Cross-Segment Partial overlap

Rachel Walker

University of Southern California

Research in collaboration with Michael Proctor, Macquarie University

Inside Segments Workshop

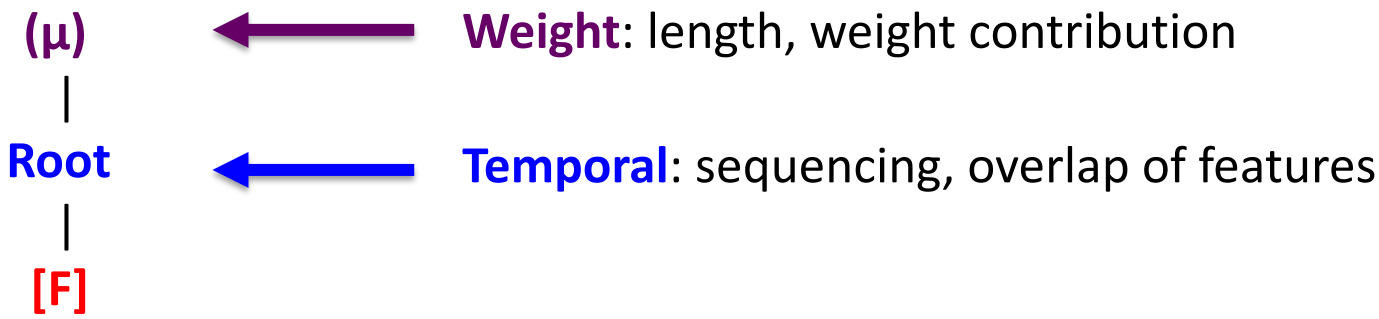
LSA, January 6, 2019

New York City

1. Introduction

1 Introduction

Classic sub-syllabic hierarchical structure



- Temporal organization is a relation among roots; weight is assigned to roots.

Empirical: Patterns in rimes with coda liquids in American English.

Segment structure:

- Two kinds of *partial segment behavior* with respect to temporal structure (extending terminology of Padgett 2002 on "partial feature class behavior")
  - **Sequencing of subsegments** (atomic elements) within a segment
  - **Cross-segment partial overlap**
- Support for encoding **temporal organization** and **blending strength** at subsegmental level, as in gestural representations (Browman & Goldstein 1986 et seq.).

2. Rimes with coda liquids in American English

2. Rime phonotactics in GenAm

- English exhibits an upper limit on constituents in the rime
  - Attributed to a moraic or skeletal frame, as in many other languages

  (Kenstowicz & Kisseberth 1979, Clements & Keyser 1983, Zec 1995).
- Under study: **General American English (GenAm):**
  - Typified by rhotic varieties spoken in much of midwestern and western U.S (Wells 1982).
- GenAm word-final syllables: **trimoraic maximum**
  (Hammond 1999, Hall 2001, 2002).
- Coda Cs in GenAm each contribute 1μ
  - But final coronal obstruents may be nonmoraic (Hall 2002). Discussion of GenAm codas here excludes those with a final coronal obstruent.

2. Rime phonotactics in GenAm

- GenAm tense/lax distinction involves a **quantity distinction**.
  - Tense Vs are bimoraic, e.g. [iː], [eɪː], [uː]
  - Lax Vs are monomoraic, e.g. [ɪ], [ɛ], [ʊ]
  - "True" diphthongs ([aɪ], [aʊ] [ɔɪ]) are bimoraic

    (Halle & Mohanan 1985, Hammond 1997)

Predictions under 3μ maximum:

1. **Both long and short vowels could occur before a simple coda**
   - Hence long (tense) Vs, short (lax) Vs, diphthongs are possible.
2. **Only short (lax) vowels before a complex coda.**

