A Gestural Account of Neutral Segment Asymmetries in Harmony

2015 Annual Meeting on Phonology
October 10, 2015
Vancouver, B.C.

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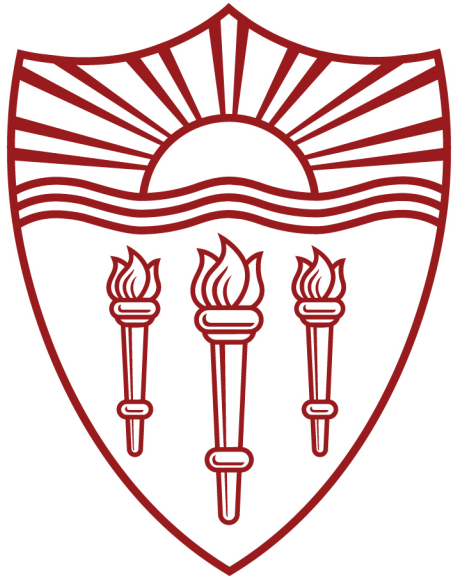


Overview

- Neutral segments: non-participants in harmony
  - Blockers: block the spread of a harmonizing feature
  - Transparent segments: do not block the spread of a harmonizing feature
- Typical analysis: feature co-occurrence restriction between harmonizing feature and some feature of intended target

Overview

- Prediction of previous accounts: sets of attested transparent and blocking segments are identical

- Transparent segments are a subset of attested neutral segments in rounding harmony and nasal (vowel-consonant) harmony

Proposal: a gestural representation of harmony

- Allows for use of two distinct mechanisms of neutrality in harmony
- Accounts for limited set of transparent segments

Neutral Segment Asymmetry in Nasal Harmony

	Neutral Segments	Language
Blockers	Obstruents	Kayan (Blust 1972)
	Obstruents, liquids	Warao (Osborn 1966)
	Obstruents, liquids, glides	Sundanese (Robins 1957)
Transparent Segments	Obstruents	Tuyuca (Barnes & Takagi de Silzer 1976)

typological generalization: Walker (1998/2000)

Neutral Segment Asymmetry in Rounding Harmony

	Neutral Segments	Language
Blockers	Non-high vowels	Turkish (Clements & Sezer 1982)
	High Vowels	Ulcha (Kaun 1995 citing Sunik 1985)
Transparent Segments	High front vowels	Halh Mongolian (Svantesson et al. 2005)

typological generalization: Kaun (1995)

