

Laryngeal timing variability in Sevillian Spanish metathesis

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Sevillian Spanish metathesis

- Sevillian Spanish metathesis sound change (ongoing)
- Many varieties of Spanish have debuccalization of coda /s/ to [h]
- Sevillian Spanish change in progress from h-stop to stop-h (/sp, st, sk/: [hC] → [Ch])

UR

a. /tʃispa/

b. /pasta/

c. /kasko/

Debuccalization

[tʃihpa]

[pahta]

[kahko]

Metathesis

[tʃipha]

[patha]

[kakho]

‘spark’

‘pasta’

‘helmet’

(Torreira 2006; Torreira 2007; O’Neill 2010; Torreira 2012; Ruch & Harrington 2014; Ruch & Peters 2016)

Sevillian Spanish metathesis

- Divergence between phonology and phonetics
 - The stop-h sequences resulting from metathesis are treated as /sC/ clusters phonologically
 - Listeners interpret metathesized [h] as belonging to preceding word and syllable:

Listeners hear		Listeners interpret	
[tjene phali]	→	/tjene <u>s</u> pali/	'2sg has <i>pali</i> ' (Gilbert 2023)
[gi.na.ka.pho]	→	/ginaka <u>s</u> po/	nonce word (Gilbert In revision)

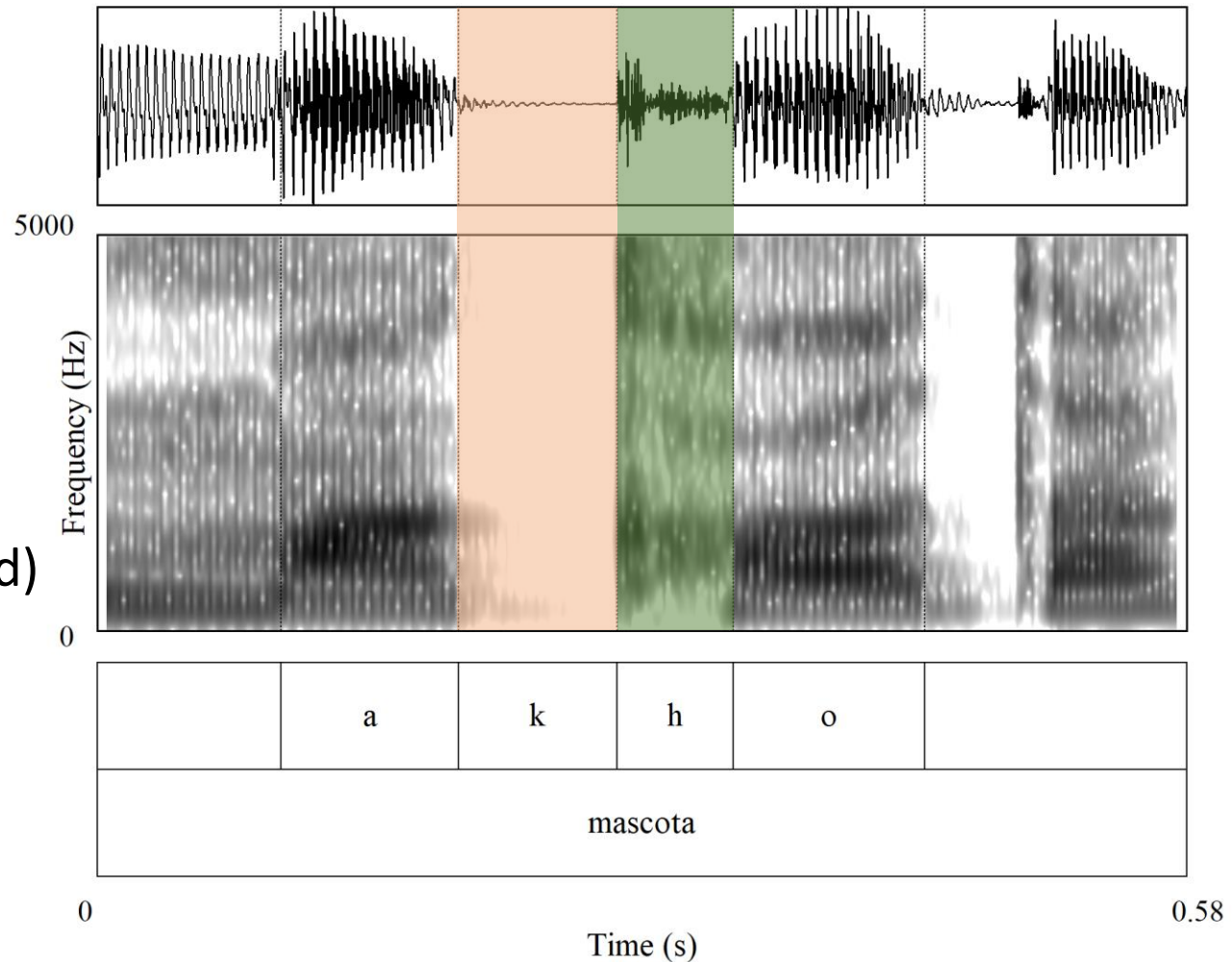
- But these stop-h sequences look and sound like aspirated stops

