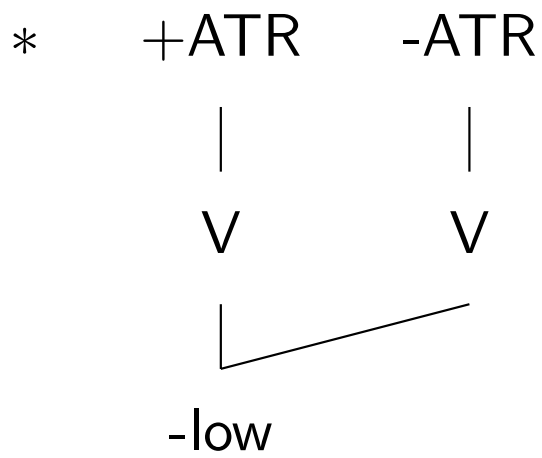
	+ATR	-ATR
-low	i	ɪ
	u	ʊ
	e	ɛ
	o	ɔ
+low	ɜ	a

- -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 adjacent vowels associated to a single -low feature from being associated to different ATR features

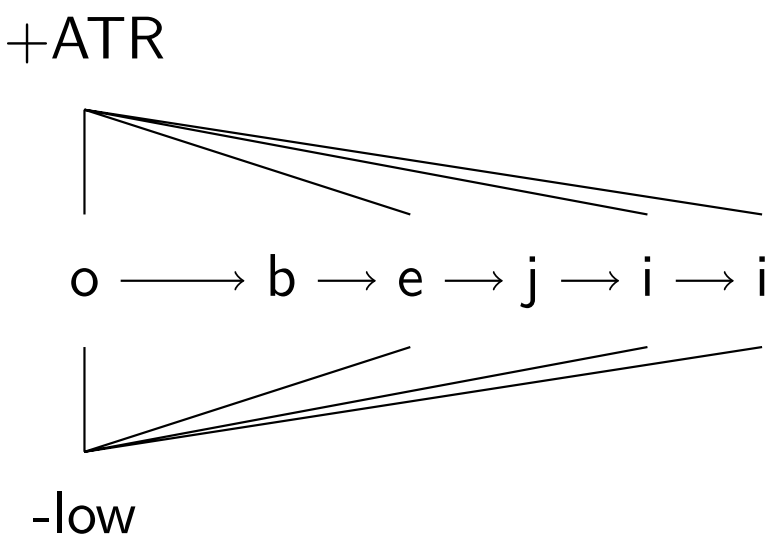
(21)



Blocking Vowels: Akan

- Akan FSC in (21) allows grammatical spreading AR

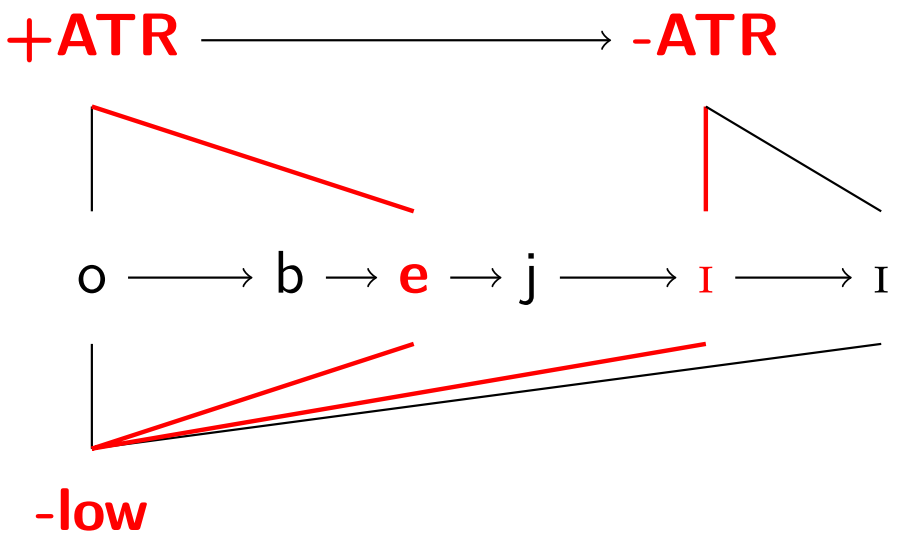
(22) [obejii] 'he came and removed it'



Blocking Vowels: Akan

- and (21) rules out an ungrammatical disharmonic AR because it contains the forbidden substructure