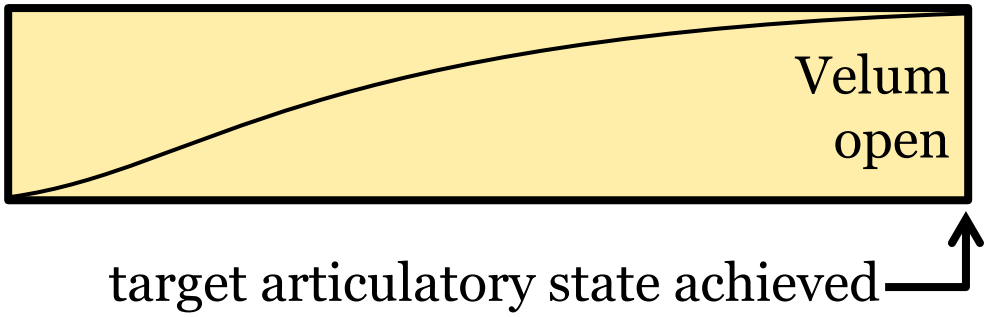
A Solution for the Neutrality Asymmetry

Proposal: a gesture-based analysis of harmony

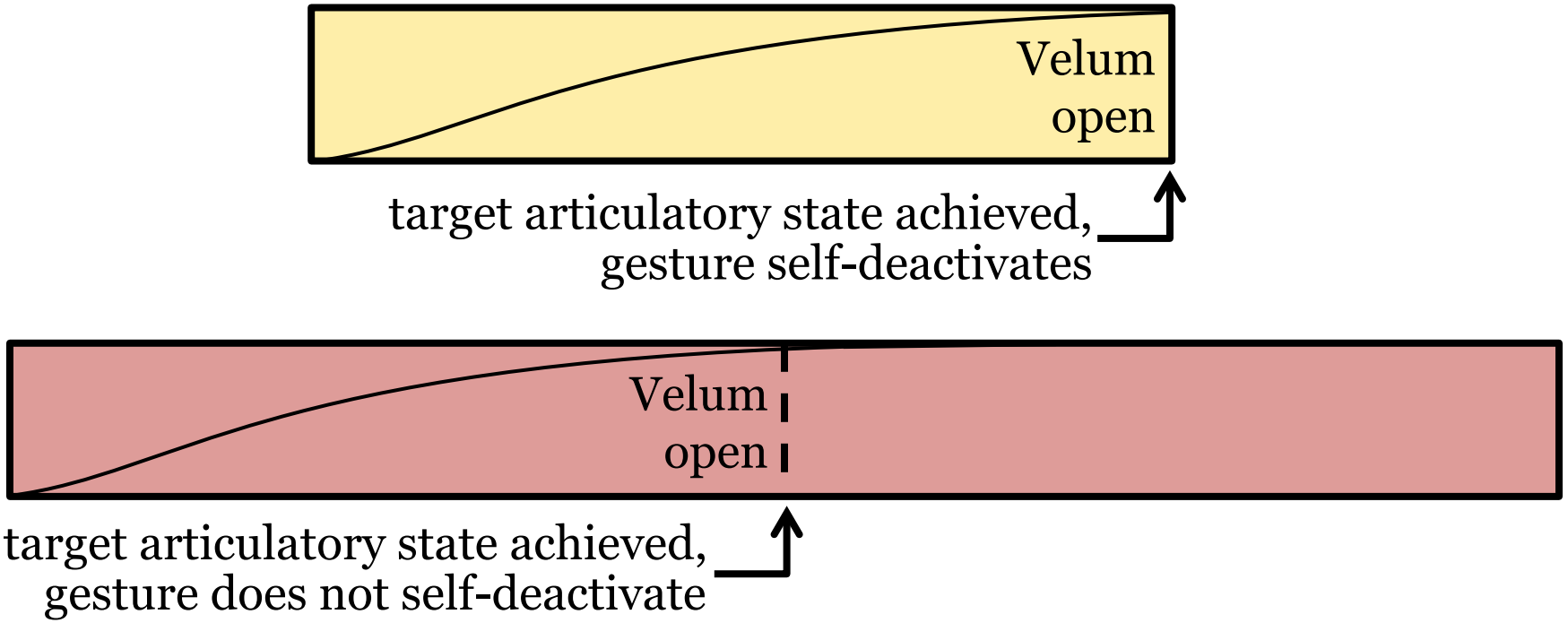
- Transparency and blocking are results of two distinct mechanisms of neutrality
- Transparency-inducing mechanism available to a limited set of segments
- Blocking mechanism available to all neutral segments

The Gestural Harmony Model

- Gestures: task-based, spatiotemporal units of representation (Browman & Goldstein 1986, 1989)
- Gestural parameters:
  - Goal articulatory state (open velum, protruded lips)
  - Activation duration
  - Articulators
  - Strength (ability to command articulators)



The Gestural Harmony Model



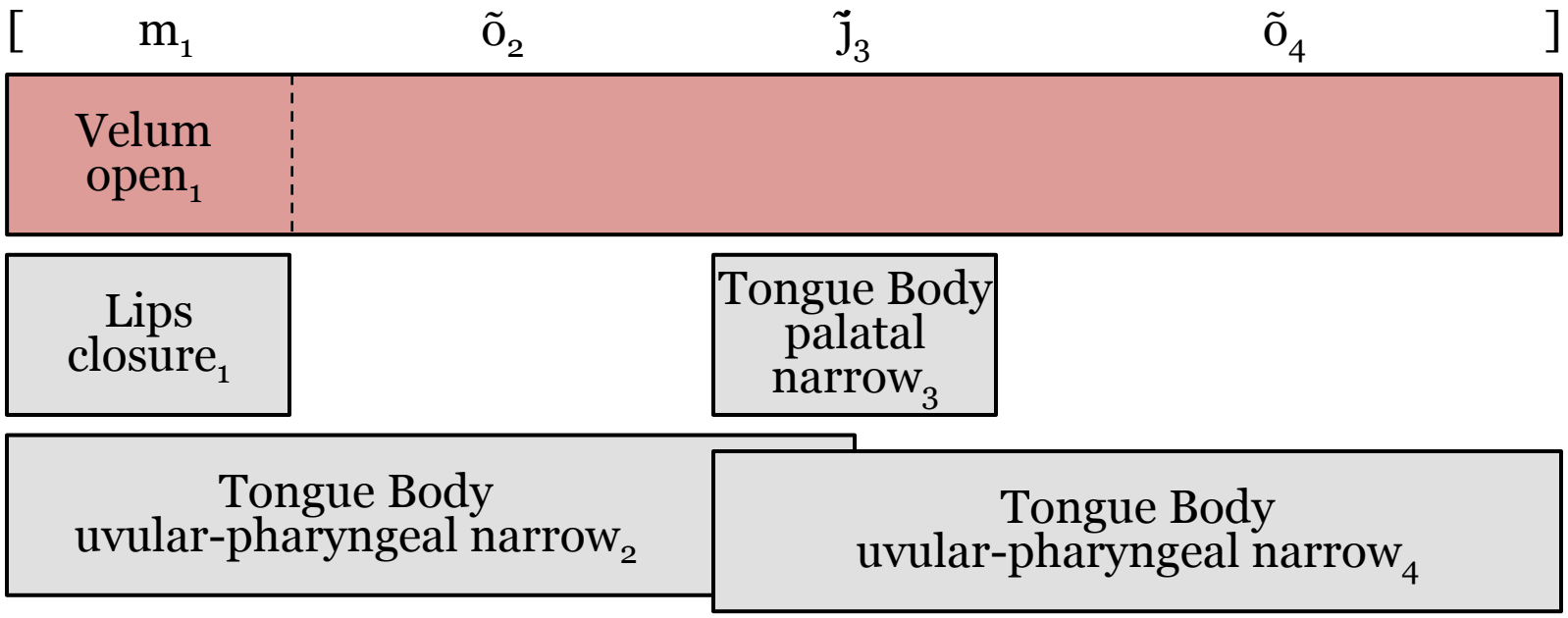
Harmony is the result of overlap by a non-self-deactivating gesture with extended duration.