Sevillian Spanish metathesis

/sC/: /maskota/
[h] = 62ms

Cf. other VOTs
English (aspirated)
/k/ = 70-80ms

Spanishes (unaspirated)
/k/ = 20-30ms



Aspirated stops vs. Sevillian stop-h

- Surface pronunciation looks and sounds like that of aspirated stops
....but behave like /sC/ clusters phonologically
- **Difference between phonetics and phonological behavior**
- **What is the nature of the phonetic differences between aspirated stops and derived stop-h sequences?**

More broadly: are there phonetic correlates to abstract phonological differences?

Segments and clusters

- Distinction between stop-h sequences and aspirated stops is similar to distinction between other types of **(complex) segments** vs. **clusters**:



- This difference in representation must be learnable
 - Phonotactic distribution, frequency, syllabic affiliation, decomposability, **phonetics and articulation**, etc. (overview in Gouskova & Stanton 2021)

Segments and clusters

- Complex segments and clusters sometimes differ phonetically in predicted ways (Trubetzkoy 1939; Riehl 2008; Cohn & Riehl 2016)
 - Also contradictory findings
 - Greek affricates (Arvaniti 2007); Javanese nasal-stop sequences (Adisasmito-Smith 2004); Bura labiovelars (Maddieson 1983); nasal-stop sequences in Chaga and English (Browman & Goldstein 1986)
- Common diagnostic acoustic characteristics: duration (total; of the parts); duration of preceding vowel; nasalization in preceding vowel (nasal-stop sequences)

Segments and clusters

- Complex segments and clusters are predicted to differ articulatorily
 - Differences in **gestural alignment** (Browman & Goldstein 1986; Shaw et al. 2021)
 - Differences in **gestural coherence** and **timing variability** (Saltzman & Munhall 1989:365; Löfqvist 1991:346; Byrd 1996a; Shaw et al. 2021)
 - Differences in **how gestures are timed across morpheme and word boundaries** (Cho 2001), and in **different prosodic positions** (Jang 2011)

