Morphological Consonant Mutation as Gestural Affixation

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CLS 50

1. Introduction

- Some languages signal morphological information through mutation of a root consonant
- Often analyzed as affixation of one or more 'floating' features rather than full segments (Lieber 1987; Akinlabi 1996; Zoll 1996; Wolf 2007)
- This analysis over-generates a typology of consonant mutation as not all features are attested as affixes in consonant mutation phenomena

> Main claim: Gestural representation of consonant-mutating affixes provides better fit to attested mutation phenomena

- It is possible to construct a grammar that operates over gestures and is able to account for various consonant mutation systems, including those that require complex temporal representations of speech

2. Consonant Mutation: An Overview

- Chaha (Gurage) uses labialization at the right edge of a word to signal third person masculine singular object (McCarthy 1983)

(1)

a.	danag 'hit'	danag^{w} 'hit him'
b.	nadaf 'sting'	nadaf^{w} 'sting him'
c.	nakab 'find'	nakab^{w} 'find him'

- Zoque (Mixe-Zoquean) uses palatalization at the left edge of a word to signal third person (Wonderly 1951)

(2)

a.	pata 'mat'	p^{j}ata 'his mat'
b.	mula 'mule'	m^{j}ula 'his mule'
c.	kama 'cornfield'	k^{j}ama 'his cornfield'
d.	hajah 'husband'	h^{j}ajah 'her husband'

- Affixation of floating features:
  - Chaha: [labial] (V-place) suffix
  - Zoque: [coronal] (V-place) prefix

- Affix landing sites show alternations when docking a floating feature with a consonant at the relevant edge of a root consonant results in an illicit segment

- Chaha labialization avoids coronals—will infix to avoid them and fail to surface in coronal-only forms

(3)	a. nakas 'bite'	nak^{w}as 'bite him'	*nakas^{w}
	b. kafat 'open'	kaf^{w}at 'open him'	*kafat^{w}
	c. sadad 'chase'	sadad 'chase him'	*sadad^{w}, *sad^{w}ad, *s^{w}adad

- Zoque palatalization avoids consonant clusters—will fail to surface in cluster-initial forms

(4)	a. plato 'plate'	plato 'his plate'	*pl^{j}ato, *p^{j}lato, *p^{j}ato, *plat^{j}o
	b. fruta 'fruit'	fruta 'his fruit'	*fr^{j}uta, *f^{j}ruta, *f^{j}uta, *frut^{j}a
	c. mwestra 'sample'	mwestra 'his sample'	*mw^{j}estra, *m^{j}westra, *m^{j}estra

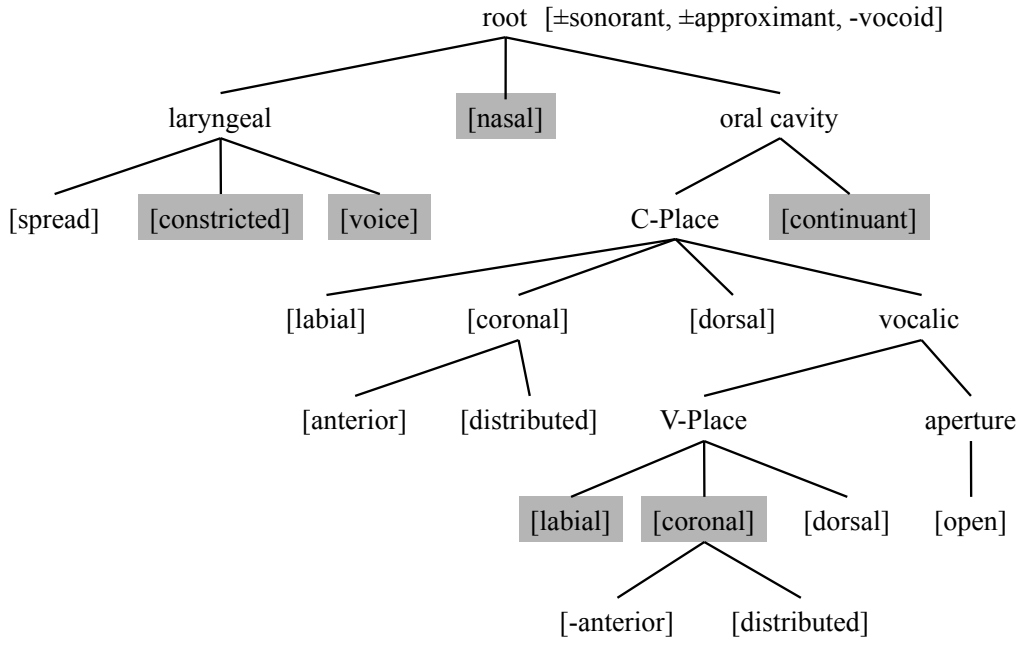
- Alternations in featural docking: choosing whether/where a consonant-mutating affix docks is based on a phonological grammar