Nasal Harmony in Warao

Nasal harmony is triggered by a nasal consonant or vowel and blocked by liquids and obstruents (Osborn 1966):

Full harmony	Blocking
a. [mõj̃õ] ‘cormorant’	c. [õĩɦõɾo] ‘kind of tree’
b. [inãwãɦã] ‘summer’	d. [nãõte] ‘he will come’

Nasal Harmony via Extended Velum Opening Gesture



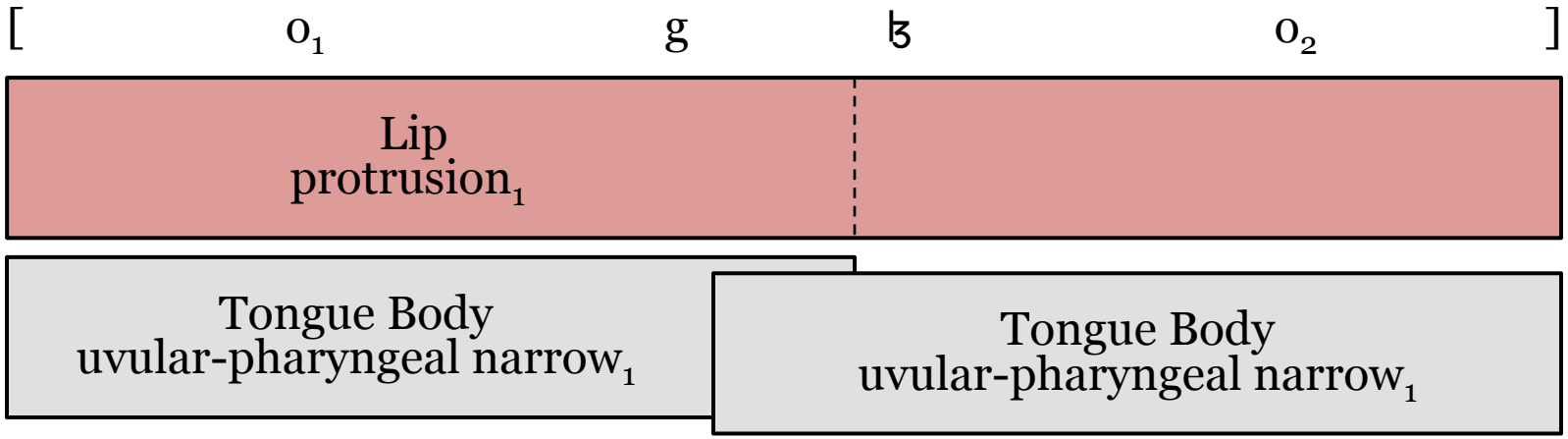
subscript: segment-to-gesture correspondence

Rounding Harmony in Halh (Khalkha) Mongolian

- Rounding harmony is triggered by mid round vowel; high front vowel /i/ is transparent (Svantesson et al. 2005):

Full harmony	Transparent /i/
a. [og-ɮo] 'give (past)'	b. [poor-ig-o] 'kidney (acc. refl.)'
cf. [it-ɮe] 'eat (past)'	cf. [piir-ig-e] 'brush (acc. refl.)'

Rounding Harmony via Extended Lip Protrusion Gesture



Incompatible vs. Antagonistic Gestures

- Gestural antagonism: two concurrently active gestures make directly opposing demands of an articulator
- Gestural incompatibility: concurrent activation of two gestures is articulatory or perceptually difficult

Antagonistic gestures are incompatible, but incompatible gestures are not necessarily antagonistic.

A Solution for the Neutrality Asymmetry

Proposal: gestural antagonism and gestural incompatibility as distinct motivators of neutrality

- Transparency: result of concurrent activation of two *antagonistic* gestures
- Blocking: result of a ban on concurrent activation of two *incompatible* gestures

Coactivation Transparency

Transparency is the result of the concurrent activation of two antagonistic gestures.