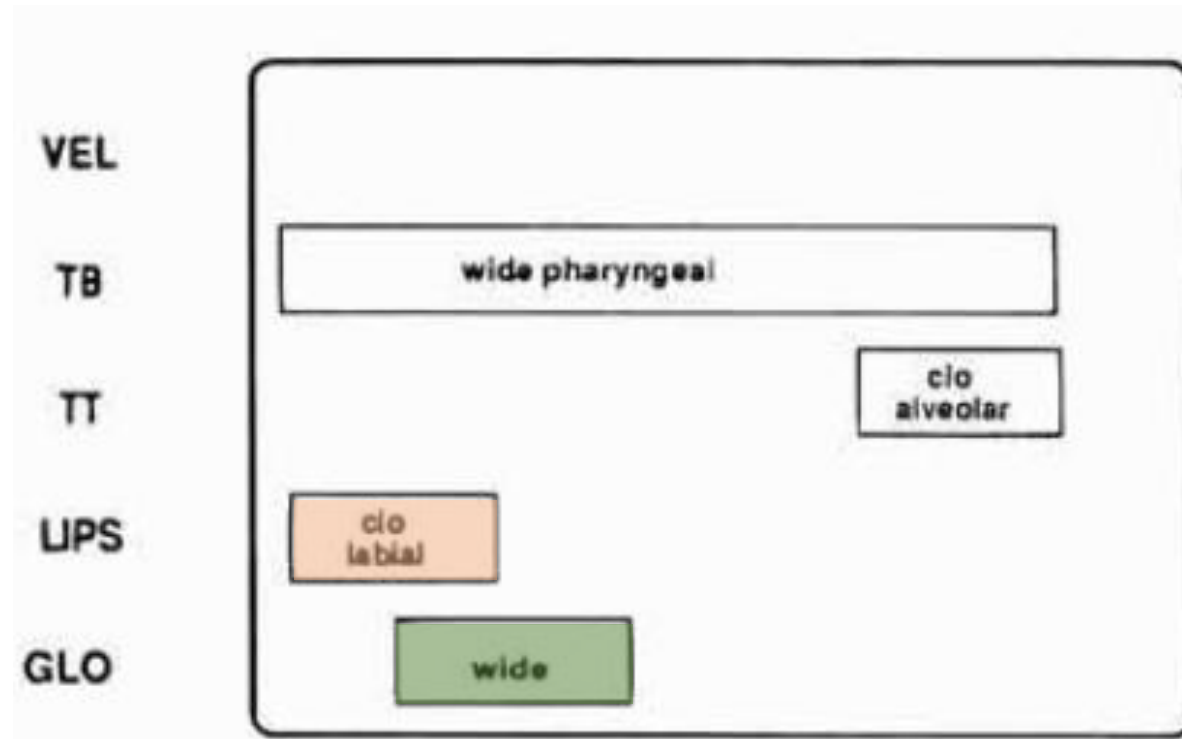
- My research investigates these predictions in a new context: stop-laryngeal sequences

What do stop-h and aspirated stops share?

- Both consist of laryngeal gesture and stop closure gesture

Aspirated stop

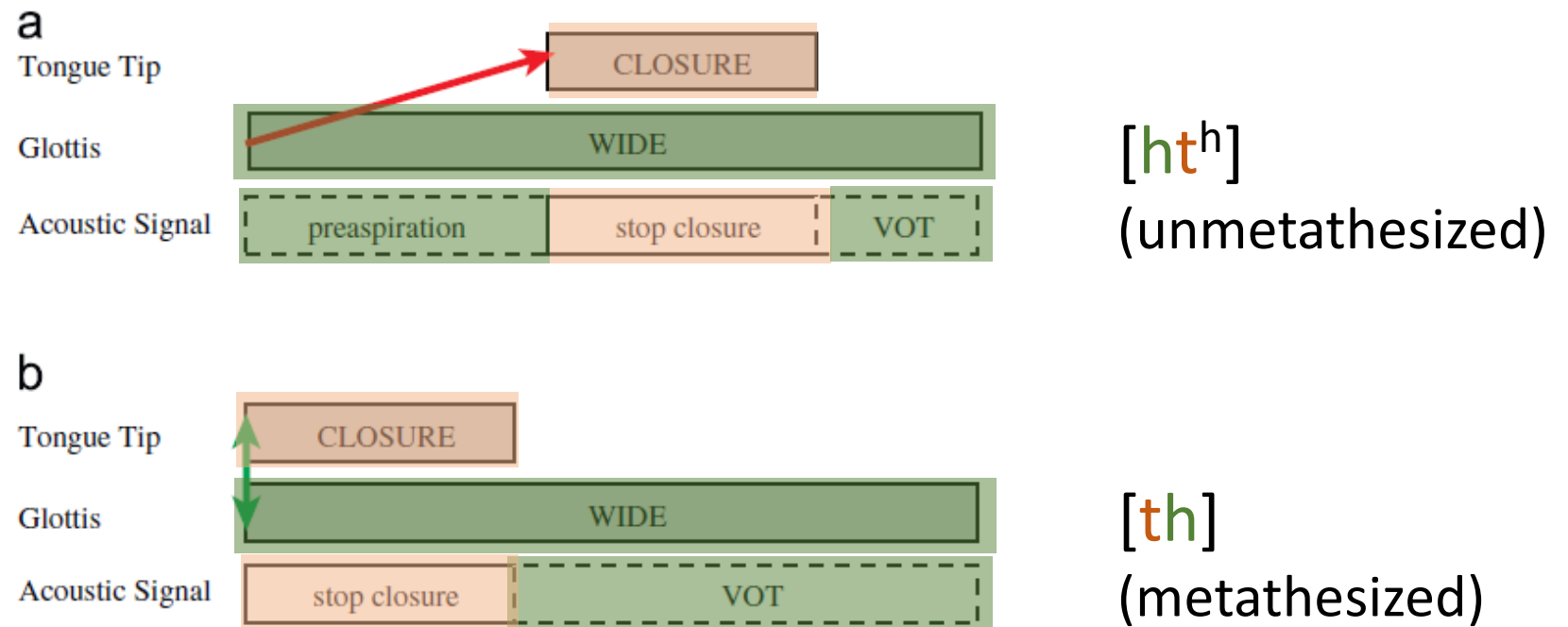
‘pad’
[phæd]