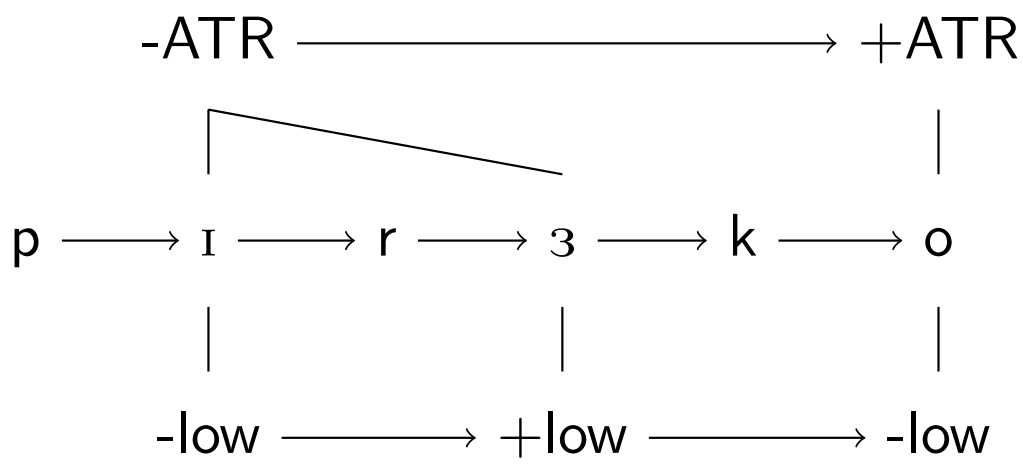
(23) Ungrammatical AR



Blocking Vowels: Akan

- The same FSC in (21) also allows a grammatical disharmonic AR with a +low vowel

(24) [pɪrɜko] 'pig'



Spreading is local

Spreading ARs...

- consist of an unbounded span of contiguous vowels associated to a single ATR feature node

Spreading is local

Spreading ARs...

- consist of an unbounded span of contiguous vowels associated to a single ATR feature node
- OR when two different ATR features are present, the features are adjacent to each other regardless of how many vowels are associated to each

Spreading is local

Spreading ARs...

- consist of an unbounded span of contiguous vowels associated to a single ATR feature node
- OR when two different ATR features are present, the features are adjacent to each other regardless of how many vowels are associated to each

- the FSC posited in (21) captures the Akan ATR harmony pattern for words with and without blocking +low vowels

Transparent Vowels: Finnish

Finnish Back harmony:

- Harmonizing vowels in a root are associated to a single back feature

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)

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)

- 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	

- Default -back suffix vowel: [tienæ] ‘road’

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	

- Default -back suffix vowel: [tienæ] 'road'
- Two harmonizing vowels in sequence are associated to a single back feature: [poutɑ] 'fine weather'

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	

- Default -back suffix vowel: [tienæ] 'road'
- 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'

Transparent Vowels: Finnish

Table 2: Finnish Vowels

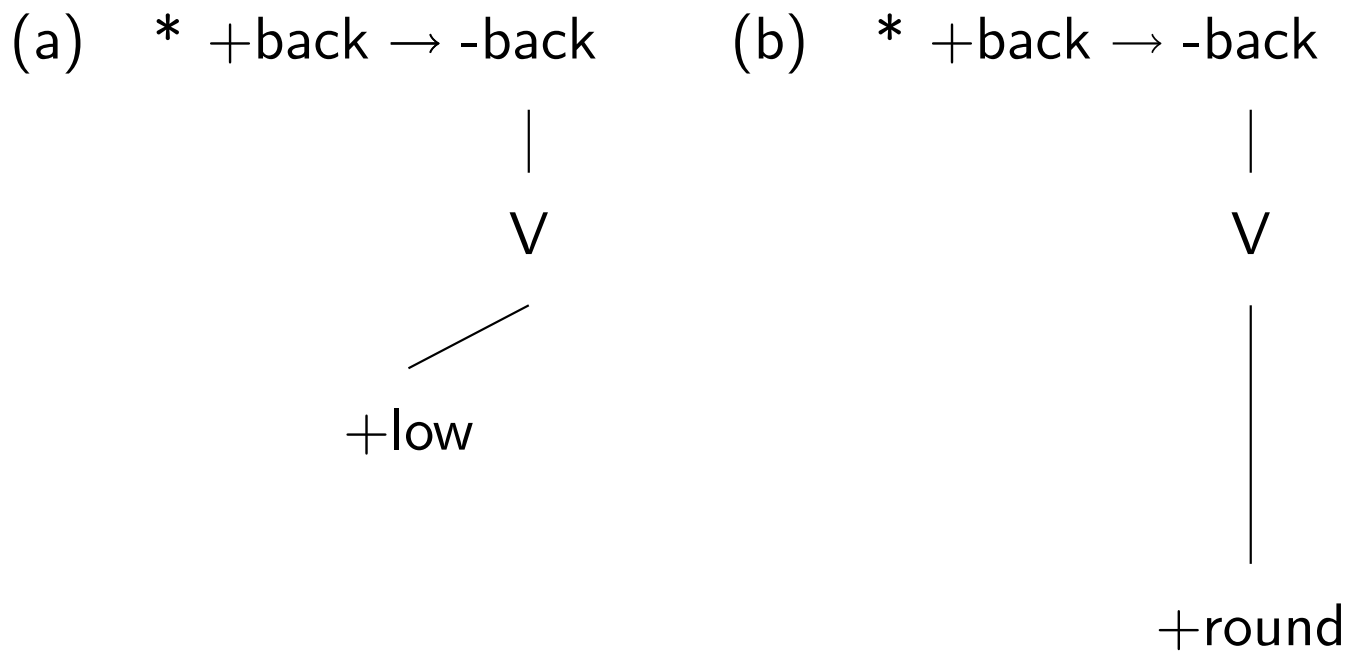
	-round	+round		
-low	i, iː	y, yː	u, uː	
	e, eː	ø, øː	o, oː	
+low		æ, æː	ɑ, ɑː	-round
	-back		+back	