- Antagonistic gestures: directly opposing goal articulatory states
- Transparency: harmonizing gesture and a gesture that it overlaps are antagonistic

Nasal Harmony Transparency in Tuyuca

Morphemes are either oral or nasal; obstruents are transparent (Barnes & Takagi de Silzer 1976):

Full harmony	Transparency
a. [j̃ãmĩ] ‘night’	d. [mĩpĩ] ‘badger’
b. [w̃ĩnõ] ‘wind’	e. [w̃ãtĩ] ‘demon’
c. [j̃õr̃ẽ] ‘small hen’	f. [j̃õsõ] ‘bird’

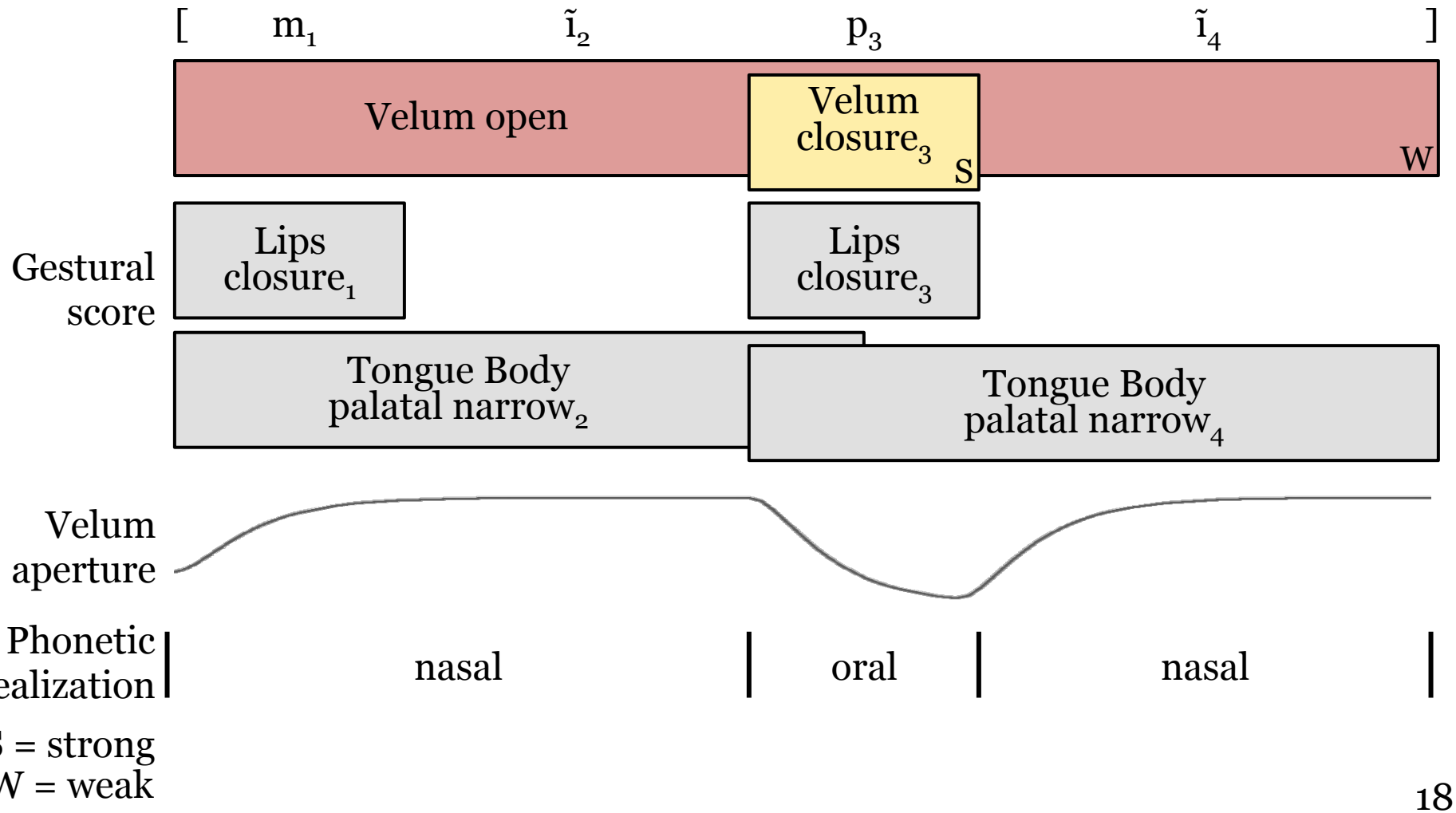
Obstruent Transparency in Nasal Harmony

- Gestural representation of obstruents includes:
  - Oral constriction gesture
  - Glottal gesture (unless voiced)
  - Velum *closure* gesture

- Velum closure gesture: tight seal of velopharyngeal port necessary for obstruency

- Raising of velum reported during production of oral stops (Lubker 1968, Bell-Berti & Hirose 1975, Bell-Berti 1976)