Browman & Goldstein 1992

What do stop-h and aspirated stops share?

- Sevillian metathesis is often described as shift in timing of stop closure gesture in relation to laryngeal (adapted from Parrell 2012)



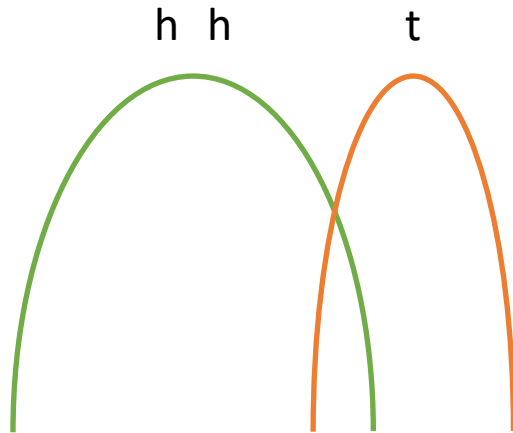
Potential differences: Sevillian stop-h vs. aspirated stops

- Distinction is not in *which* gestures are used, but in other properties

Hypothesized differences	Predictions for Sevillian stop-h (vs. aspirated stops)
Different timing of laryngeal gesture (Browman & Goldstein 1986; Hoole & Bombien 2017)	Differences in timing of glottal opening; differences in pre/post breathiness, acoustics of stop release, and coarticulation with surrounding vowels
Lower gestural cohesion in clusters than complex segments (Saltzman & Munhall 1989; Löfqvist 1991; Byrd 1996a)	High(er) variability in timing of laryngeal gesture around stop closure
Difference in featural specification of stop	Lack of 'VOT' lengthening as enhancement method in prosodically strong positions ([h] is not contrastive feature of stop)