2. Rime phonotactics – Liquids and tense/lax vowels

Vowel	Nuclear μs	Coda /l/		Coda /ɹ/	
		CVl]σ	CVlC]σ	CVɹ]σ	CVɹC]σ
[iː]	2	*peel*		*peer*	
[ɪ]	1	*pill*	*milk*		
[eɪ̯ː]	2	*pail*		*pair*	
[ɛ]	1	*bell*	*elk*		
[uː]	2	*pool*		*boor*	
[ʊ]	1	*pull*	*wolf*		
[oʊ̯ː]	2	*pole*		*bore*	
[ɔ]	1	*pall*	*golf*		*pork*
[ɑ]	1	*pall*	*golf*	*par*	*park*
[æ]	1	*pal*	*scalp*		
[ʌ]	1	*mull*	*bulk*		
[əɹ̯ː]	2	*furl*			

- Pronunciation after Hammond (1999), Weide (1994) (with edits by Hayes).
- Assumption: Words like *furl* contain [əɹ̯ː] (Ladefoged & Maddieson 1996).

On rimes with true diphthongs, see Lavoie & Cohn (1999), Cohn (2003), Cohn & Tilsen (2015).

2. Rime phonotactics – Liquids and tense/lax vowels

Vowel neutralization in context of coda /ɹ/ and issues for 3μ frame

1. **Vowel *quantity* (tense/lax) contrast is neutralized before coda /ɹ/**
   - Could expect this restriction to follow from 3μ maximum, which is responsible elsewhere in GenAm for neutralization of V length in context of coda Cs.
   - Could suggest that coda /ɹ/ in GenAm is **bimoraic** – pursued here with qualifications.
2. **Vowel *quality* contrast is neutralized before /ɹ/ in a complex coda**
   - Only low back vowels ([ɑ]/[ɔ]) in this context (Proctor & Walker 2012)
   - If coda /ɹ/ is bimoraic, VɹC rimes are expected to **exceed** the 3μ maximum, (wrongly) predicting that ɑɹC and ɔɹC rimes are unacceptable.
   - Root-based mora assignment predicts sensitivity to the **quantity** of Vs in the syllable, **not their quality**.

3. Analysis of Representations

3.1 Production of coda liquids in GenAm

1. Liquids involve **two lingual constriction actions**: **/ɹ/** – Coronal and Pharyngeal; **/l/** – Coronal and Dorsal.

2. In coda /ɹ/ and /l/, the dorsal/pharyngeal constriction **precedes** the coronal constriction.

3. The rhotic exhibits overall **greater coarticulatory dominance** than the lateral.

4. For coda /ɹ/, less movement is observed in the pharyngeal region from **low back vowels ([ɑ], [ɔ])** to the rhotic than with other peripheral vowels.

(Delattre & Freeman 1968, Zawadzki & Kuehn 1980, Sproat & Fujimura 1993, McMahon et al. 1994, Browman & Goldstein 1995, Gick 1999, 2003, Gick et al. 2002, 2006, Campbell et al. 2010, Scobbie & Pouplier 2010, Proctor & Walker 2012, Proctor et al. 2018)

3.2 Representation – Overview

Proposal 1: Temporal structure in rimes with /ɹ/

- Temporal structure in rimes with /ɹ/ is **sensitive to vowel quality**.
- Pharyngeal constriction of /ɹ/ **substantially overlaps** with constriction formation of highly similar vowels [ɑ], [ɔ].
- Such overlap does not occur for other peripheral vowels, which involve considerably distinct lingual constrictions.
  - High coarticulatory dominance of /ɹ/ prevents its overlap with considerably distinct vowels, while maintaining vowel quality distinctions.

Proposal 2: Moraic contribution of /ɹ/

- Coda /ɹ/ **variably maps to one or two moras**, depending on the degree to which it can overlap with the nuclear vowel.