Coactivation Transparency in Nasal Harmony



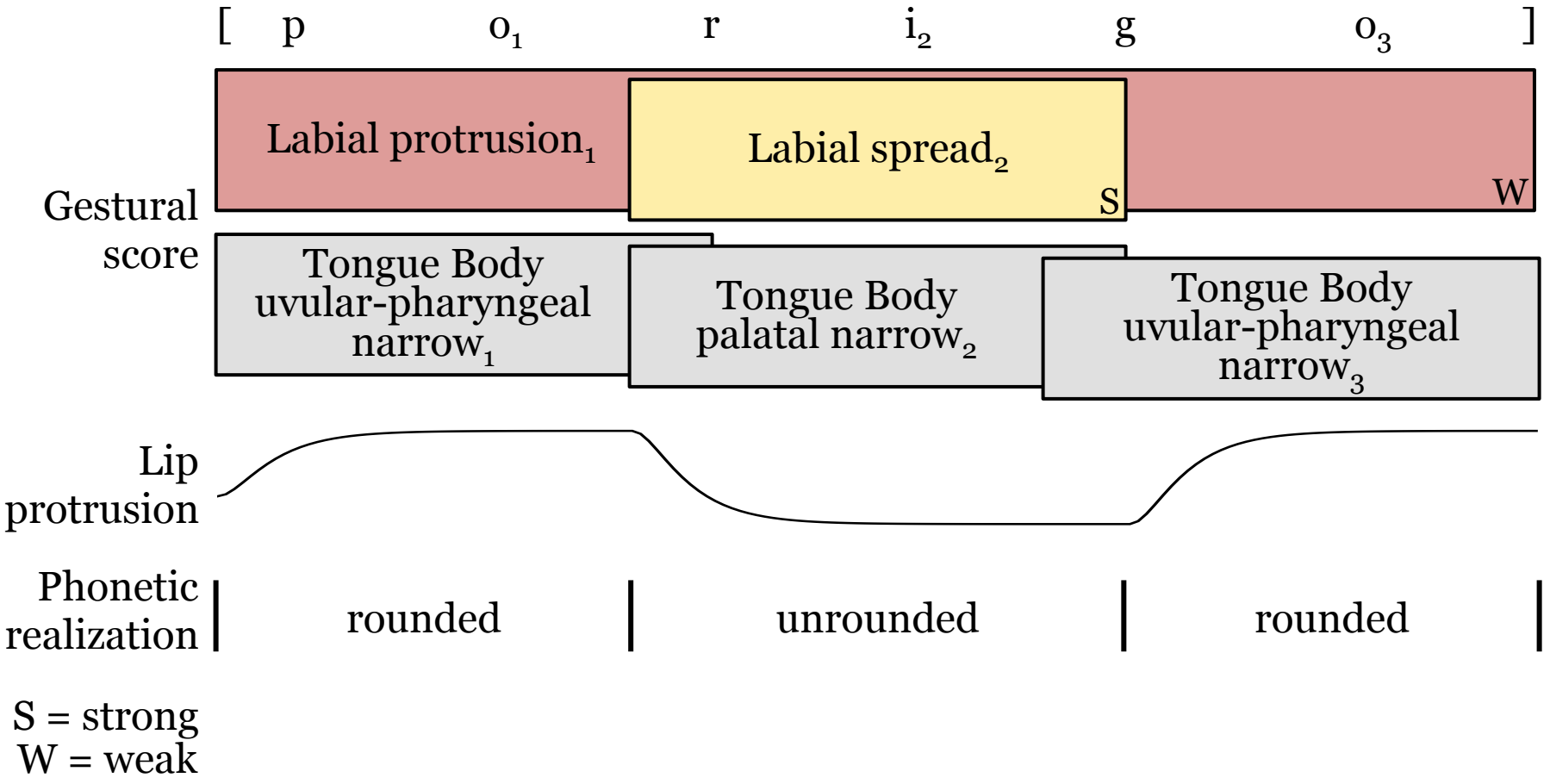
High Front Vowel Transparency in Rounding Harmony

- Gestural representation of high front vowel includes:
  - Palatal constriction gesture
  - Lip *spreading* gesture

- Lip spreading gesture: raises F2, maximizing perceptual distance from back vowels

- Controlled lip spreading reported during production of /i/ (Hadding, Hirose, & Harris 1976; Sussman & Westbury 1981; Goldstein 1991)

Coactivation Transparency in Rounding Harmony



Summary: Coactivation Transparency

- Correctly predicts which segments can be transparent within nasal harmony and rounding harmony
- Harmony is represented locally, resulting in gestural antagonism with transparent segments
- Derivational opacity is unnecessary (cf. Piggott 1992 and Walker 1998/2000 for nasal harmony)