- Default -back suffix vowel: [tienæ] 'road'
- 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 or +low vowels from being associated to a -back feature that succeeds a +back feature

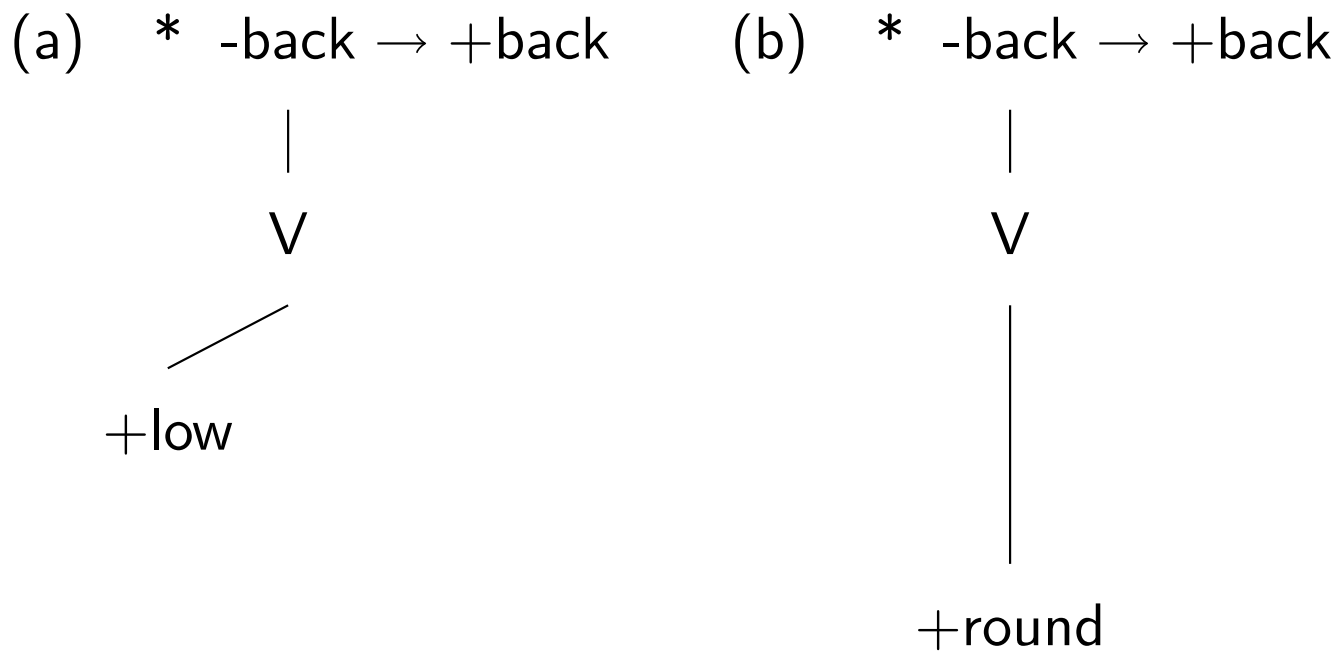
(25) Finnish FSCs



Transparent Vowels: Finnish

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