3.3 Representation – Liquid-internal

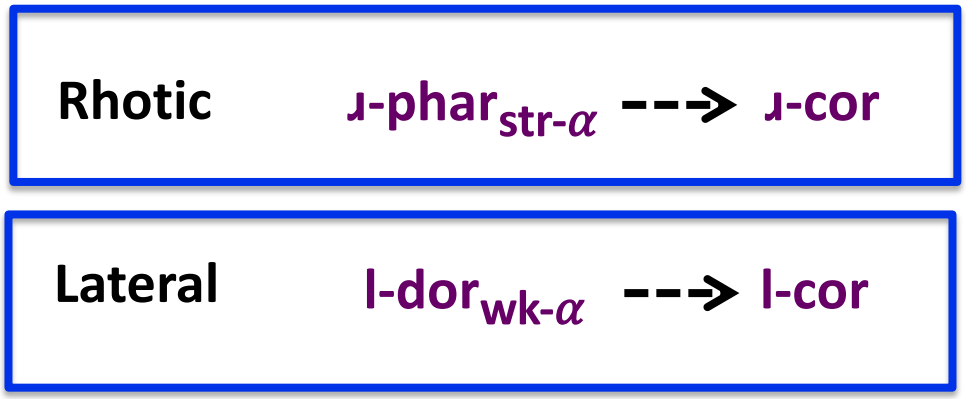
Phonological representation fitting with characteristics of liquids

- **Gestures** are subsegmental phonological units specified for
  - Articulator
  - Goal articulatory state
  - **Blending strength** (α-value); correlates with coarticulatory dominance
    - If overlapping gestures impose conflicting demands, their goal articulatory states are blended and might not be achieved (Browman & Goldstein 1986 et seq., Saltzman & Munhall 1989, Iskarous et al. 2012, Smith 2018; cf. Lionnet 2016.)
- **Temporal structure:** Two coordination relations for gestures
  - **Synchronous**: Simultaneous onset of gestures
  - **Sequential**: Onset of following gesture sequenced with release or offset of preceding gesture.

3.3 Representation – Liquid-internal

GenAm coda liquids

- **Segment-internal sequencing of lingual gestures**



- Dashed arrow represents sequential relation
- **ɹ-phar** = TB gesture of /ɹ/, **ɹ-cor** = TT gesture of /ɹ/
- **l-dor** = TB gesture of /l/, **l-cor** = TT gesture of /l/
- Blending strength: str-α (strong) or wk-α (weak)
  (str/wk is sufficient here – but α is more finely scaled)

3.4 Representation – Coordination and Weight

Gestures in phonological grammar

- Temporal structure over gestures is **constrained by grammar**.
- Implementation using OT constraints.

  (Gafos 1996/1999, 2002, Davidson 2003, Hall 2003, Bradley 2005, 2007, Casserly 2012, Tejada 2012, Smith 2018, Walker & Proctor 2018.)

Coda weight

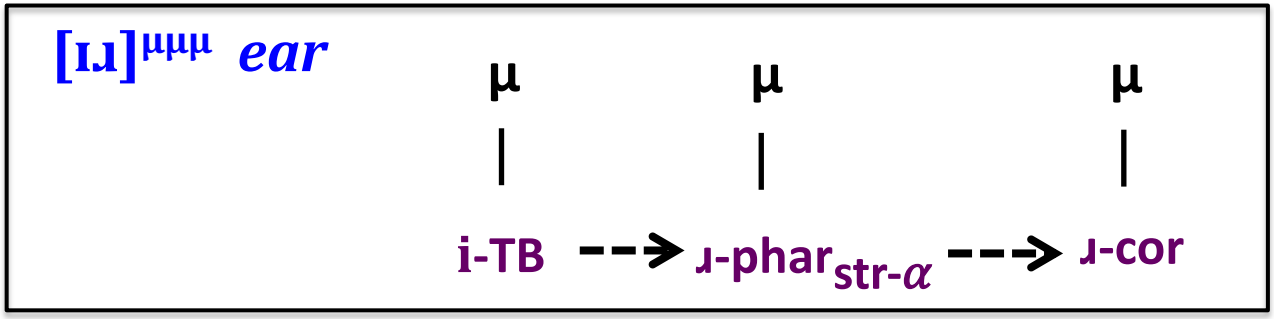
- Computed at **subsegmental** level.
- Assign a violation to every gesture in a syllable that lacks an associated mora that is sequenced directly or by transitivity after a head (lingual) vowel gesture (= WEIGHT-BY-POSITION).

  (Browman & Goldstein 2000, Nam 2007; on concept of V and C head gestures see Gafos 2002 and Smith 2018.)