Blocking as a Ban on Gestural Overlap

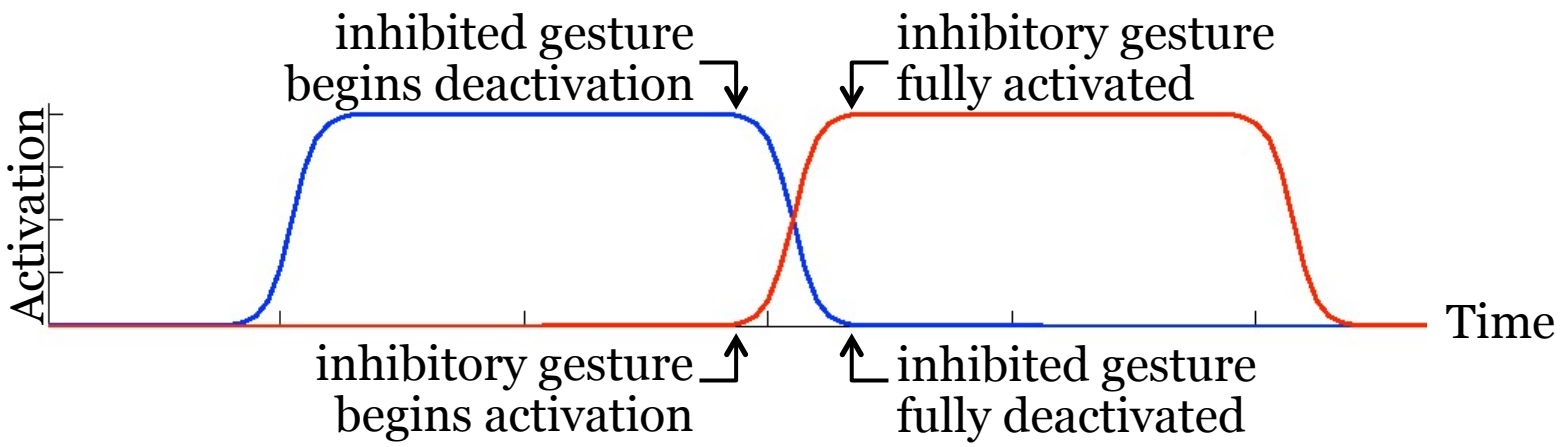
> Blocking is the result of a ban on the concurrent activation of two incompatible gestures.

- Incompatible gestures: articulatorily or perceptually difficult
- Blocking: harmonizing gesture and a gesture that it overlaps are incompatible

Preventing Overlap with Gestural Inhibition

- Inhibition relation between gestures prevents their concurrent activation
- Representation of inhibition:

Inhibited Gesture ✖ · · · · · Inhibiting Gesture



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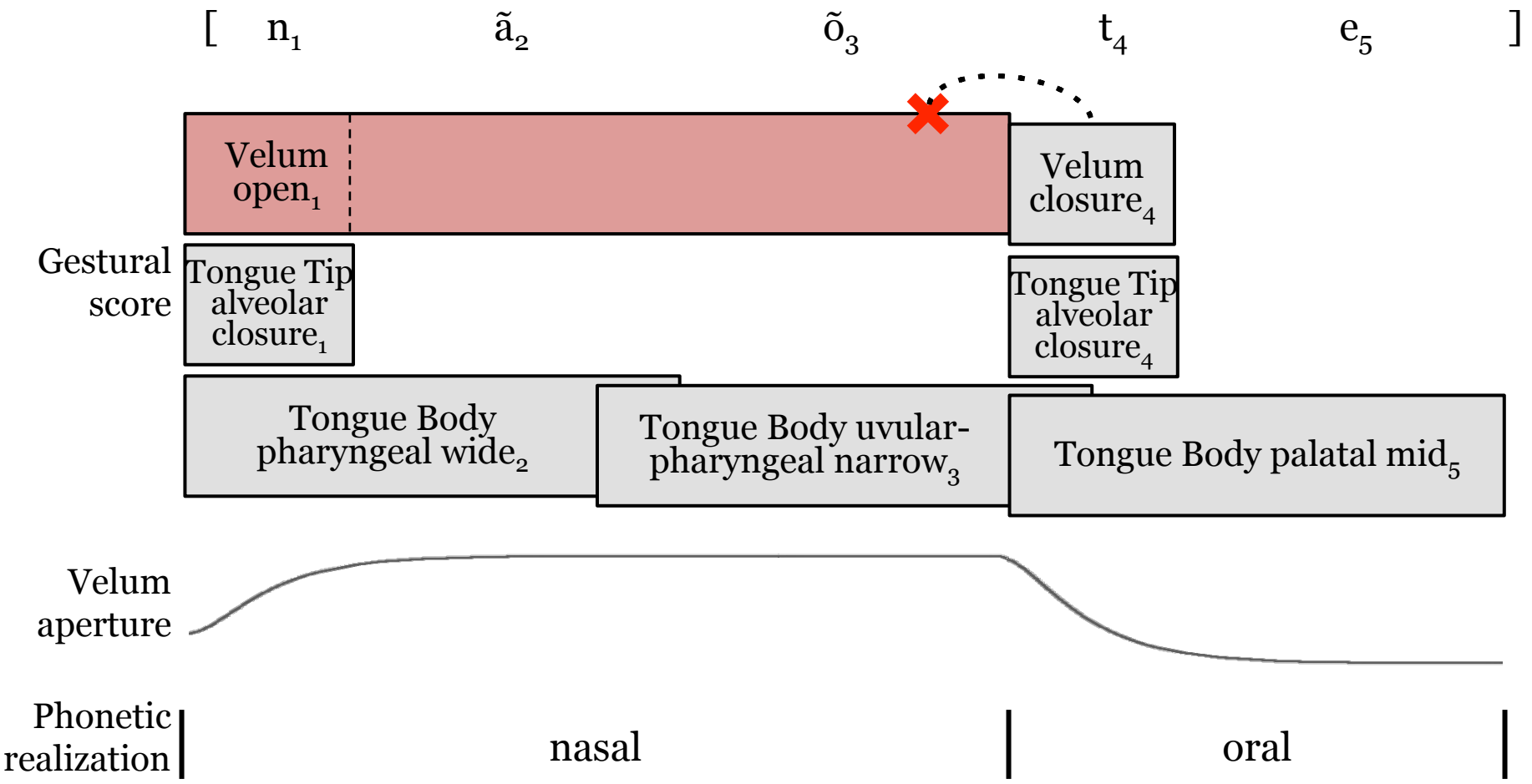
Gestural Inhibition in Nasal Harmony



