Vowel colouring patterns in Bzhedugh Adyghe

Evidence for cumulative constraint interaction

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Console XXIV, York

Outline

Bzhedugh Adyghe

Adyghe:

- One of the four languages belonging to the Northwest Caucasian family
- 100,000 speakers in Russia (stable), 300,000 in Turkey (dwindling)
- Bi-/Trilingualism (Höhlig, 1997)

Bzhedugh:

- One of the four main dialects of Adyghe
- 15,000 speakers in 20 villages along the Pshish and Psekupe rivers in Adygea (Russia) (Sitimova, 2004)

Caucasian languages

taken from Gippert (2010),

http://titus.uni-frankfurt.de/didact/karten/kauk/kaukasf.jpg

Typological profile of Bzhedugh Adyghe

- Rich consonant inventory
- Small vertical vowel phoneme inventory
- Lack of lexical tone and stress
- Polysynthetic verbal morphology
- Absolutive/Ergative Alignment

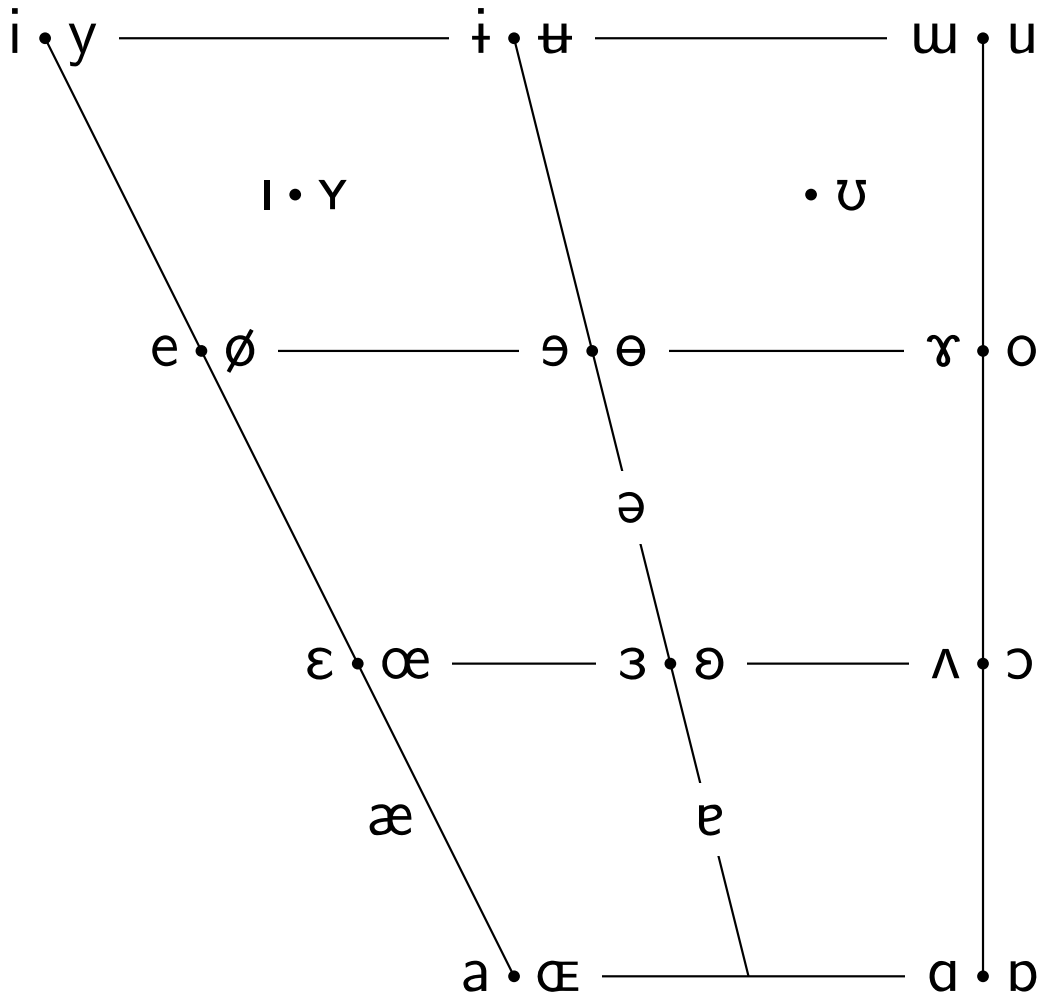
Consonant inventory

b	p	p^h	p’	$p’^w$	f	w	m	
d	t	t^h	t’	$t’^w$	r	n		
z	$\widebridge{dz}$	s	$\widebridge{ts}$	$\widebridge{ts^h}$	$\widebridge{ts’}$			
ʒ	$\widebridge{dʒ}$	ʃ	$ʃ^h$	$\widebridge{tʃ}$				
$ʒ^j$	$\widebridge{dʒ^j}$	$ʃ^j$	$ʃ^{jh}$	$\widebridge{tʃ^j}$	$\widebridge{tʃ^{jh}}$			
ẑ	$ẑ^w$	$\widebridge{dẑ^w}$	ŝ	$ŝ^w$	$\widebridge{tŝ^w}$	ŝ’	$ŝ’^w$	$\widebridge{tŝ’^w}$
ɮ	ɬ	ɬ’						
j								
g∼ɣ	g^w	k^w	$k’^w$					
ʁ	$ʁ^w$	q	q^h	q^w	q^{wh}	χ	$χ^w$	
ħ								
ʜ								
ʔ	$ʔ^w$							

Vowel inventory

- Vowel phonemes: /ə, ɐ, a/ (Sitimova, 2004; Smeets, 1984)
- But: rich allophony

Vowel space



Vowel colouring and prosodic boundaries

- Coarticulation: overlapping of articulatory movements associated with separate sound segments (Hardcastle, 2006)
- Consonant-vowel interactions: consonants and vowels frequently assimilate or dissimilate in place to one another (Padgett 2011 a.o.)
- Degree of (phonetic) coarticulation and likelihood of (phonological) CV interactions decrease if prosodic boundaries intervene

