An Emergent Approach to the Guttural Natural Class

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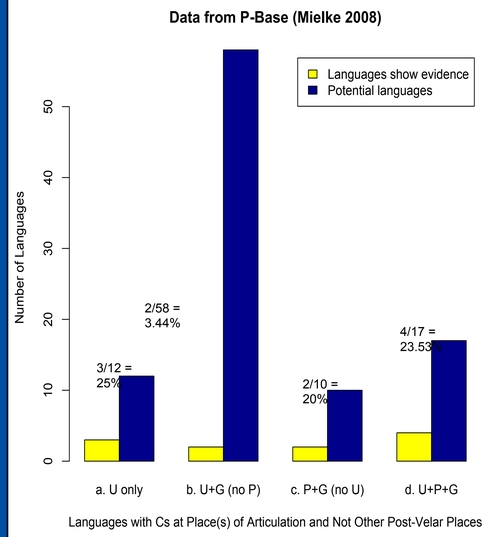
The Guttural Natural Class

- Hayward & Hayward 1989, McCarthy 1994: Uvular, pharyngeal, and glottal (post-velar) consonants form a natural class unified by *zone of constriction*
- *Evidence*: Effects that require phonology to refer to uvular, pharyngeal, and glottal consonants as a group. For example:
  - Most common evidence: Vowel effects (esp. lowering and backing to /a/)
  - Also: Root co-occurrence constraints, coda avoidance, degemination, transguttural harmony, etc.
- *Expectation*: If uvulars, pharyngeals, and glottals are part of a universal, innate guttural natural class, they should provide surface evidence (most likely lowering or backing effects on vowels) of the class, no matter which other post-velars are present.

Typological Data

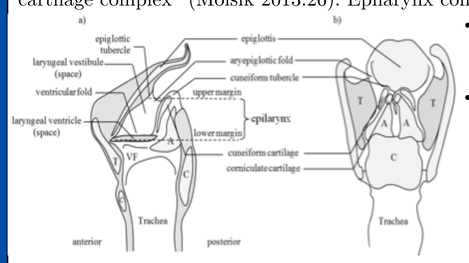


- U = Uvular, P = Pharyngeal, G = Glottal
- In languages with only one post-velar PoA, sought lowering or backing effects on vowels
- In languages with 2+ post-velar PoA, sought patterning together of 2+ places
- In 396 languages with only glottals, only 1 (Amharic) showed effects on vowels, but this is clearly historical residue (*χ,*h,*ħ > h; cf. how /h/ from *k > h causes no effects; Hayward & Hayward 1989)
- *Counter to expectation, uvulars and glottals almost never pattern together in the absence of pharyngeals*

- P-Base (Mielke 2008) under-reports cases of guttural natural class, based on new typological survey: No instances of all post-velar PoA patterning together, even though this is attested in Arabic (McCarthy 1994), Moses-Columbia (Rose 1996), etc.
- ***Claim:*** *Pharyngeal consonants pull other consonants into phonologically patterning with them. Uvulars can exceptionally do this. This happens for articulatory and acoustic reasons. The guttural natural class is phonetically "natural" but emergent.*

Pharyngeals "Pull In" Other Cs: Articulation

Pharyngeals (and epiglottals) are articulated by constricting the epilarynx, "the set of structures comprising the ventricular folds, aryepiglottic folds, epiglottis, and arytenoid cartilage complex" (Moisik 2013:26). Epilarynx constricts in two ways.

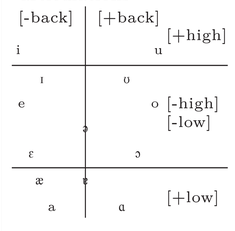


- Via intralaryngeal musculature
  - Affects vowels, not necessarily other consonants
- Via musculature outside larynx
  - Raises larynx, bringing glottis into contact with ventricular folds; affects glottal consonants
  - Retracts tongue, affecting uvular consonants which are articulated with tongue dorsum

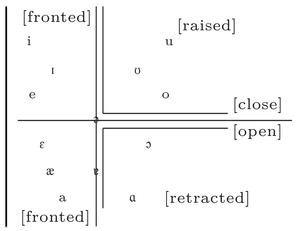
(Diagram from Moisik 2013:20)

Articulatory-Acoustic Interaction: Vowel Effects

- To relate vowel effects to articulation of post-velars, need to know vowels' articulations

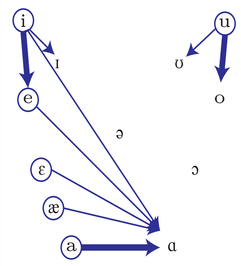


Standard Acoustic Vowel Features

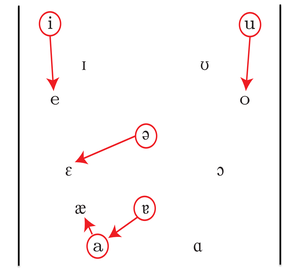


Articulatory Vowel Features (Esling 2005, Moisik 2013)

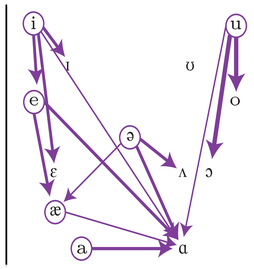
- [raised]: Tongue is back and up; main gesture for uvulars
- [retracted]: Tongue is back and down; gesture is synergistic with constriction of epilarynx
- Epilarynx constriction usually causes tongue retraction, but need not