Summary: Blocking as Gestural Inhibition

- Harmonizing and blocking gestures are incompatible with one another
- Gestural incompatibility may lead to a ban on temporal overlap, enforced by gestural inhibition
- Incompatibility is articulatorily and perceptually based and not limited to gestural antagonism

Neutrality in Harmony via Feature Co-occurrence Constraints

- Analyses of harmony using feature co-occurrence restrictions to account for all neutral segments:
  - Embedded feature domains (Smolensky 1993)
  - Grounded path conditions (Archangeli & Pulleyblank 1994)
  - Optimal Domains Theory (Cole & Kisseberth, 1994, 1995)
  - Targeted constraints (Bakovic & Wilson 2000)
  - Sympathy Theory (Walker 1998/2000)
  - Span Theory (McCarthy 2004, O'Keefe 2005)
- Incorrect prediction of these accounts: all attested blockers may also behave transparently

Neutral Segments in Optimal Domains Theory (ODT)

- Wide Scope Alignment (WSA): align the edge of a feature domain (F-domain) with the edge of a word/morpheme

- Expression: a feature must be affiliated with every segment in its F-domain

- Co-occurrence restriction: a segment may not bear features F and G

Overgeneration of Transparency

- Transparency:

Wide Scope Alignment Co-occurrence restriction	>>	Expression

- Blocking:

Expression Co-occurrence restriction	>>	Wide Scope Alignment

- Prediction: any attested neutral segment may behave transparently under some constraint ranking

Overgeneration of Transparent Segments in Nasal Harmony

- Liquid blocking of nasal harmony (attested):

  *NasalLiquid, Expression >> WSA(nasal)

- Liquid transparency in nasal harmony (not attested):

  *NasalLiquid, WSA(nasal) >> Expression

Overgeneration of Transparent Segments in Rounding Harmony

- Non-high vowel blocking of rounding harmony (attested):

  *ROLO, Expression >> WSA(round)

- Non-high vowel transparency in rounding harmony (not attested):

  *ROLO, WSA(round) >> Expression

Conclusion

- Gestural Harmony Model provides two distinct mechanisms responsible for neutrality:
  - Transparency via coactivation: concurrent activation of *antagonistic* gestures
  - Blocking via gestural inhibition: ban on temporal overlap of *incompatible* gestures
- Allows a local, non-derivationally opaque representation of transparency in harmony
- Avoids over-generation of predicted transparent segments in nasal harmony and rounding harmony
- Next step: extending harmony typology to additional non-self-deactivating gestures

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Appendix I: Gestural Strength

- Gestural antagonism resolved by Task Dynamic Model of speech production (Saltzman & Munhall 1989)
- Articulatory state = weighted average of two gestures' goal articulatory states
- Weights = gestural strengths

Appendix I: Gestural Strength

- Velum closure: goal velum aperture -2mm
- Velum opening: goal velum aperture 5mm

Velum Closure Strength	Velum Opening Strength	Weighted Average
0.5	0.5	-2*0.5 + 5*0.5 = 1.5 mm
0.25	0.75	-2*0.25 + 5*0.75 = 3.25 mm
0.75	0.25	-2*0.75 + 5*0.25 = -0.25 mm

Appendix II: Blocking in Rounding Harmony in Ulcha

- Rounding harmony is triggered by a mid round vowel and blocked by high vowels (Kaun 1995):