Prosodic domains and prosodic boundaries

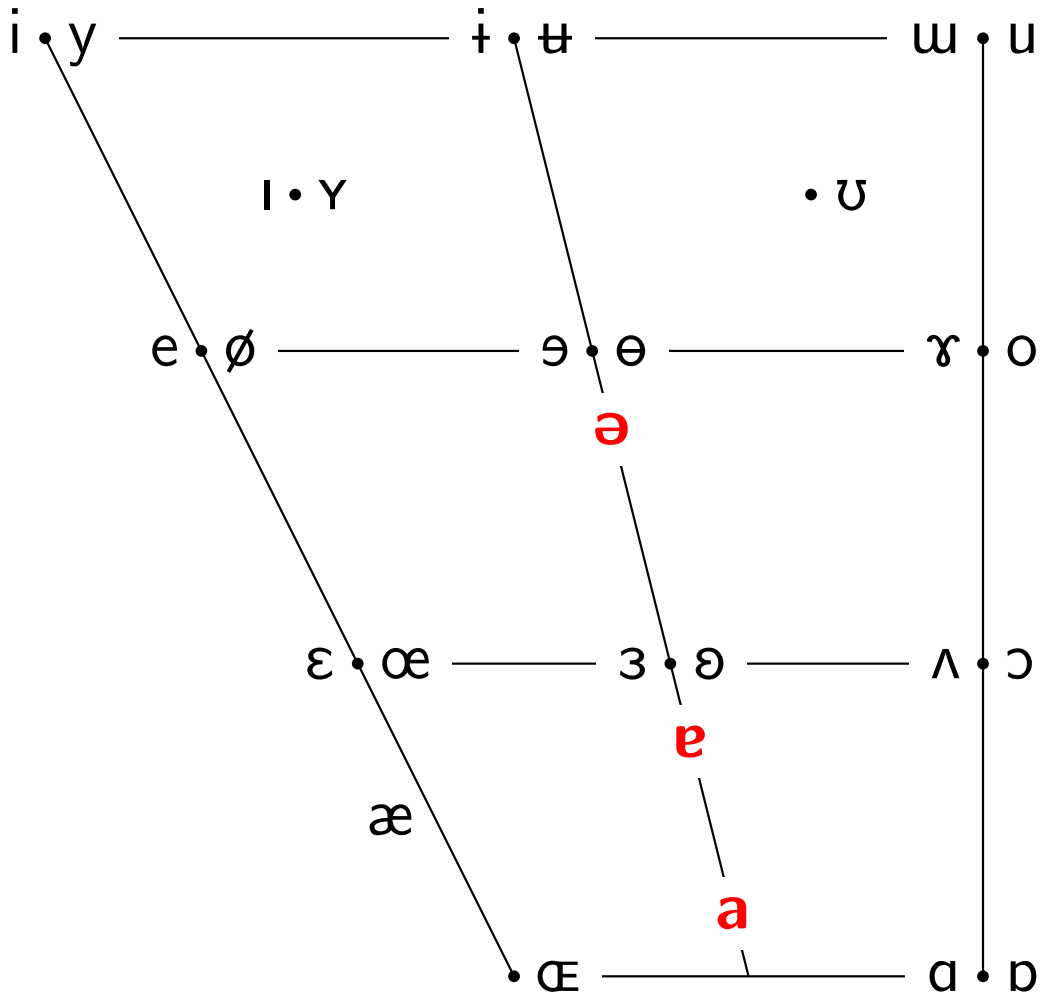
The prosodic hierarchy:

- Prosodic structure consists of prosodic categories of different types
- Prosodic categories are ordered in a hierarchy
- Competing theories about domains and labels (Jun, 2005; Nespor and Vogel, 2007; Selkirk, 1986)

Vowel colouring and prosodic boundaries

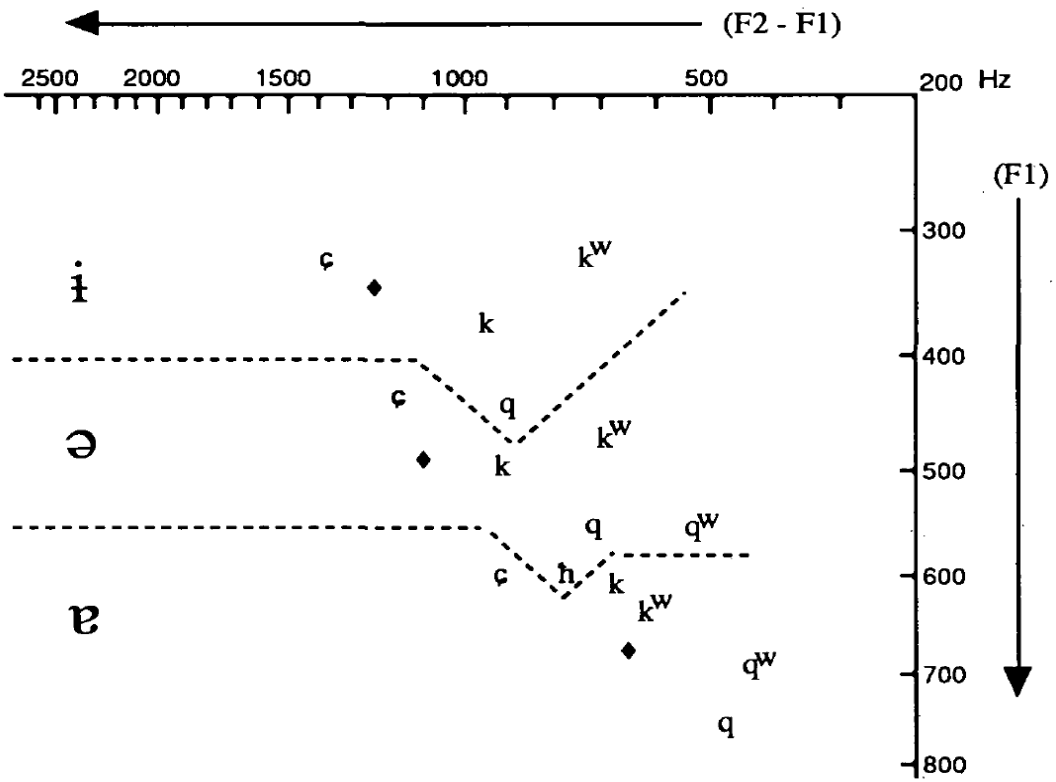
- Postboundary (domain-initial) vowels are coarticulated less with preceding vowels across a higher prosodic boundary (IP) than across a lower prosodic boundary (ip, Wd) (Cho, 2004)
- Lack of across-syllable coarticulation facilitates Wd boundary recognition (Mattys, 2004)
- Articulatory strengthening at prosodic domain boundaries (Fougeron and Keating, 1997)
- Single acoustic cues vs. subjective perceived boundary strength (Mann and Repp, 1981)