3. Units of Representation: Features vs. Gestures

- Feature-based grammar of consonant mutation predicts that any non-root node feature should be able to float, as in Autosegmental Phonology (Goldsmith 1976, 1990), and therefore act as a morpheme

- Features implicated in featural affixation are a subset of those found in a fully articulated structure of consonant-affiliated features

(5) A consonantal feature geometric tree (from Clements & Hume 1995):



- Lieber (1987): features that may act as affixes tend to correspond to those that describe some additional action of the vocal tract

- No formal way to call out this group of gesture-describing features—not organized together and do not otherwise form a natural class in any feature geometric models

Proposal: actions of the vocal tract are the affixes and thus the units of representation in a phonological system

- Gestures as units of phonological representation are the basis of Articulatory Phonology (Browman & Goldstein 1986, 1992, henceforth AP)

- Gestures in AP: representational units that specify a goal action of the vocal tract (e.g., full closure at alveolar ridge, lip protrusion, velum opening)

- Set of gestures not directly analogous to set of segments or features, and thus make different predictions about what objects are available to serve as morphemes

(6) Consonant-affiliated gestures of English

Labial closure /b/	Tongue Tip-alveolar closure /d/	Tongue Body-velar closure /g/	Glottis open [-voice]
Labial critical /v/	Tongue Tip-dental critical /ð/	Tongue Body-palatal narrow /j/, /ʲ/	Glottis closure /ʔ/, [constricted glottis]
Lip Protrusion [round]	Tongue Tip-alveolar critical /z/		Velum open [nasal]
	Tongue Tip-alveopalatal critical /ʒ/		
	Tongue Tip-alveopalatal closure /dʒ/		
	Tongue Tip-palatal narrow /ɹ/		
	Tongue Tip-alveolar narrow /l/		

- Highlighted gestures: those whose addition to a form does not necessarily increase the number of consonants in that form, leading to traditional analysis as features, not segments

- Remaining gestures: those that necessarily correspond to full segments in traditional analysis

- All gestures can stand on their own as morphemes, with some being analyzed as featural affixation and some as typical segmental affixation

- All gestures corresponding to sub-segmental elements are attested as consonant-mutating gestural affixes[1]

(7) Mutation phenomena captured by gestural representation

Gesture	**Mutation Phenomenon**	**Language**
palatal narrow constriction	Palatalization	Zoque, Chaha
lip protrusion	Labialization	Chaha
velum opening	Nasalization	Zoque, Terena
glottal opening	Voicing	Breton, Aka
glottal closure	Glottalization	Yowlumne (Yawelmani)

Gestural representation of consonant-mutating affixes provides a better fit to attested morphological consonant mutation phenomena than a featural representation does

4. Mutation Grammar: Constraints Over Gestural Organization

- Gestural representations, like segmental/featural representations, can be analyzed in Optimality Theory (Prince & Smolensky 1993, henceforth OT)

- Input: Gestures have simple linear ordering

(8)

1	2	3	4	5	
$Gest_C$	$Gest_V$	$Gest_C$	$Gest_V$	$Gest_C$	ex. /badag/

- Multi-gestural consonants (nasals, liquids, voiceless consonants, consonants with secondary articulations): composite gestures share a linear ordering indexation

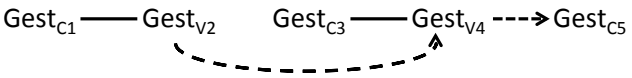
(9)

1	2	3	4	5	
$Gest_C$	$Gest_V$	$Gest_C$ $Gest_V$	$Gest_V$	$Gest_C$	ex. /balag/

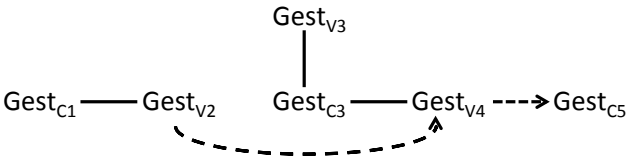
- Output: gestures are coupled to one another in an in-phase or anti-phase relation (Browman & Goldstein 2000)

[1] Gestural representation of consonant-mutating affixation has trouble dealing with mutation phenomena based on the feature [continuant], e.g. Fula, Nuer, and some Celtic languages. This may require some rethinking of sub-gestural representation, which is the next stage of this project.