<u>Full harmony</u>

a. [goro] ‘far’

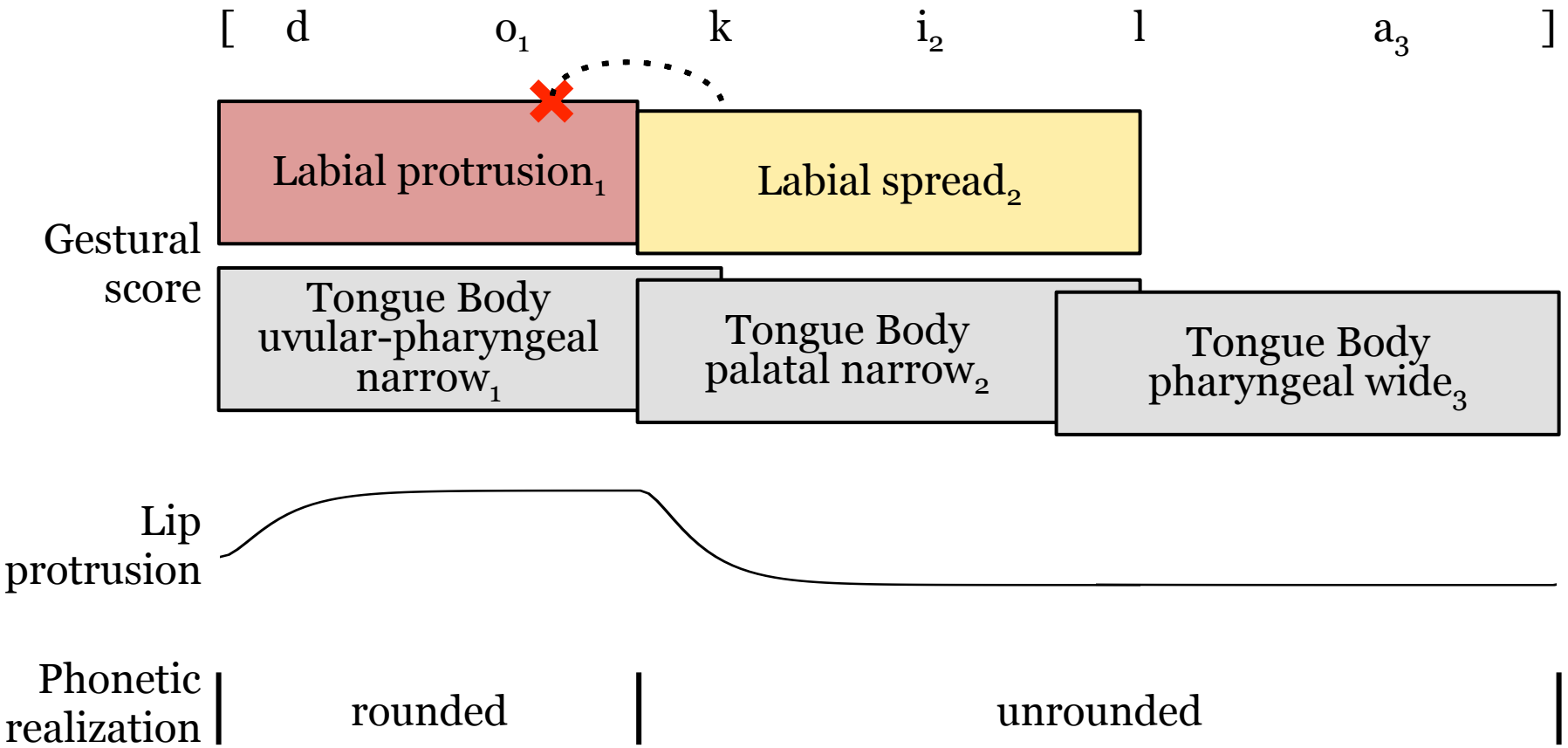
b. [totoŋgo] ‘multi-colored’

<u>Blocking</u>

c. [do:kila] ‘inside’
*[do:kilo]

d. orkiqtala ‘uncomfortably’
*[orkiqtolo]

Appendix II: Blocking in Rounding Harmony in Ulcha



Appendix III: ODT Overgeneration of Transparent Segments in Nasal Harmony

- Liquid blocking of nasal harmony (attested):

*NasalLiquid, Expression >> WSA(nasal)

Input: /nala/	*NasLiq	EXPRESSION	WSA(nasal)
a. [(nãl̃ã)]	*!		
b. [(nãlã)]		*!	
☞ c. [(nã)la]			**

Appendix III: ODT Overgeneration of Transparent Segments in Nasal Harmony

- Liquid transparency in nasal harmony (not attested):

*NasalLiquid, WSA(nasal) >> Expression

Input: /nala/	*NasLiq	WSA(nasal)	EXPRESSION
a. [(nãl̃ã)]	*!		
☞ b. [(nãlã)]			*
c. [(nã)la]		*!*	