Effects of Uvulars Only



Effects of Pharyngeals Only



Effects of All Post-Velars When Behaving as Class

- Effects on vowels based on new typological survey: Data for uvulars from 10 languages, for pharyngeals from 2, for post-velars behaving as a class from 9.
- Line thickness reflects number of attestations of the effect in survey. Circled vowels are those that undergo changes.
- Uvulars: Vowels assimilate toward [+back] and [retracted]
- Pharyngeals: Vowels assimilate toward [open] and [front]
- Post-Velars as a Class: Vowels assimilate toward [retracted] and [open]

Articulatory-Acoustic Similarity Scales

- Can construct scales of similarity to uvular and pharyngeal consonants starting with the most similarly articulated vowels going to least similarly articulated vowels
- Uvulars articulated with [raised]: tongue raising gesture, back and up
- Pharyngeals articulated with constriction of epilarynx, which usually causes tongue retraction, [retracted]

Similarity to Uvular Consonants

Step	*Features*	*Vowels*
1	raised, +back, +high	u
2	raised, +back	u, ʊ, o
3	+back	u, ʊ, o, ɔ, ɑ
4	open	ɛ, æ, a, ɐ, ɑ, ɔ
5	front	i, ɪ, e, ɛ, æ, a
6	close	i, ɪ, e, o, ʊ, u
7	front, close	i, ɪ, e
8	front, close, +high	i

Similarity to Pharyngeal Consonants

Step	*Features*	*Vowels*
1	open, retracted, +low	ɑ
2	open, retracted	ɑ, ɔ
3	open, +back	ɐ, ɑ, ɔ
4	open	ɛ, æ, a, ɐ, ɑ, ɔ
5	open, front	ɛ, æ, a
6	front	i, ɪ, e, ɛ, æ, a
7	close	i, ɪ, e, o, ʊ, u
8	front, close	i, ɪ, e
9	close, +high	i, u
10	front, close, +high	i

- Step 1 is most similar vowel; Step 8, 10 is the least similar
- Step 8, 10 for both is /i/: Its dissimilarity makes it a target for assimilation, but also allows it to sometimes block assimilatory processes (San'ani Arabic; Watson 2002:280)

Vowel Effects in Terms of Similarity Scales

- Vowels with the most similar articulation to consonants are minimally displaced to achieve minimum distinctiveness of the vowel and consonant
  - The step 1 vowels displace to step 2 (uvulars) or step 5 (pharyngeals)
- Uvulars often lower /u/ to [o] and pharyngeals front /ɐ~ɑ/ to [æ]
- Vowels with articulations that do not contain at least one of the features in step 1 or that contain an oppositely valued feature (or articulatorily opposite feature) can be targets of assimilation (step 4+ for uvulars, step 6+ for pharyngeals)
  - *Most Common Goal of Assimilation:* Retracted vowels, especially /ɑ/
  - Displaced vowels show element that is most important to retain: [+back] for uvulars, [open] for pharyngeals
  - [open] and [+back] vowels are the [retracted] vowels; [retracted] is strongly associated with pharyngeals; *retracted vowels are compatible with uv. and phar. Cs*

Deriving Vowel Effects

- *CV$_{\text{Step \#}}$ constraints penalize a consonant C (where U = Uvular, P = Pharyngeal) in the same syllable as a vowel from Step # of the consonant's similarity hierarchy
- Each hypothetical example shows displacement of a vowel that is too similar to the consonant as well as assimilation for vowels that are too dissimilar

- Before coda pharyngeals in Cairene Arabic: i → ɛ; u → o; ɐ → æ

/tiʕbuʕtɐʕ/	*PV$_{\text{Step 8}}$	ID(hi)	*PV$_{\text{Step 3}}$	ID(fr)	IDV
tiʕbuʕtɐʕ	2!		1		
tɛʕbuʕtɐʕ	1!	1	1		1
tɛʕboʕtɐʕ		2	1!		2
> tɛʕboʕtaʕ		2		1	3

- Adjacent to uvulars in Jaqaru: i → e; u → o; a → ɑ

/qiquqa/	*UV$_{\text{Step 1,8}}$	ID[hi]	*UV$_{\text{Step 5}}$	ID[fr,-bk]	IDV
qiquqa	2!		2		
qequqa	1!	1	2		1
qeqoqa		2!	2		2
> qeqoqɑ		2	1	1	3

Conclusions and Future Directions

- Although uvulars *and* pharyngeals can independently affect vowels, pharyngeals pull other places of articulation in to phonological patterns with them far more frequently than uvulars do: This is unexpected if there is a universal guttural natural class
- The post-velars patterning together is still "natural" since phonetics influences patterns: E.g. epilarynx connects the articulators of uv., phar., and glot. Cs
- Connections to epilarynx help explain how pharyngeals can "pull in" other consonants
- Step 1 vowels are "displaced" from post-velars with which they overlap too much in articulation; Vowels which share no articulatory overlap assimilate to post-velars
- Future work will focus on refining/expanding the similarity scales and the theoretical mechanisms for modeling the effects of post-velars on vowels
- Another future goal: Explain and model how uvulars and pharyngeals "pull in" other segments, including rhotics, labialized segments, ejectives

References

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