- Coupling represents timing relation between two gestures as well as syllabification of gestures and is therefore subject to constraints
  - In-phase coupling: two gestures occur synchronously, as between a vowel and its onset consonantal gesture (solid line)
  - Anti-phase coupling: two gestures occur sequentially, as between a vowel and its coda consonantal gesture (dashed arrow)

(10) 

cf. (8)

(11) 

cf. (9)

- COUPLE constraints determine which gestures are coupled to one another in the output (similar to ASSOC(IATE) constraints of Davidson (2003))

(12) COUPLE(C,V): Assign a violation mark for any consonantal gesture that is not coupled in-phase to the following nuclear vocalic gesture.

(13) COUPLE(C,C): Assign a violation mark for any consonantal gesture that is not coupled anti-phase to the following adjacent consonantal gesture.

(14) COUPLE(V,V): Assign a violation mark for any nuclear vocalic gesture that is not coupled anti-phase to the following nuclear vocalic gesture.

- Affix alignment constraints: determine which edge of a root a gestural affix will couple with, and penalize infixation, following Generalized Alignment (McCarthy & Prince 1993)

(15) PREFIX: Assign a violation mark for every root gesture that precedes some morpheme X.

(16) SUFFIX: Assign a violation mark for every root gesture that follows some morpheme X.

- A gestural affix will couple to a root affix according to the COUPLE and affix alignment constraints, selecting a consonant at the relevant edge
- Sometimes coupling between gestures results in a marked structure, as captured by gestural co-occurrence constraints

(17) $Gest_1$—$Gest_2$: Assign a violation mark for a pair of gestures of type $Gest_1$ and $Gest_2$ that are in coupling relation X with one another.

- Multiple strategies for avoiding markedness due to coupling of a gestural affix to a root consonantal gesture
  - Infixation: find another root gesture to couple with (Chaha labialization)
  - Failure to realize an affix: delete offending gestural affix (Chaha labialization and Zoque palatalization)
  - Root Alteration: delete offending root gesture (Zoque nasalization)
  - Alternative Coupling: rearrange gestures temporally (Zoque nasalization and Yowlumne glottalization)

5. Using alternative coupling to avoid marked coupling relations: Zoque nasalization

- Nasalization at left edge marks first person in stop-initial forms, forming a prenasalized stop rather than a fully nasal consonant

(18)

a.	buru 'donkey'	^{m}buru 'my donkey'	*muru
b.	disko 'record'	^{n}disko 'my record'	*nisko
c.	pama 'clothing'	^{m}bama 'my clothing'	*^{m}pama, *mama
d.	tatah 'father'	^{n}datah 'my father'	*^{n}tatah, *natah

- Gestural affix: velum opening
- Active markedness constraint:

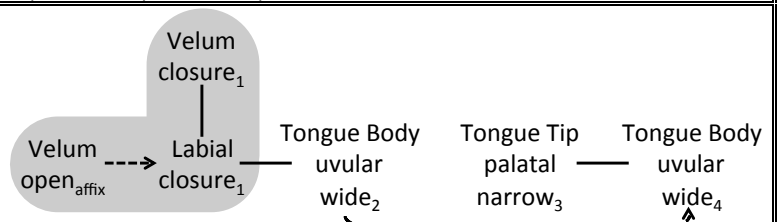
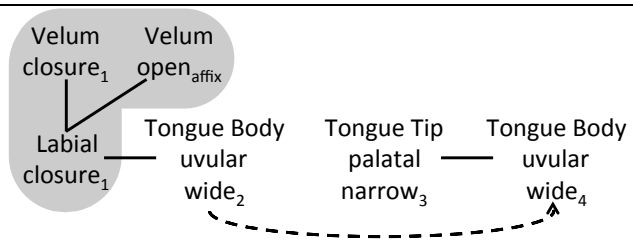
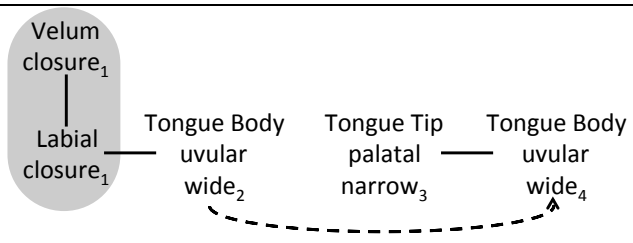
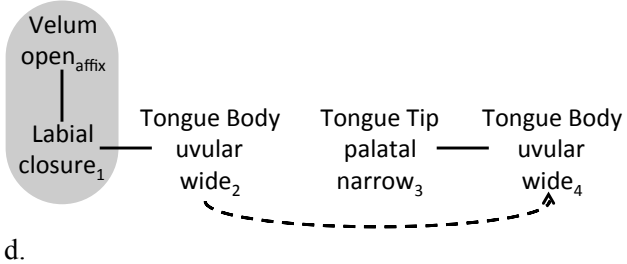
(19) *Velum Opening—Oral Closure—Velum Closure: Assign a violation mark for any consonantal gesture that is coupled in-phase to both a velum opening gesture and a velum closure gesture.[2]

- Oral stops are represented by gestures for some oral closure as well as velum closure—the oral closure gesture can't be coupled in-phase to two conflicting velum gestures
- Solution: couple the velum opening gestural affix to the root with an anti-phase relation instead, resulting in a prenasalized stop

[2] Simultaneous opening and closing of the velum is impossible, so this constraint may actually be a restriction on GEN. It is included here as an undominated constraint for purposes of illustration, along with its violating candidate (b. in tableau 20).

- Deletion of gestures from marked structures is prevented by constraints for:
  - Root faithfulness: MAXGEST(root)-IO
  - Affix preservation: MORPHEMEREALIZATION, abbreviated MORPHREAL (Samek-Lodovici 1992)

(20) Marked structure avoided by employing anti-phase coupling

Input: Velum open$_{prefix}$ (N_{prefix}) / Labial closure$_1$, Velum closure$_1$; Tongue Body uvular wide$_2$; Tongue Tip palatal narrow$_3$; Tongue Body pharyngeal wide$_4$ (b_1 u_2 ɹ$_3$ u_4)	*VelOpen —C— VelClo	MORPH REAL	MAXGEST (root)-IO
☞ a.  [^{m}buɹu]			
b.  [b̃uɹu]	*!		
c.  [buɹu]		*!	
d.  [muɹu]			*!

- Formation of a prenasalized stop from addition of a velum opening gestural affix allows for avoidance of marked structure (two conflicting velum gestures) without having to delete any gestures that are present in the input

- Another type of avoidance of marked structure in Zoque: voiceless stops become voiced when prenasalized by deleting the root-initial consonant's glottal open gesture

(21) *Velum Opening—Oral Closure—Glottal Opening: Assign a violation mark for any consonantal gesture that stands in any coupling relation with both a velum opening gesture and a glottal opening gesture.

(22) Marked structure avoided by deletion of a root gesture

Input: Velum open$_{prefix}$ (N_{prefix}) — Labial closure$_1$, Glottis open$_1$, Velum closure$_1$; Tongue Body pharyngeal wide$_2$; Labial closure$_3$, Velum open$_3$; Tongue Body pharyngeal wide$_4$ (p_1 a_2 m_3 a_4)	*VelOpen —C— GlotOpen	MORPH REAL	MAXGEST (root)-IO
☞ a. Velum open$_{affix}$ → Labial closure$_1$ (Velum closure$_1$); Tongue Body pharyngeal wide$_2$ — Labial closure$_3$ (Velum open$_3$) — Tongue Body pharyngeal wide$_4$ [^{m}bama]			*
b. Velum closure$_1$, Glottis open$_1$ — Labial closure$_1$; Tongue Body pharyngeal wide$_2$ — Labial closure$_3$ (Velum open$_3$) — Tongue Body pharyngeal wide$_4$ [pama]		*!	
c. Velum open$_{affix}$ → Labial closure$_1$ (Velum closure$_1$, Glottis open$_1$); Tongue Body pharyngeal wide$_2$ — Labial closure$_3$ (Velum open$_3$) — Tongue Body pharyngeal wide$_4$ [^{m}pama]	*!		