Vowel space: Bzhedugh vowel phonemes



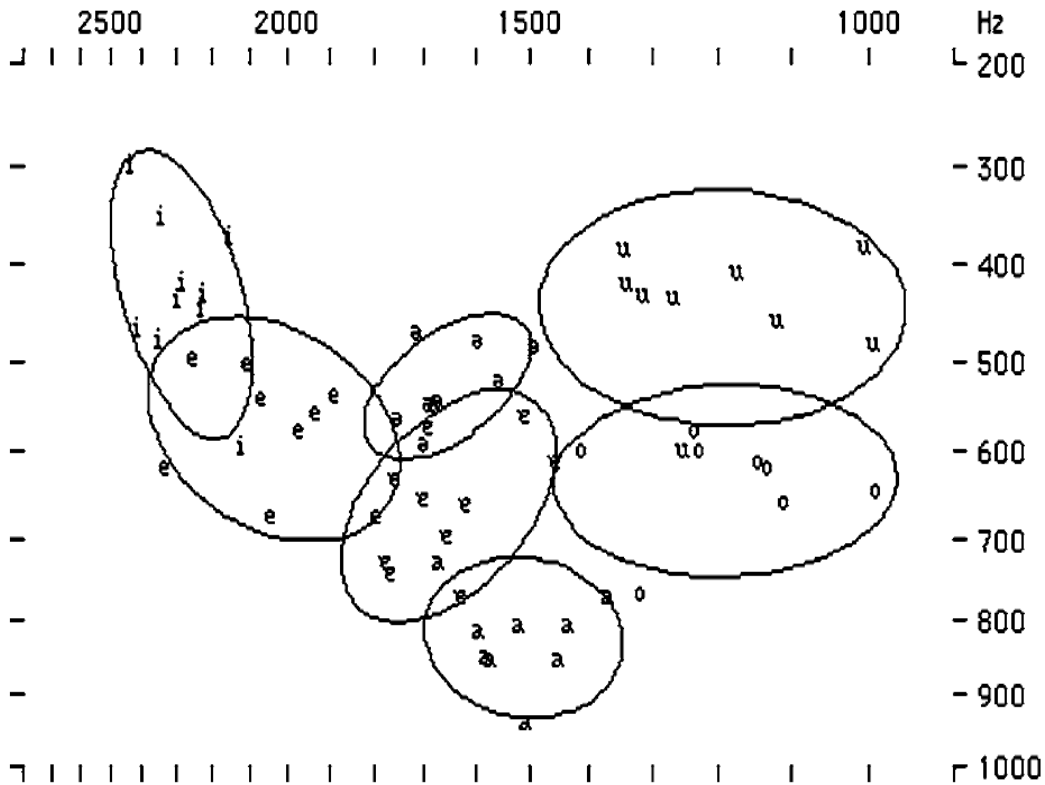
Vowel space

- Contextual allophony: preceding consonants in literary (Terek) Kabardian (Choi, 1991)



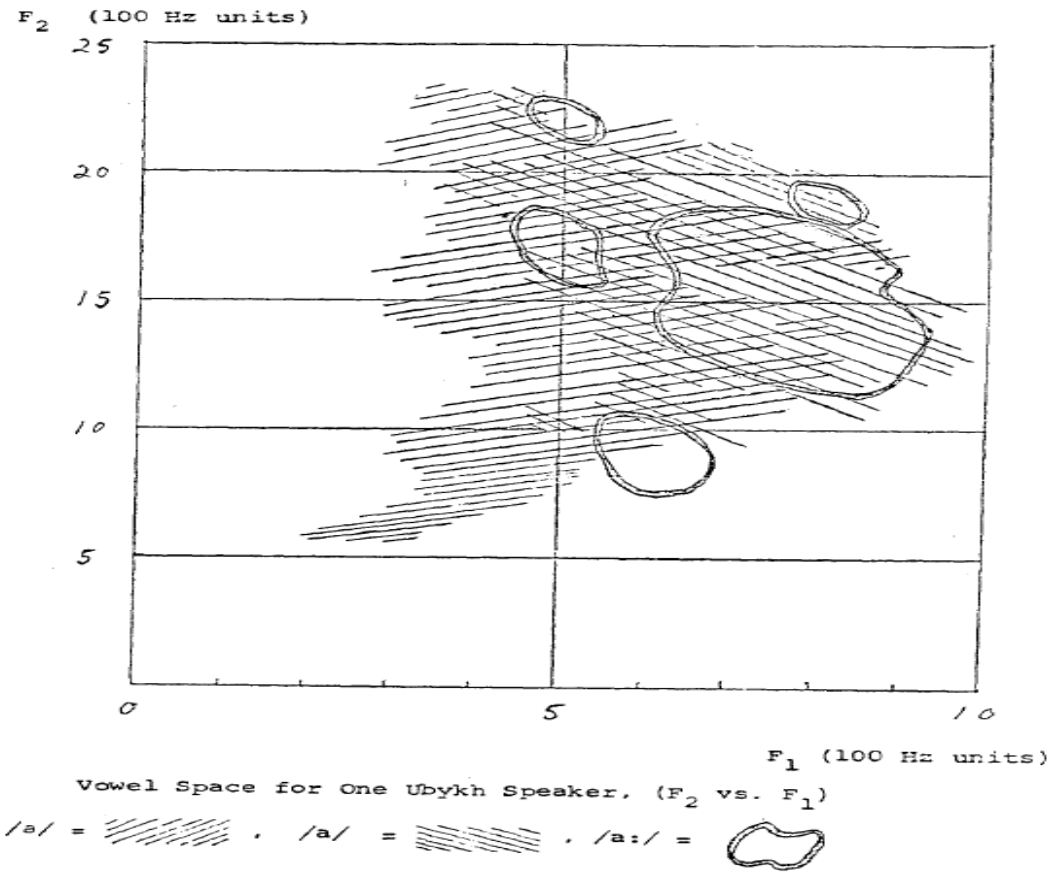
Vowel space

- Contextual allophony: preceding consonants in Turkish Kabardian (Gordon and Applebaum, 2006)



Vowel space

- ATB neutralisation in Ubykh (Colarusso, 1988)



Vowel colouring in Bzhedugh Adyghe

- Field trip to the village of Vochepshiy (Очэпщы/Вочепший), Russia, in July 2014
- Investigating the acoustic properties of /ə, ɐ/ in various phonetic environments
- Main findings:
  - Labialised consonants induce *rounding* of adjacent vowels in the same syllable
  - Coronal and palatalised consonants cause *fronting* of adjacent following vowels
  - Posterior consonants cause *backing* of adjacent preceding vowels
- On closer inspection, the *backing* pattern was found to depend on several different factors