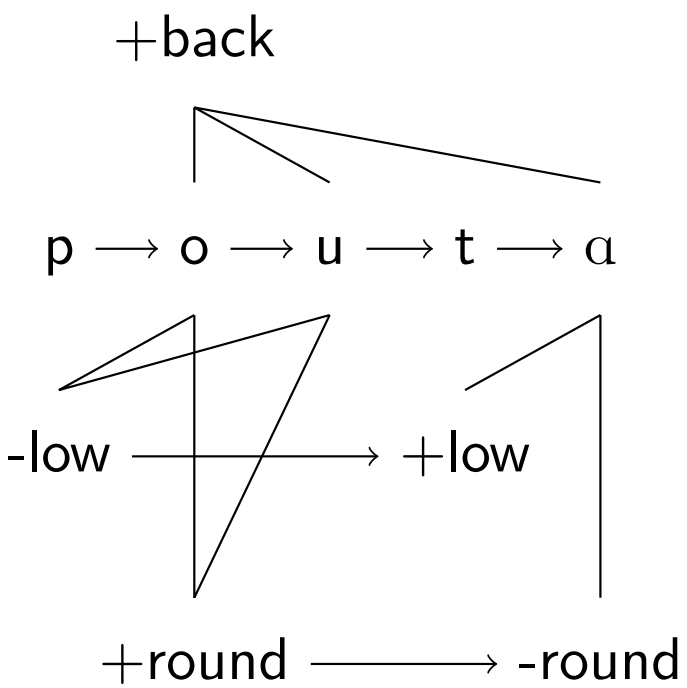
(26) Finnish FSCs



Transparent Vowels: Finnish

- A fully harmonic word does not violate any Finnish FSCs

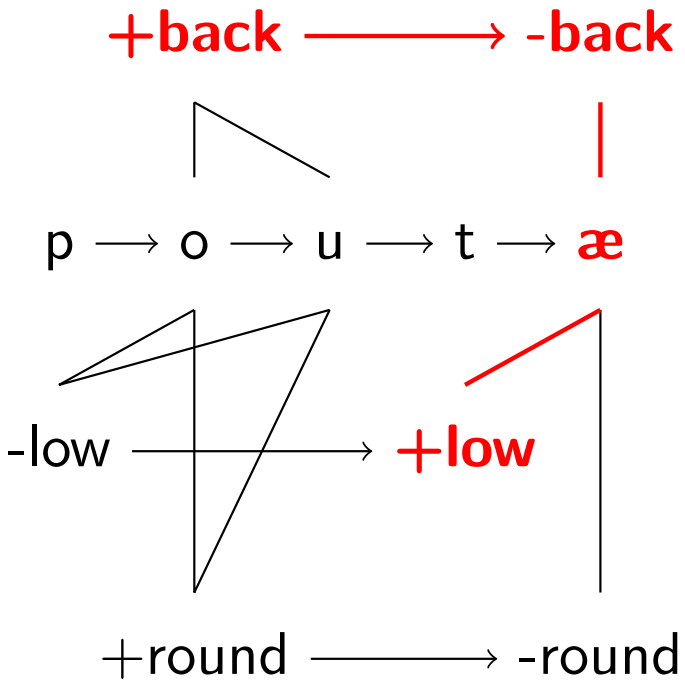
(27) [pouta] 'fine weather'



Transparent Vowels: Finnish

- A disharmonic word is ungrammatical because it contains the forbidden structure of (25a)