- Alternative coupling can avoid marked structure when a gestural co-occurrence constraint specifies a type of coupling relation (in-phase or anti-phase) that should not exist between two gestures

- When a gestural co-occurrence constraint does not specify a type of coupling relation, any coupling between two gestures will be marked and alternative coupling will not avoid the creation of marked structure

- Segmental alternative employing Aperture Theory (Steriade 1993): stops have two ordered aperture positions (root node-like elements) for closure and release, with only the closure taking on an affixed [nasal] feature

  - Aperture Theory points to the need in segmental theory for a richer representation of time than simple linear ordering

  - Gestural representation captures temporal aspect of prenasalization without resorting to distinguishing types of consonants by number of aperture positions/nodes

6. Using alternative coupling to avoid marked coupling relations: Yowlumne glottalization

- In Yowlumne (Yokutsan) glottal-initial suffix -(ʔ)aa marks verbs as continuative, with the glottal element surfacing either as an onset to the suffix or as glottalization of a sonorant root consonant (Newman 1944; Archangeli 1988)

(23)

a. t̪up- 'lead by the hand'	t̪op.ʔaa- 'lead by the hand (continuative)'	*t̪o.pʔaa-
b. max- 'procure'	max.ʔaa- 'procure (continuative)'	*ma.xʔaa-
c. t̪ʰaw- 'shout'	t̪ʰa.wʔaa- 'shout (continuative)'	*t̪ʰaw.ʔaa-
d. t̪ʔum- 'devour'	t̪ʔoo.mʔaa- 'devour (continuative)'	*t̪ʔum.ʔaa-

- Glottalization is realized in different positions depending on the shape of the root: must only dock with a post-vocalic sonorant, and otherwise surfaces as a full glottal stop

- In a featural/segmental framework: glottalization surfaces in some cases as a feature that must dock to a segment and in other cases as a full segment

- In a gestural framework: affix begins with a glottal closure gesture that enters into different coupling relations with elements of the root based on phonotactic restrictions

- Active markedness constraints:

(24) restated from 12 COUPLE(C,V): Assign a violation mark for any consonantal gesture that is not coupled in-phase to the following nuclear vocalic gesture.

(25) *GlotClo—C—Glot: Assign a violation mark for any consonantal gesture that is coupled to two glottal gestures.[3]

[3] As we saw in the case of Zoque nasalization, this may actually represent a restriction on GEN as it is violated by potentially phonetically impossible consonants that include two glottal gestures. Here it is represented as high-ranking and inviolable.

- Oral stops are underlyingly specified as glottalized, voiceless aspirated, or voiceless unaspirated—no voiced oral stops

- In AP, voicelessness is captured by a glottal opening gesture, and voicing by lack of this gesture

(26)

Plain obstruents:	Aspirated obstruents:	Glottalized obstruents:	Nasals:
Glottis open (short) | Tongue Tip alveolar closure	Glottis open (long) | Tongue Tip alveolar closure	Glottis closure | Tongue Tip alveolar closure	Velum open | Tongue Tip alveolar closure

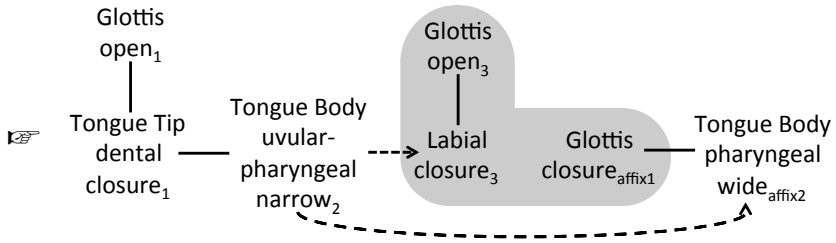
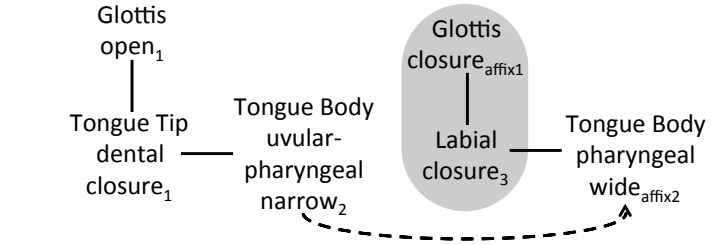
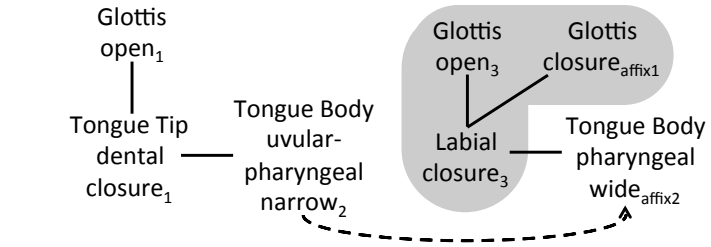
- All oral stops in Yowlumne are either voiceless or glottalized, so in all cases they will already be coupled to some kind of glottal gesture and thus unable to take on another