Rounding, fronting and backing

(1)

a. /ŝʷəzə/ → [ŝʷʏ.zɪ]
'woman'

b. /qəq/ → [qɤq]
'stutterer'

c. /dɐʁʷ/ → [dœʁʷ]
'good (predicative form)'

d. /dɐʁʷə/ → [dɛ.ʁʷɵ]
'good (attributive form)'

- Various processes can apply simultaneously, e.g. *fronting* and *rounding* in (1-a)

Rounding, fronting and backing

(1)
a. /ŝʷəzə/ → [ŝʷʏ.zɪ]
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'good (attributive form)'

- *Rounding* is sensitive to the σ domain: heterosyllabic labialised consonants do not trigger rounding (1-d)

Rounding, fronting and backing

(1)
a. /ŝʷəzə/ → [ŝʷʏ.zɪ]
'woman'
b. /qəq/ → [qɤq]
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c. /dɐʁʷ/ → [dœʁʷ]
'good (predicative form)'
d. /dɐʁʷə/ → [dɛ.ʁʷɵ]
'good (attributive form)'

- A single adjacent uvular is not sufficient to trigger *backing* (1-c), and progressive fronting takes precedence over regressive *backing* (1-d)

Backing: complications

(2)
a. /χʷəʁɐ/ → [χʷo.ʁɐ]
'became'
b. /xɐkʷ/ → [xɘkʷ]
'land (predicate form)'
c. /ʁʷɐgʷə/ → [ʁʷɘ.gʷɵ]
'way (attributive form)'
d. /ʁʷɐgʷ/ → [ʁʷɔgʷ]
'way (predicative form)'

- *Backing* can apply when there is one posterior consonant in the same syllable and an adjacent one in a different syllable (2-a)

Backing: complications

(2)
a. /χʷəʁɐ/ → [χʷo.ʁɐ]
'became'
b. /xɐkʷ/ → [xɵkʷ]
'land (predicate form)'
c. /ʁʷɐgʷə/ → [ʁʷɵ.gʷɵ]
'way (attributive form)'
d. /ʁʷɐgʷ/ → [ʁʷɔgʷ]
'way (predicative form)'

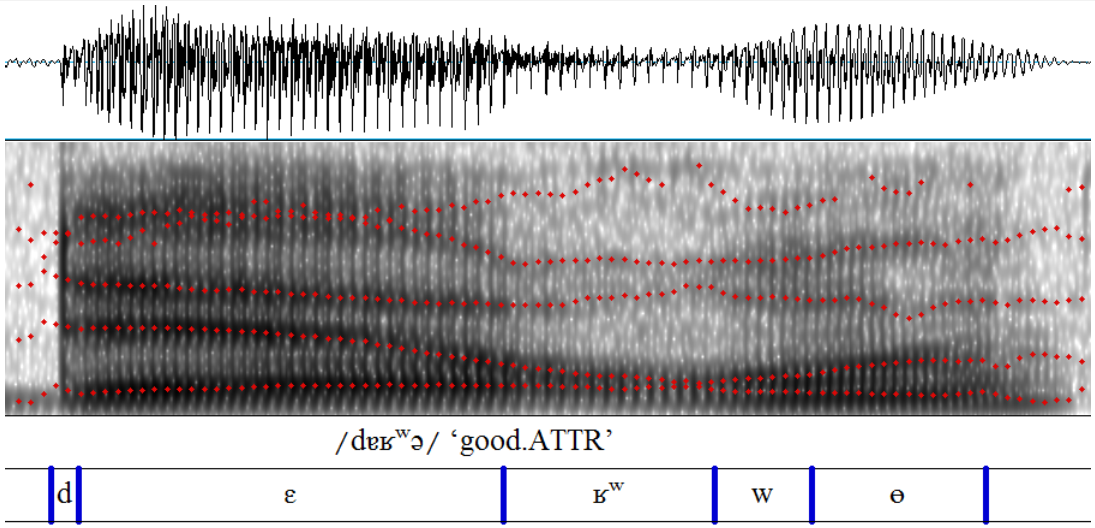
- However, this applies only to uvulars; two velars cannot trigger *backing* even when they are in the same syllable (2-b)

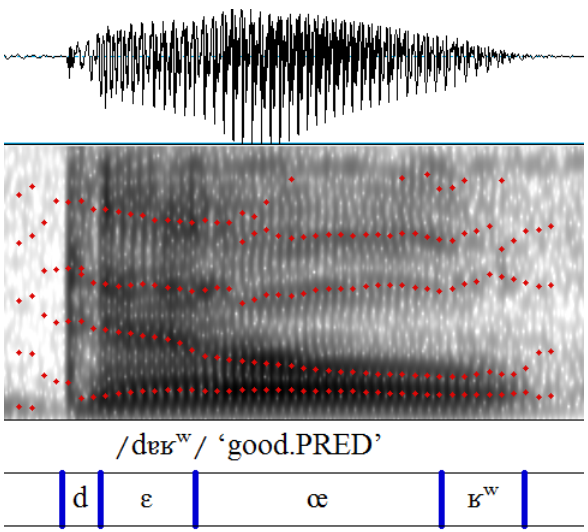
Backing: complications

(2)
a. /χʷəʁɐ/ → [χʷo.ʁɐ]
'became'
b. /xɐkʷ/ → [xɵkʷ]
'land (predicate form)'
c. /ʁʷɐgʷə/ → [ʁʷɵ.gʷɵ]
'way (attributive form)'
d. /ʁʷɐgʷ/ → [ʁʷɔgʷ]
'way (predicative form)'