Sevillian (partial) metathesis

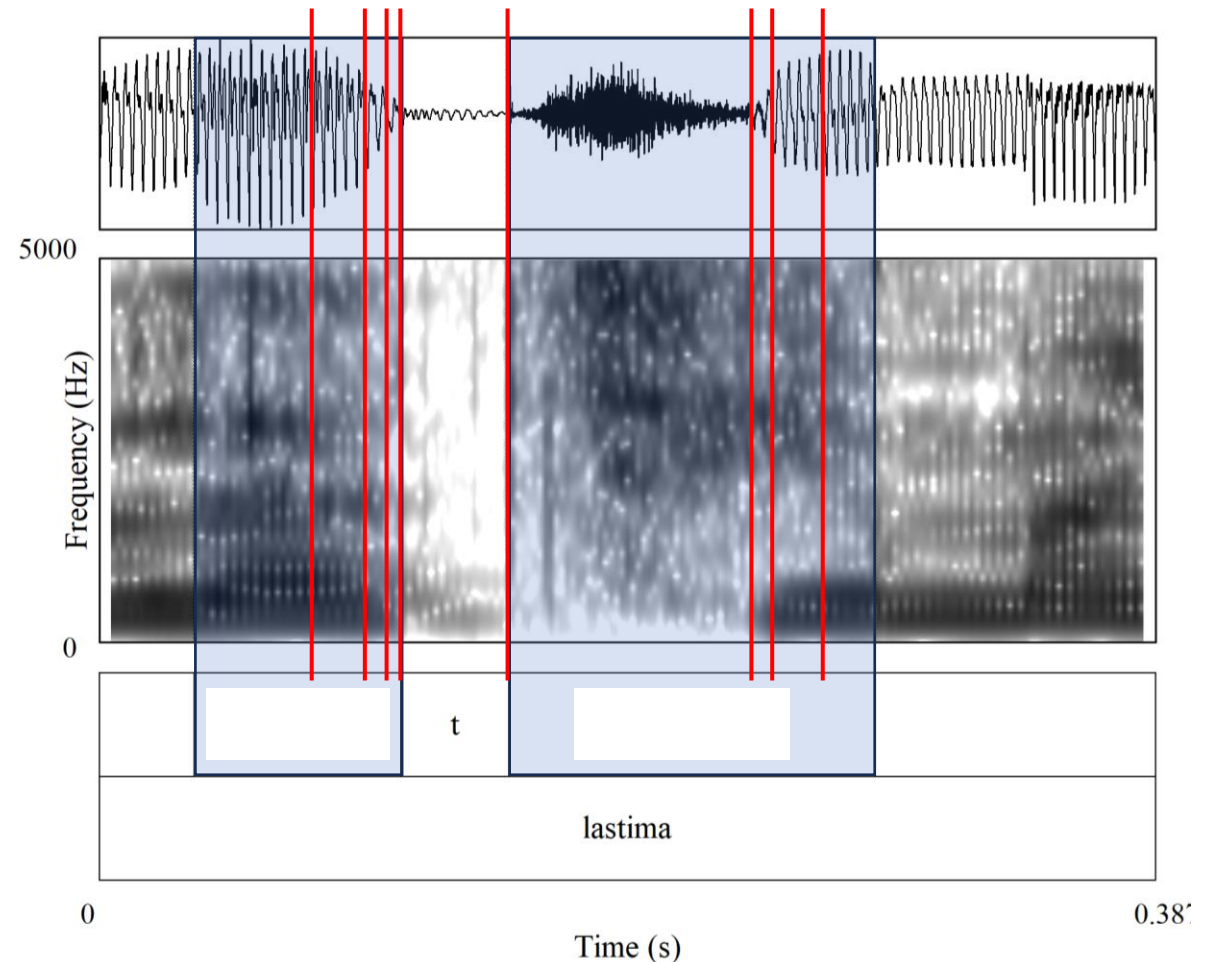
- Why suspect stop-h sequences might differ in timing and cohesion?
- Metathesized forms are the majority of forms in conversational speech (70%)
- ‘Split’ forms ([hth]) are also reported (11%) (Ruch 2008)
- Under gestural explanation, ‘split’ forms are expected



- Split forms may provide important evidence *against aspirated stop representation* for learners

Sevillian (partial) metathesis

- Reported rate of split forms is low, but might be undercounted
- Challenge: [h] is difficult to segment