3.4 Representation – Coordination and Weight

Vowel quantity neutralization – *Within-segment sequencing*

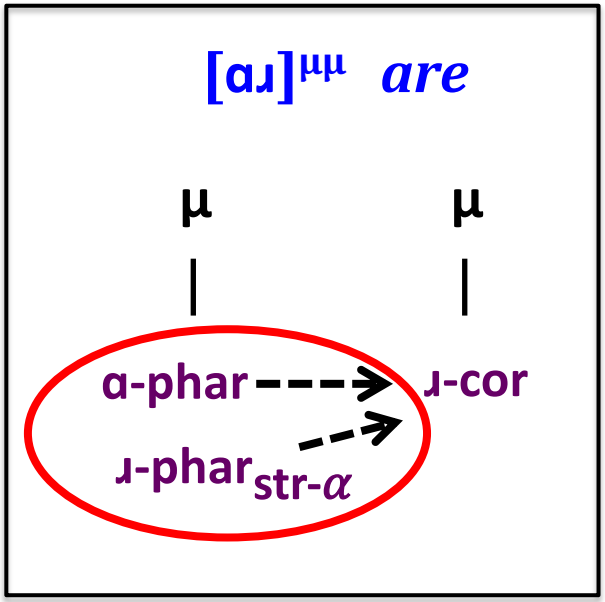
- Affects Vs differing in length (tense/lax) with a lingual constriction considerably distinct from ɹ-phar, with a **strong** blending strength.
- To preserve vowel quality, ɹ-phar is **sequenced** after the vowel's lingual gesture (i-TB = tongue body gesture of [iː]/[ɪ]).
  - **Result**: coda /ɹ/ is **bimoraic** and the preceding V is short.
  - A long V or additional coda C would exceed 3μ.

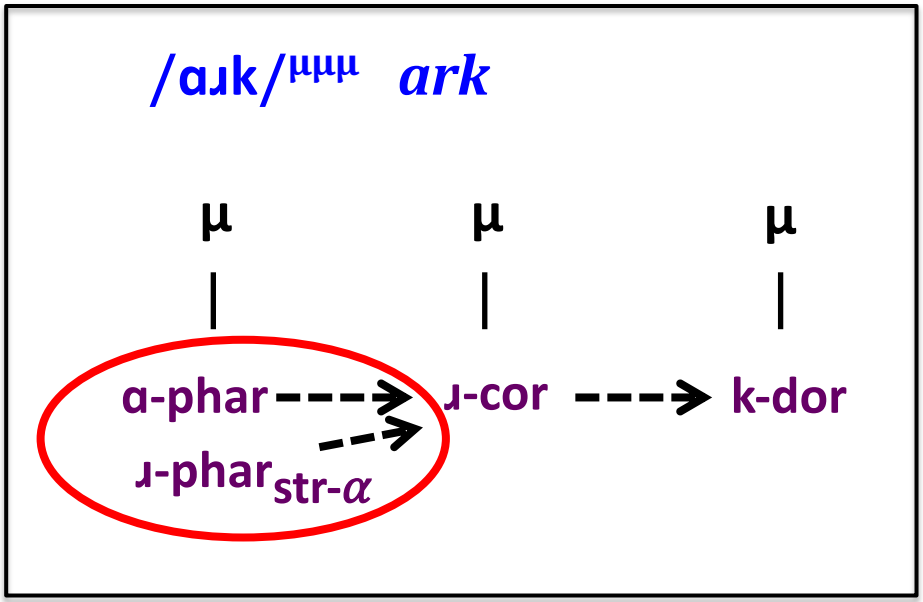


3.4 Representation – Coordination and Weight

Special status of [ɑɹ] and [ɔɹ] – *Cross-segment Partial Overlap*

- Despite its strong blending strength, the ɹ-phar gesture does not interfere in a neutralizing fashion with the TB gesture of /ɑ/ and /ɔ/, because of their similarity.
- Hence, ɑ/ɔ-phar and ɹ-phar can **overlap** and are **not sequenced**. Each is coordinated to precede ɹ-cor.
- **Result**: coda /ɹ/ adds only **1μ** to a syllable with /ɑ/ or /ɔ/.