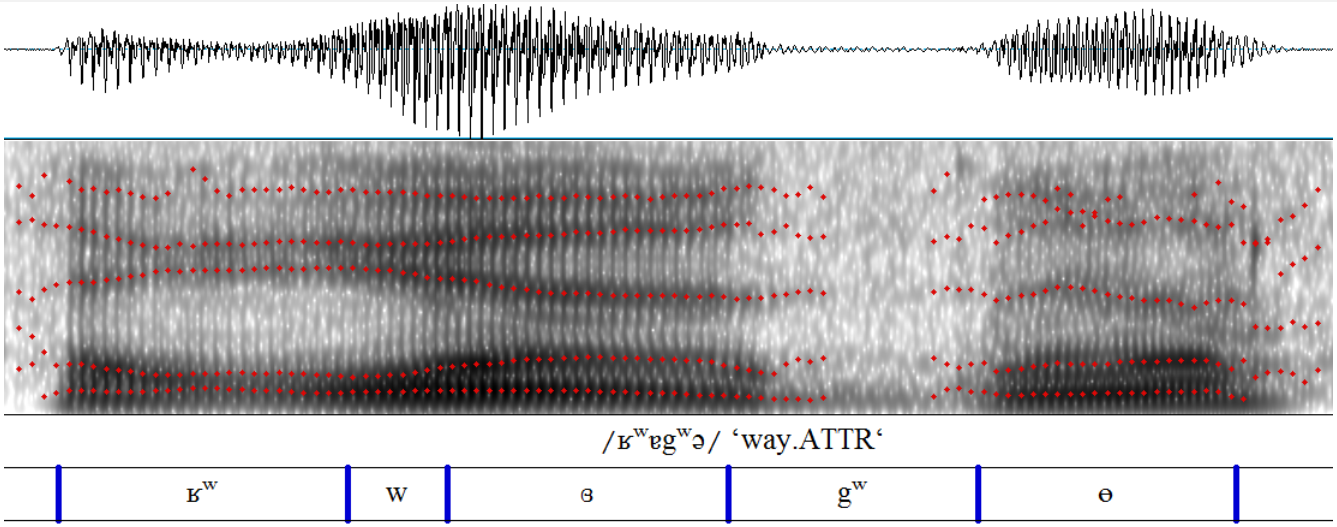
- When there are both a velar and a uvular adjacent to a non-low vowel, *backing* is triggered only if they are in the same syllable ((2-c)-(2-d))

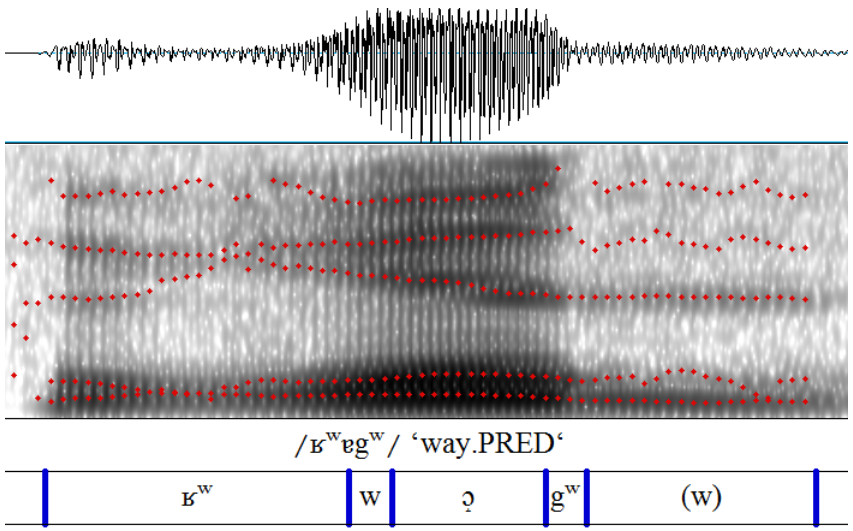
Acoustic evidence: Rounding





Acoustic evidence: Backing





Acoustic evidence

Average acoustic data from 2 speakers x 4 tokens:

Vowel	Stimulus	Gloss	F1_av	F1_std	F2_av	F2_std
ə	ŝʷəzə	woman	408	19	1750	141
ə	χʷəʁɐ	became	440	40	771	62
ɐ	ʁʷɐgʷə	way.ATTR	528	46	1270	190
ɐ	ʁʷɐgʷ	way.PRED	516	64	956	101

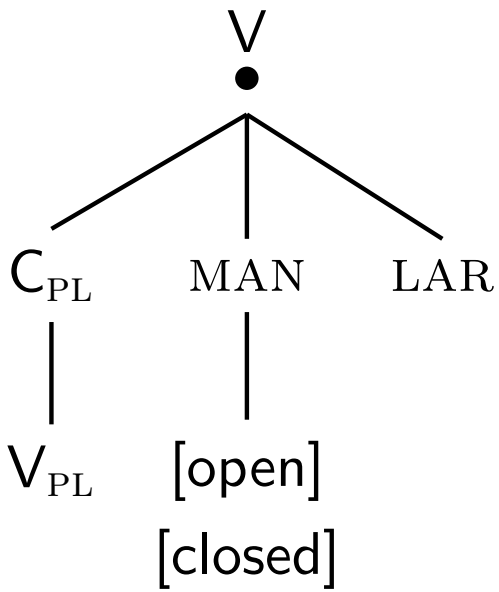
- Qualities of the allophonous variants are clearly distinct and not simply the results of coarticulatory effects

Basic Assumptions

- **Feature Geometry**: Segmental features are organised in a hierarchical structure, each structural node instantiates a separate tier (Clements and Hume, 1995; McCarthy, 1988; Morén, 2003)
- **Optimality Theory (OT)**: Competition of several output candidates from a single input, licensing of winner candidate is governed by ranked and violable constraints (Prince and Smolensky, 1993)
- **Harmonic Grammar**: Adding weights to constraints (Pater, 2009)

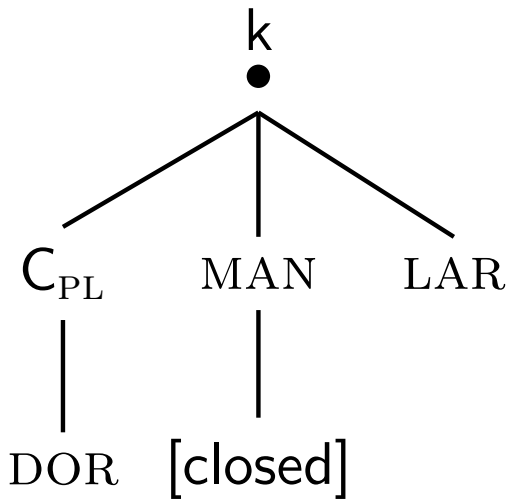
Feature Geometry: Underlying representations

Representation of vowels:



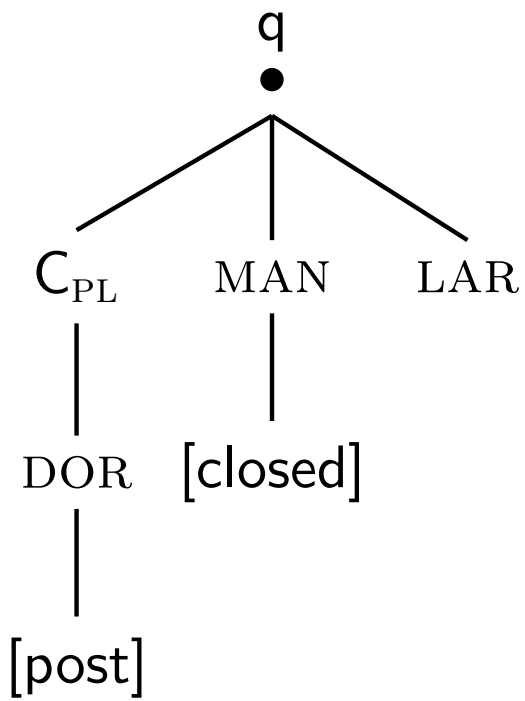
Feature Geometry: Underlying representations

Representation of velars:



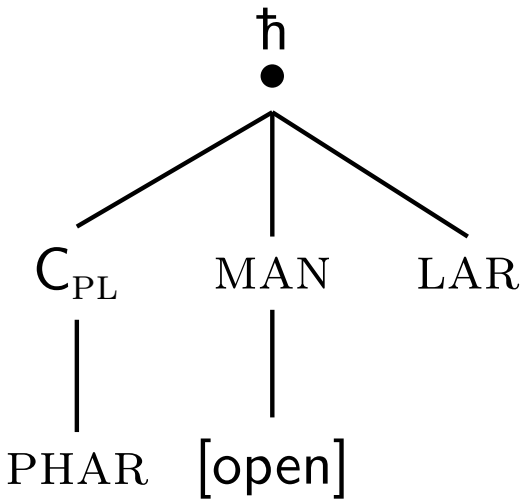
Feature Geometry: Underlying representations

Representation of uvulars:



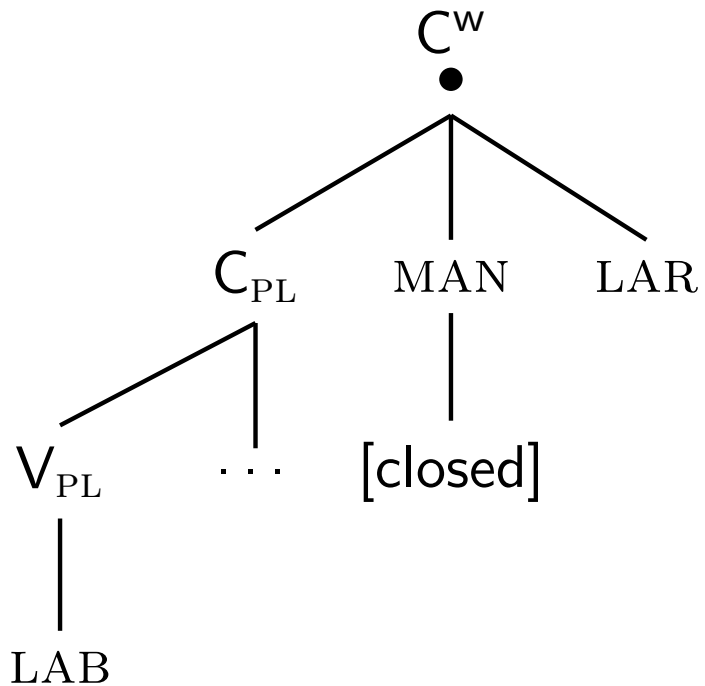
Feature Geometry: Underlying representations

Representation of pharyngeals:



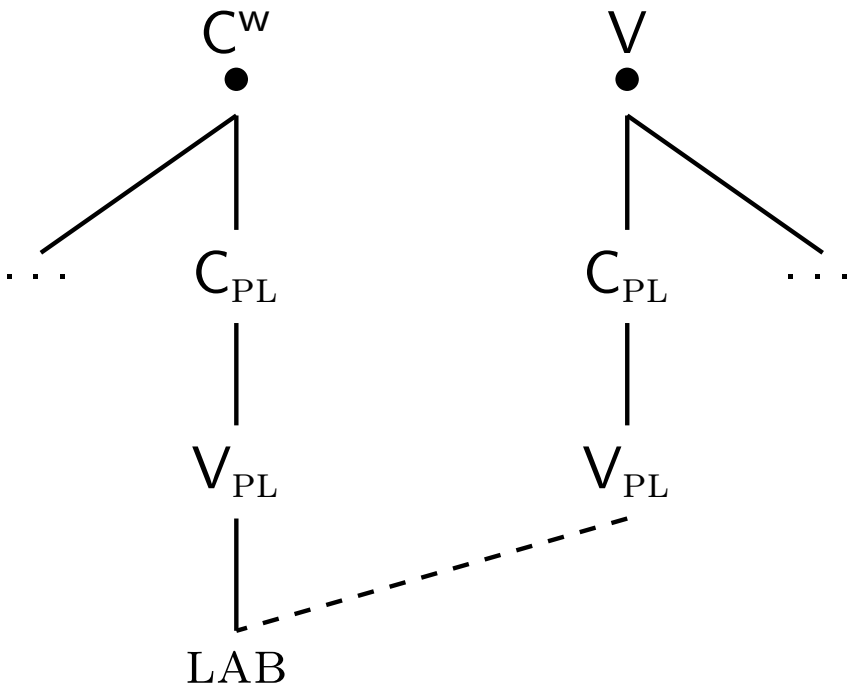
Feature Geometry: Underlying representations

Representation of labialised consonants:



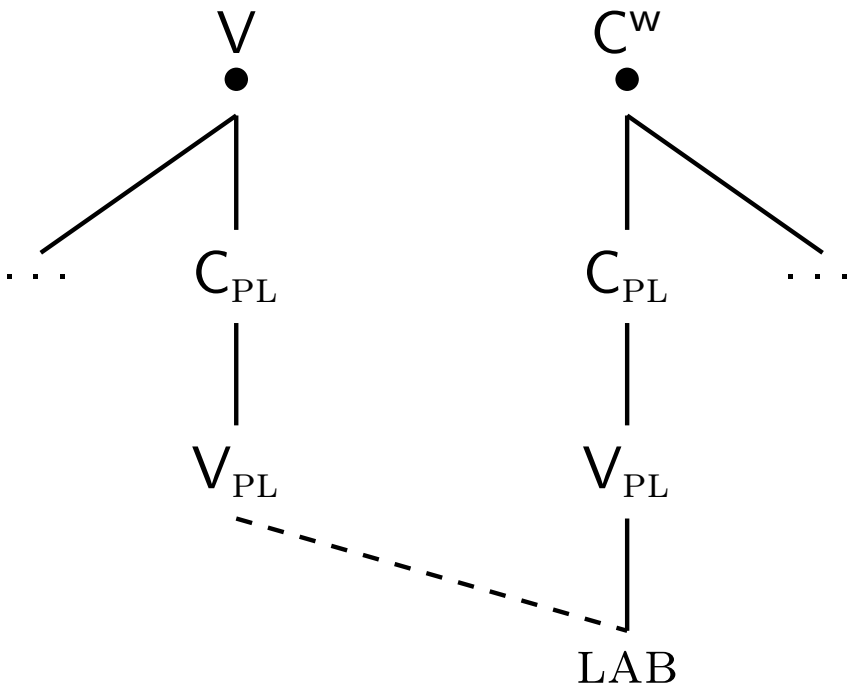
Feature Geometry: Spreading

Spreading of LAB from left to right:



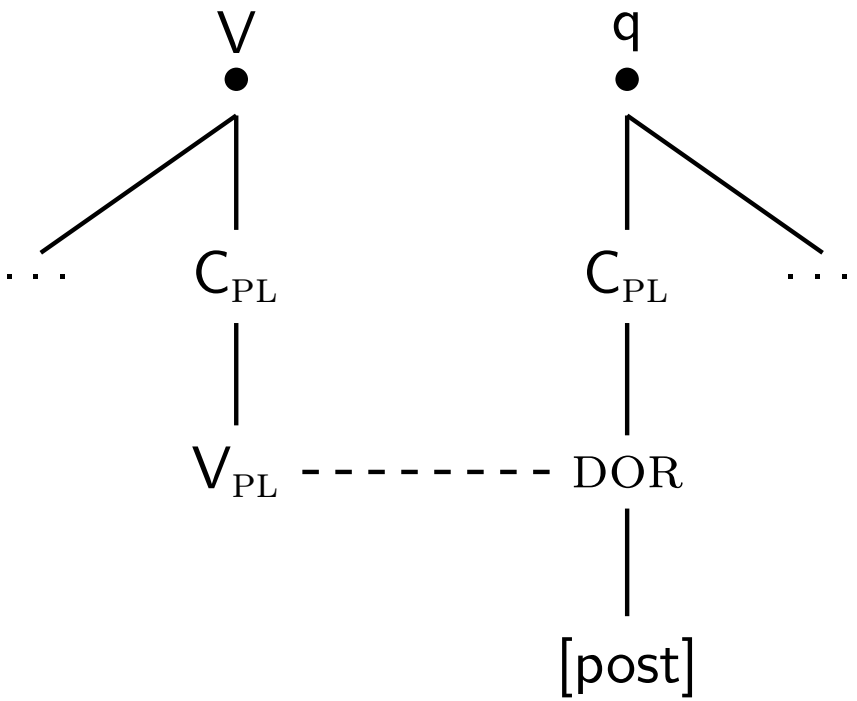
Feature Geometry: Spreading

Spreading of LAB from right to left:



Feature Geometry: Spreading

Spreading of DOR only from right to left:



Constraints

(3) $\textsc{Dep}^{\mathrm{V_{PL}}}_{\downarrow \mathrm{F}}$: Count one * for each epenthetic association line between a $\mathrm{V_{PL}}$ node and a segmental feature ("do not spread") (Trommer, 2011)

(4) $\textsc{Crisp}(\textsc{Edge})$: Count one * for each phonetically visible association line that links two elements dominated by different σ ("do not spread across syllable boundaries") (cf. Basri, Broselow, and Finer 1999)

(5) $\mathrm{A}(\textsc{gree})(\mathrm{X})$: Count one * for each adjacent VC or CV sequence that does not agree in X specifications

(6) $\mathrm{A}(\textsc{gree})(\mathrm{X})$-[p(osterior)]: Count one * for each pair of adjacent VC or CV sequences that do not agree in X and posterior specifications (cf. Kimper 2011)

Standard OT: Rounding

- *Rounding* (spread of LAB from one V_{PL} node to another) always applies within a syllable, but never across a syllable boundary
- Constraint ranking:

  $\textsc{Crisp} \gg \textsc{A}(\textsc{lab}) \gg \textsc{Dep}^{V_{PL}}_{\downarrow F}$

(7)		χʷəʁɐ	Crisp	A(LAB)	$\textsc{Dep}^{V_{PL}}_{\downarrow F}$
	a.	χʷə.ʁɐ		*!**	
☞	b.	χʷo.ʁɐ		**	*
	c.	χʷo.ʁʷɐ	*!	*	**
	d.	χʷo.ʁʷɘ	*!*		***

Standard OT: Backing

- *Backing* (spread of DOR from one C_{PL}node to a V_{PL} node) never applies if no [post] features are present (i.e. if only velars are involved)
- Constraint ranking:

$$\textsc{Dep}^{V_{PL}}_{\downarrow F} \gg \textsc{A}(\textsc{Dor})$$

(8)		xɐkʷ	Crisp	A(lab)	$\textsc{Dep}^{V_{PL}}_{\downarrow F}$	A(dor)
☞	a.	xɵkʷ				**
	b.	xɔkʷ			*!	

Standard OT: Backing

- *Backing* always applies if two dorsal consonants carrying [post] features (i.e. uvulars) are adjacent to a vowel, regardless of syllable boundaries
- Constraint ranking:
  A(Dor–[p]) ≫ Crisp

(9)		χʷəʁɐ	A(Dor–[p])	Crisp	Dep $^{V_{PL}}_{\downarrow F}$	A(Dor)
	a.	χʷə.ʁɐ	*!**			***
☹	b.	χʷo.ʁɐ	*!	*	*	*
☛	c.	χʷo.ʁʌ		*	**	

- Problem: ranking predicts overapplication
  (the same problem would arise if the two constraints were ranked the same)

Standard OT: Backing

- *Backing* always applies if two dorsal consonants carrying [post] features (i.e. uvulars) are adjacent to a vowel, regardless of syllable boundaries
- Alternative constraint ranking:
  $\textsc{Crisp} \gg \textsc{A}(\textsc{Dor}\text{–}[\text{p}])$