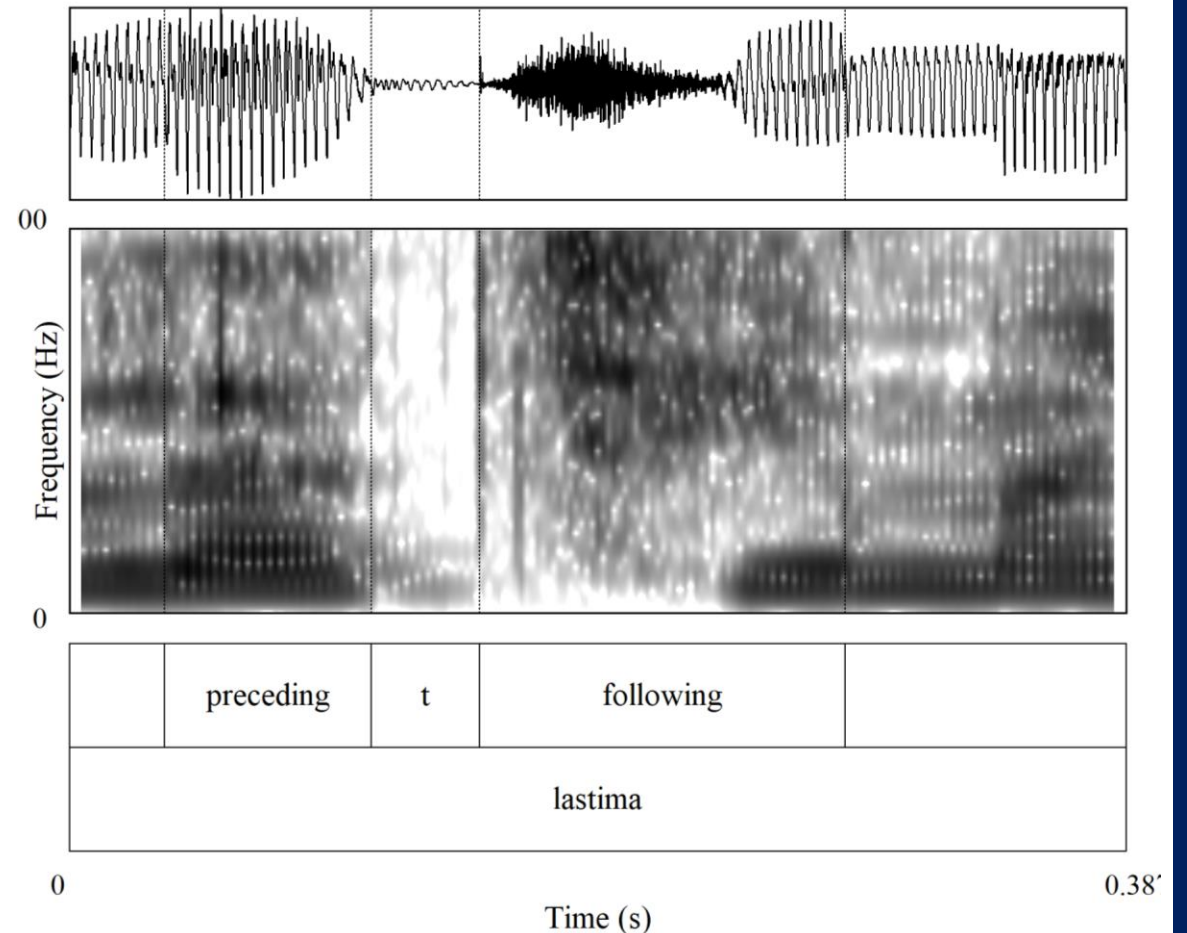


This talk

- **Main question: What cues to segmental status are present in Sevillian stop-h sequences?**
 - Production study: laryngeal timing and variability in Sevillian stop-h sequences (acoustic data)
- **Results suggest that:**
 1. Sevillian metathesis is often incomplete, and occurs via gestural re-alignment
 2. Laryngeal timing is highly variable between-speakers
- **Implication feeding future work:**
 1. Timing and timing variability of laryngeal gesture in relation to stop closure may differ in Sevillian as compared to aspirated stops
→ phonetic evidence of representational difference

Production study: Measurements

- Use breathiness as proxy for timing of laryngeal
- Cepstral Peak Prominence (CPP)
 - Measure of noise/irregularity in signal (Hillenbrand & Houde 1996)
 - Measured at 10 points over intervals *preceding* and *following* the stop closure (PraatSauce; Kirby 2018)
 - Captures breathiness even when [h] is not segmentable



Production study: Sevillian data

- Production data from 24 speakers (female, ages 18-24)
- Target words (C, SC, Affricate, CC) controlled for vowel context and stress

	/p, t, k/	/sp, st, sk/	Affricate	/pt, kt/	
a...a	/fa'tales/	/kas'tano/	/ta'tfaba/	/kap'taba/	90 unique words per speaker, 2 repetitions
a...e	/ma'teria/	/pas'teles/	/ta'tfemos/	/kap'temos/	
....					