(27) Preference for glottalization to avoid creating a coda

Input:	*GlotClo —C— Glot	MAXGEST (root)-IO	COUPLE (C,V)
Tongue Tip dental closure$_1$ · Tongue Body pharyngeal wide$_2$ · Lip Protrusion$_3$ · Glottis open$_1$ · Tongue Body uvular narrow$_3$ · Glottis closure$_{affix1}$ · Tongue Body pharyngeal wide$_{affix2}$ ($\underline{t}^h_1$ a$_2$ w$_3$) ($ʔ_{affix1}$ a$_{affix2}$)			
☞ a. Glottis open$_1$ — Tongue Tip dental closure$_1$ — Tongue Body pharyngeal wide$_2$ — Tongue Body uvular narrow$_3$ — Lip Protrusion$_3$ — Glottis closure$_{affix1}$ — Tongue Body pharyngeal wide$_{affix2}$ [$\underline{t}^h$a.w^{ʔ}a]			
b. Glottis open$_1$ — Tongue Tip dental closure$_1$ — Tongue Body pharyngeal wide$_2$ — Tongue Body uvular narrow$_3$ — Lip Protrusion$_3$ — Glottis closure$_{affix1}$ — Tongue Body pharyngeal wide$_{affix2}$ [$\underline{t}^h$aw.ʔa]			*!

- Glottalization of the root-final sonorant allows the sonorant to couple as an onset instead of creating a cluster, and does not create a marked structure

(28) Marked structure avoided by coupling glottal gesture as full consonant

Input: Tongue Tip dental closure$_1$ / Glottis open$_1$; Tongue Body uvular wide$_2$; Labial closure$_3$ / Glottis open$_3$; Glottis closure$_{affix1}$; Tongue Body pharyngeal wide$_{affix2}$	*GlotClo —C— Glot	MAXGEST (root)-IO	COUPLE (C,V)
(t$_1$ u$_2$ p$_3$) (ʔ$_{affix1}$ a$_{affix2}$)			
☞  a. [top.ʔa]			*
 b. [to.p^{ʔ}a]		*!	
 c. [to.p̰^{ʔ}a]	*!		

- Glottalization of a stop creates a marked structure (a closure gesture with two coupled glottal gestures), so it is avoided by tolerating the creation of a consonant cluster
- Whether a glottal closure gesture surfaces coupled to a consonant (traditionally captured by a [constricted glottis] feature) or independently (traditionally captured by a glottal stop segment) depends on its coupling relations, which in turn depends on phonotactic restrictions[4]

[4] When a root ends in a consonant cluster, the glottal closure will either couple to a post-vocalic sonorant, or fail to surface if one is not available, ex. ʔilk-, ʔel^{ʔ}.kaa- 'sing' but hokn-, hok.naa- 'float.' Alternative coupling would create a CCC cluster (ex., *hokn?aa), which is not syllabifiable in Yowlumne (presumably because of gestural co-occurrence between two consonant gestures, akin to *COMPLEX).

- Eliminating the distinction between different types of phonological units (segment vs. feature) allows us to capture phenomena in which a representational unit may act as one or the other

7. Conclusion

- Gestural representations of consonant-mutating affixes provide a better fit to attested phenomena than segmental/featural representations

- Coupling relations provide a better representation of consonant mutations that involve complex temporal organization than simple linear ordering

- Next steps:

  - Consonant-mutating affixes that also trigger spreading (e.g., Terena nasalization)

  - Analyses of consonant mutation that rely on the feature [continuant], which cannot be directly translated into a gesture

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