(10)		χʷəʁɐ	Crisp	A(Dor–[p])	Dep $^{V_{PL}}_{\downarrow F}$	A(Dor)
☛	a.	χʷə.ʁɐ		***		***
☹	b.	χʷo.ʁɐ	*!	*	*	*
	c.	χʷo.ʁʌ	*!		**	

- Problem: ranking predicts underapplication

Harmonic Grammar

- Harmonic Grammar (HG): a connectionist model allowing for the implementation of cumulative effects (Legendre, Miyata, and Smolensky, 1990; Pater, 2009)
- Constraints are not ranked, but bear weights
- Harmonic weights are calculated into harmony scores
- The harmony score of a candidate is the sum of a candidate's violations multiplied by the weight of the respective constraint:

(11) $$\mathcal{H}_X = \sum_{i=1}^{n} v_X(C_i) \times w(C_i)$$

Deriving backing: velars

- Velars are not enough: No change in quality when a vowel is surrounded by one or two velar consonants in the same σ

(12)	xɐkʷ ‘land.PRED’	DEP $^{V_{PL}}_{\downarrow F}$ *w*=3	CRISP *w*=1.5	A(DOR–[p]) *w*=1.5	A(DOR) *w*=1	H
☞	a. xɵkʷ				-2	-2
	b. xɔkʷ	-1				-3

Deriving backing: uvulars I

- Two uvulars cause change in quality to a vowel when in the same syllable

(13)	qəq 'stutterer'	DEP $^{V_{PL}}_{\downarrow F}$ *w*=3	CRISP *w*=1.5	A(DOR–[p]) *w*=1.5	A(DOR) *w*=1	H
	a. qəq			-2	-2	-5
☞	b. qʏq	-1				-3

Deriving backing: velars + uvulars

- Vowel quality is affected by a uvular and a velar only if both are in the same syllable as the vowel

(14)	ʁʷɐgʷ 'way.PRED'	DEP $^{V_{PL}}_{\downarrow F}$ *w*=3	CRISP *w*=1.5	A(DOR–[p]) *w*=1.5	A(DOR) *w*=1	H
	a. ʁʷɘgʷ			-1	-2	-3.5
☞	b. ʁʷɔgʷ	-1				-3

(15)	ʁʷɐgʷə 'way.ATTR'	DEP $^{V_{PL}}_{\downarrow F}$ *w*=3	CRISP *w*=1.5	A(DOR–[p]) *w*=1.5	A(DOR) *w*=1	H
☞	a. ʁʷɘ.gʷɵ			-1	-2	-3.5
	b. ʁʷɔ.gʷɵ	-1	-1			-4.5

Deriving backing: uvulars II

- Gang effect: Two uvulars cause quality change to a vowel even when not in the same syllable

(16)	χʷəʁɐ 'became'	DEP $V_{PL} \downarrow F$ *w*=3	CRISP *w*=1.5	A(DOR–[ɒ]) *w*=1.5	A(DOR) *w*=1	H
	a. χʷɵ.ʁɐ			-2	-2	-5
☞	b. χʷo.ʁɐ	-1	-1			-4.5

Cumulative interactions: summary

			DEP $^{V_{PL}}_{\downarrow F}$ w=3	CRISP w=1.5	A(DOR–[p]) w=1.5	A(DOR) w=1	H
(17)		xɐkʷ					
☞	a.	xɘkʷ				-2	-2
	b.	xɔkʷ	-1				-3
(18)		qəq					
	a.	qəq			-2	-2	-5
☞	b.	qɤq	-1				-3
(19)		ʁʷɐgʷ					
	a.	ʁʷɘgʷ			-1	-2	-3.5
☞	b.	ʁʷɔgʷ	-1				-3
(20)		ʁʷɐgʷə					
☞	a.	ʁʷɘ.gʷɵ			-1	-2	-3.5
	b.	ʁʷɔ.gʷɵ	-1	-1			-4.5
(21)		χʷəʁɐ					
	a.	χʷɵ.ʁɐ			-2	-2	-5
☞	b.	χʷo.ʁɐ	-1	-1			-4.5

The case of pharyngeals and glottals

- Pharyngeals and glottals cause backing in most varieties of Circassian, cf. the following examples from literary Adyghe (Colarusso, 1988; Smeets, 1984):

(22)
a. /ħən/ → [ħɤn] 'carry'
b. /ħɐ/ → [ħʌ] 'dog'
c. /ʔɐ/ → [ʔɑ] 'hand'

- In Bzhedugh, however, no such CV interaction is attested:

(23)
a. /ħən/ → [ħən] 'carry'
b. /ħɐ/ → [ħɐ] 'dog'
c. /ʔɐ/ → [ʔɐ] 'hand'

The case of pharyngeals and glottals

- Bzhedugh has been characterised as having a rather conservative phonology, both in terms of inventory and processes (Sitimova, 2004)
- One possible account: different underlying representations for posterior sounds in literary Adyghe and Bzhedugh (see Sylak-Glassman 2014 for detailed discussion of related cases)
- Alternatively, one could also derive the divergent pattern by adjusting the constraint weights for each dialect:

Literary Adyghe: $\text{w}(\text{A}(\textsc{Phar})) > \text{w}(\ \textsc{Dep}^{\text{V}_{\text{PL}}}_{\downarrow \text{F}}\ )$

Bzhedugh Adyghe: $\text{w}(\text{A}(\textsc{Phar})) < \text{w}(\ \textsc{Dep}^{\text{V}_{\text{PL}}}_{\downarrow \text{F}}\ )$

Typology of interactions

- Possible interaction types: excitatory/inhibitory, sequential/simultaneous (Müller, 2013)
- Inhibitory simultaneous interaction: $\textsc{Crisp} \gg \mathrm{A(X)}$ would block spreading over a syllable boundary in Standard OT
- Excitatory simultaneous interaction: gang effect of markedness constraints ($\mathrm{A(DOR)}$ and $\mathrm{A(DOR)}$–[p]) on faithfulness constraints ($\textsc{Crisp}$, $\textsc{Dep}$) in Harmonic Grammar
- Excitatory sequential interaction: Apocope gives rise to resyllabification and therefore feeds *backing*
- Vowel colouring in Bzhedugh seems to be opaque and transparent at the same time

Summary and outlook

- CV interactions in Bzhedugh are sensible to both segmental place features and prosodic domains
- Cumulative effects can be modelled within the theory of Harmonic Grammar
- Global and parallel evaluation of both local and non-local phenomena
- More acoustic data needed to further explore the phonetic details of the observed patterns

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