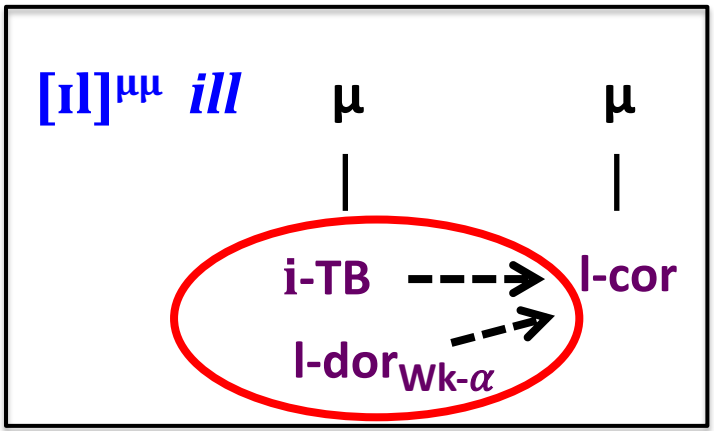


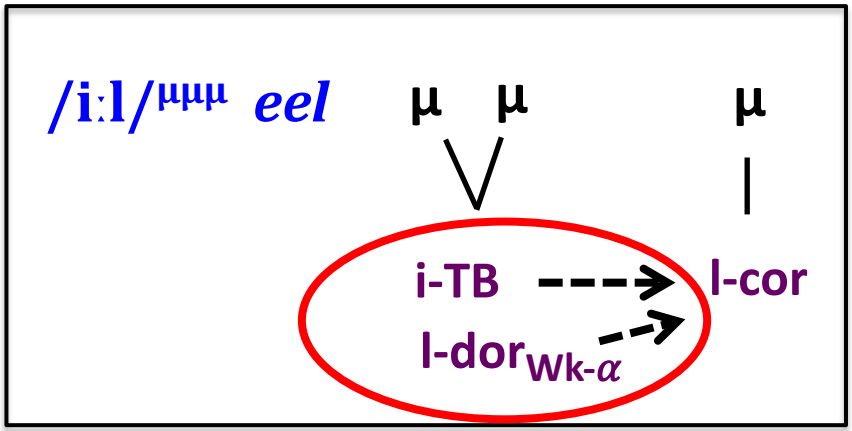


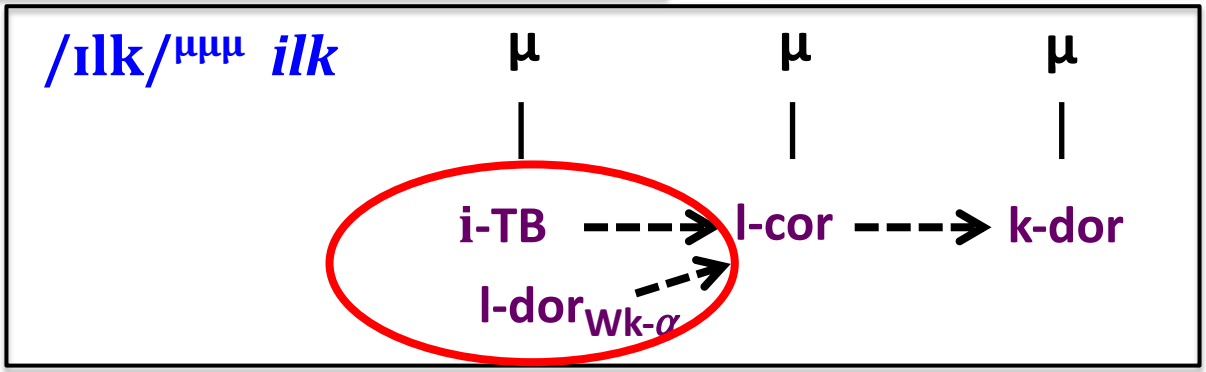
3.4 Representation – Coordination and Weight

Temporal structure of coda /l/

- l-dor has weaker blending strength than ɹ-phar in GenAm, i.e. lesser coarticulatory effect of /l/ on a preceding V.
- Like rimes where /ɹ/ contributes just 1μ, V-TB and l-dor can overlap, so /l/ adds only 1μ.