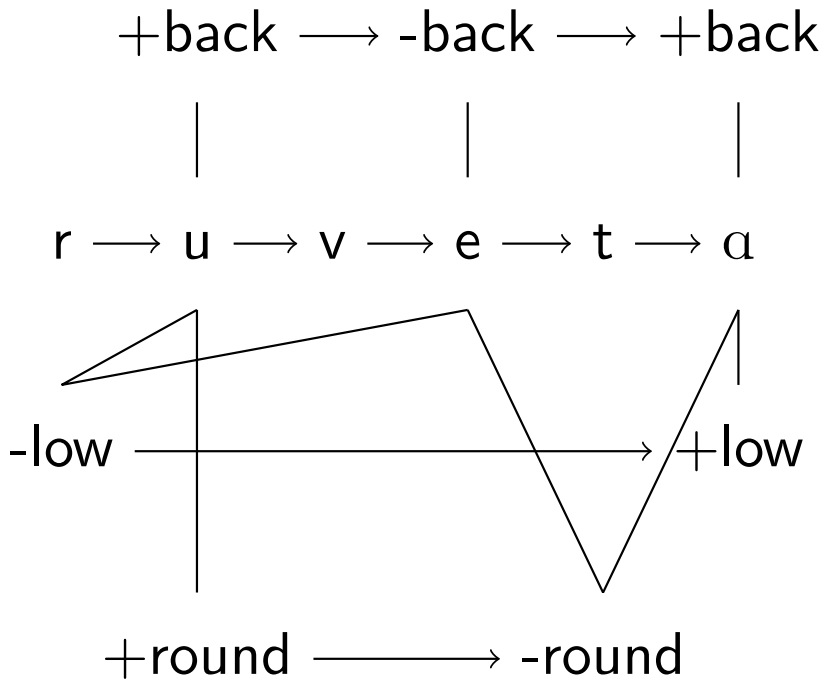
(28) Ungrammatical disharmonic word



Transparent Vowels: Finnish

- Transparent vowels [i, iː, e, eː] *do not require underspecification*

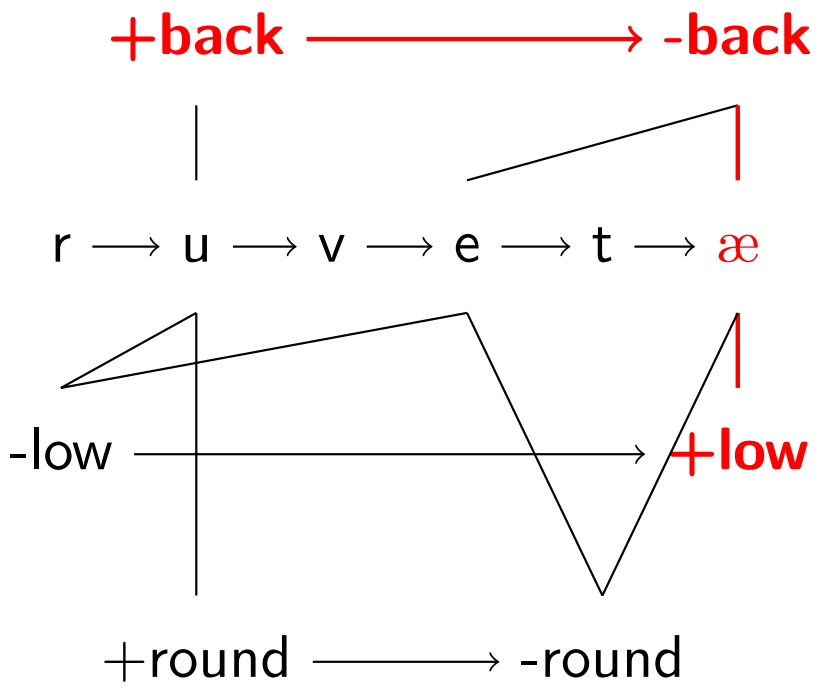
(29) [ruvetɑ] 'start'



Transparent Vowels: Finnish

- A disharmonic word with a transparent vowel is ungrammatical because it contains the forbidden structure of (25a)

(30) Ungrammatical word with transparent vowel



Agreement is local

Agreemnt ARs...

- consist of multiple iterations of the same feature, with a different intervening feature on the same tier

Agreement is local

Agreemnt ARs...

- consist of multiple iterations of the same feature, with a different intervening feature on the same tier
- result from adjacency between assimilating and intervening features

Agreement is local

Agreemnt ARs...

- consist of multiple iterations of the same feature, with a different intervening feature on the same tier
- result from adjacency between assimilating and intervening features

- The FSCs posited in (25) and (26) capture the Finnish back harmony pattern for words with and without transparent vowels

Discussion

- Well-formed surface ARs of vowel harmony are local
- Autosegmental representations of vowel harmony utilize adjacency and association relations
- FSCs capture attested vowel harmony patterns that use neutral vowels: Akan, Finnish
- Transparent vowels do not require underspecification

Discussion

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?

Future Work

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

Thank you

- QP chair- Adam Jardine
- QP committee- Bruce Tesar, Simon Charlow

References

- 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., 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.
- 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.

References

- 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.
- Ringen, C., & Vago, R. (1998). Hungarian vowel harmony in optimality. Phonology, 15, 393–416.

References

- 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.