3.5 Summary

Temporal structure

- Phonotactics involving coda liquids motivate representing temporal structure at the level of subsegments.
  - Fits with gestures as representation of subsegmental units
  - Key role for incorporating blended overlapping subsegments – sensitive to strength – in phonological patterns

Outlook – Implications for hierarchical structure

- **Partial segment behavior** with respect to temporal organization of subsegments **within** and **across** segments has potential to be addressed by representing segments as subsegmental sets, rather than based in root nodes.

  (Walker 2017, Smith 2018; this possibility was also considered by Padgett 2002)

Thank you

Appendix

Appendix: Implications for segments

Where temporal structure resides

- The account of phonotactics presented here relies on **temporal relations at subsegmental level**, not segmental level.
- Temporal role of root node insufficient and obviated.

Segments as gesture sets

- Each segment is composed of a referenceable **set** of gestures; **no root node** (Walker 2017, Smith 2018).

  (Note Padgett 2002: 98-99 and other work that reduces segmental hierarchical structure, e.g. Steriade 1987, Hayes 1990, Tilsen 2016. Related work includes Browman & Goldstein 1986 et seq., Byrd 1996, Byrd et al. 2009, a.o.)

- Input contains linear order over gesture sets representing segments

  (See Smith 2016, 2018 on linear indexation in the input as a basis of epiphenomenal segmenthood, and foundational proposals to replace association lines with coindexation by Halle & Vergnaud 1980, Hayes 1990.)

Appendix: Implications for segments

/b₁ɑ₂r₃/ *bar*

Input:

1	2	3
{labial closure}$_i$	{TB phar narrow}$_j$	{TB phar narrow str-α, TT palatal narrow}$_k$

Solid line = synchronous
Dashed arrow = sequenced

Output:

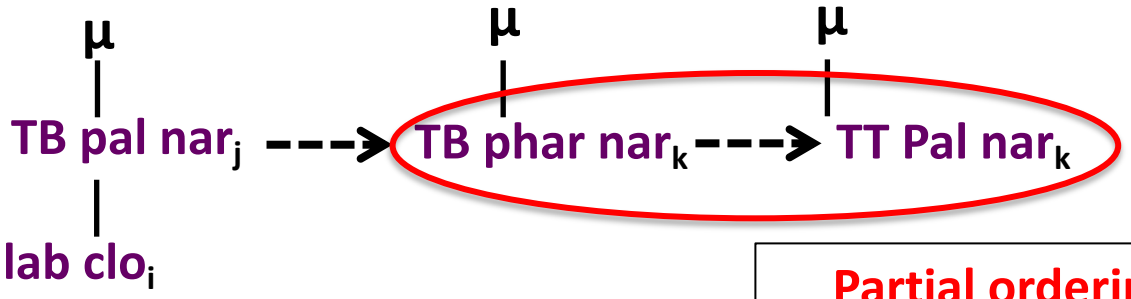
Partial overlap across segments

/b₁i₂ɹ₃/ *beer*

Input:

1	2	3
{labial closure}$_i$	{TB pal narrow}$_j$	{TB phar narrow str-α, TT palatal narrow}$_k$

Output:



Partial ordering within segments

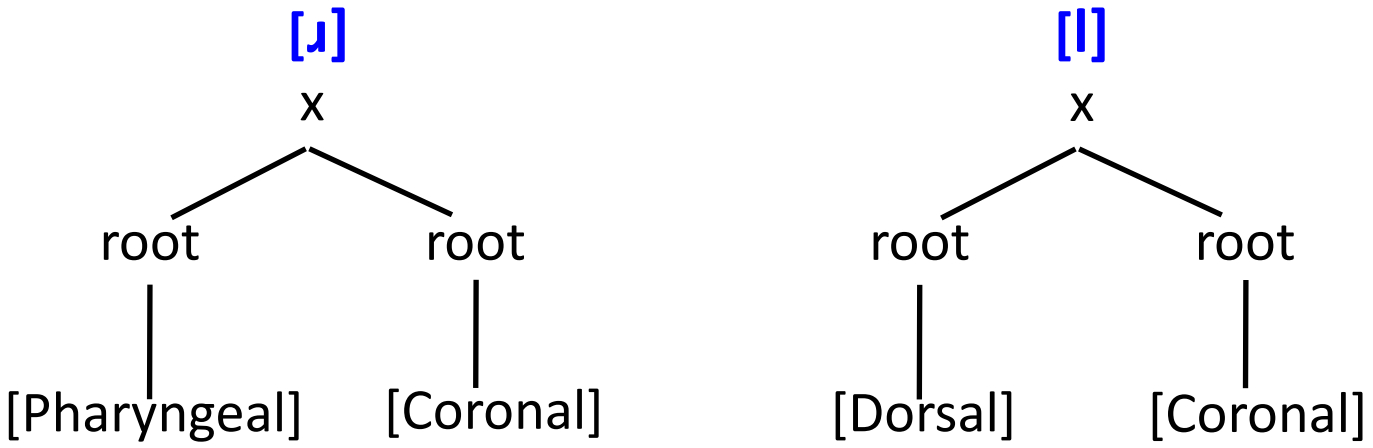
Appendix: Alternatives

Node-based intra-segmental sequencing

- Various proposals have been made to obtain within-segment sequencing of subsegments via a sequence of structural nodes.
  - **Two-root Contours** (Clements 1987, Piggott 1988, Rosenthall 1988).
  - **Aperture Theory**: Sequences of aperture positions (closure and release) in stops (Steriade 1992, 1993a, b, 1994).
  - **Q-theory**: Segments as tripartite sequences of quantized subsegments (Shih & Inkelas 2014, to appear, Inkelas & Shih to appear).
- Problems presented by partial segment behavior involving coda liquid phonotactics:
  - Segments that are partially overlapped and partially sequenced with another segment
- **Issues illustrated here with two-root approach.**

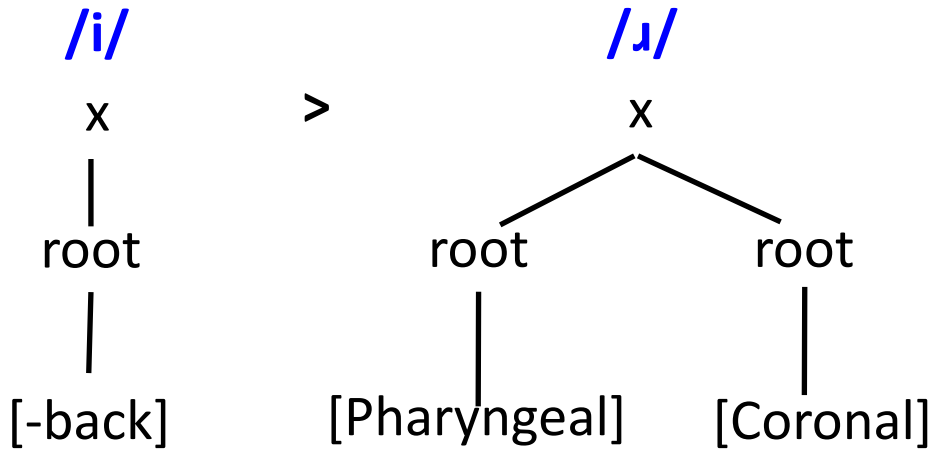
Appendix: Alternatives

- Two-root analysis employs a sequence of two root nodes under a single skeletal position.
- This approach can represent temporal ordering **internal to a segment**.
- Applied to /ɹ/ and /l/ in GenAm codas:



Appendix: Alternatives

- Whether skeletal slots, roots or some other node identifies segments, **spatial elements are ordered across segments.**
- Fails to represent overlap between V and pharyngeal subsegment of coda /ɹ/, and likewise between V and dorsal subsegment of /l/, **where non-sequenced subsegments belong to separate segments.**



[-back] of /i/ is represented as **preceding** [Phar] of /ɹ/; no overlap