- Data today: /C/, /sC/, 1 repetition per speaker
 - 1203 word tokens (/C/, /sC/)
 - 2172 preceding and following intervals

Production study: Modeling

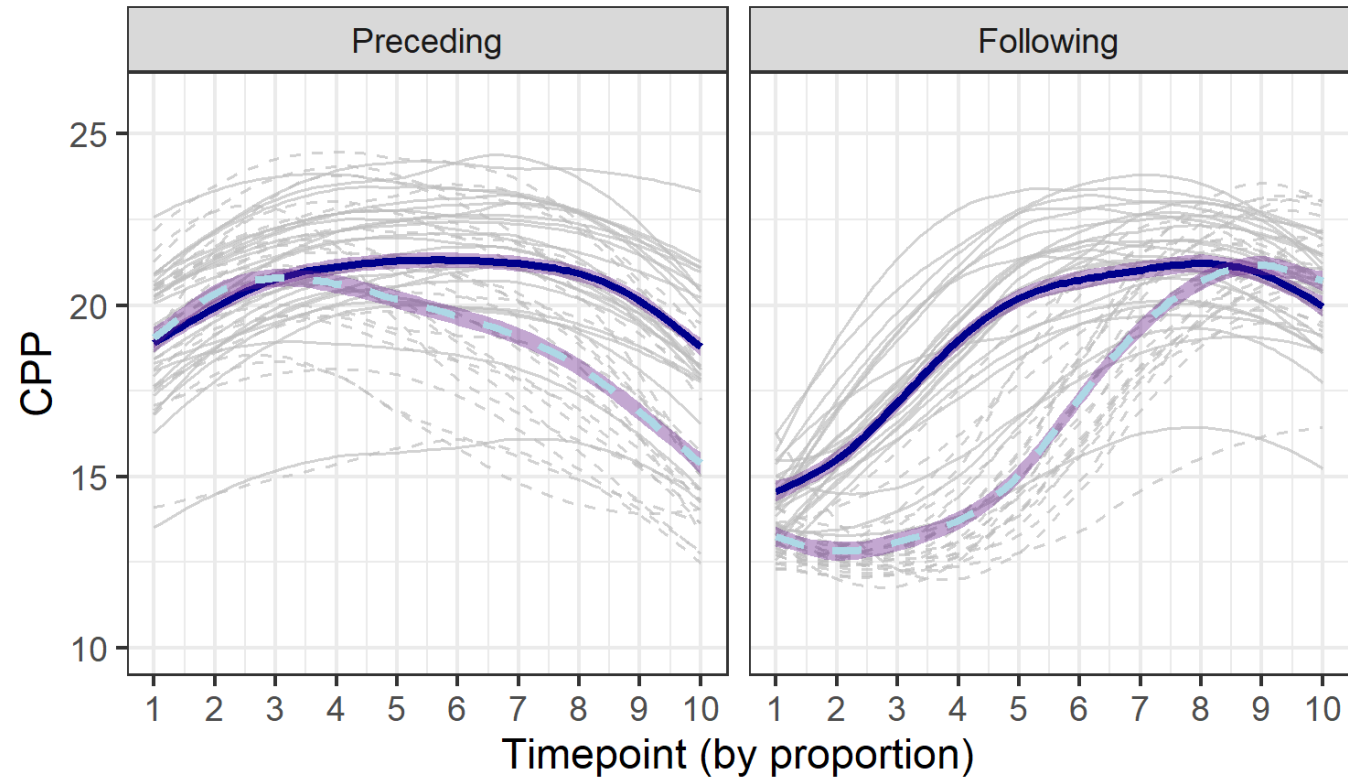
- CPP trajectories modeled with GAMs (*mgcv::gam()* [Wood 2022; 2017]; visualization with *itsadug* [van Rij et al. 2022])
 - Separate models by interval (Preceding, Following) and Group (Early, Mid, Late, No Starters)
 - Fixed effect:** WordType (C, SC, CC)
 - Smooth:** Time by WordType
 - Factor smooth:** Speaker by WordType over Time (non-linear random effect)
- GAM-predicted trajectories look similar to raw data
 - Raw data: trajectory of CPP measures
 - Modeled data: plots with significant differences between curves marked

Results: Laryngeal re-alignment

Preceding:

e.g., fatales
[fatales]

e.g., castaño
[ka(h)t(h)ano]



Following:

e.g., fatales
[fataales]

e.g., castaño
[ka(h)t(h)ano]

— c — sc

(low CPP = more breathy)

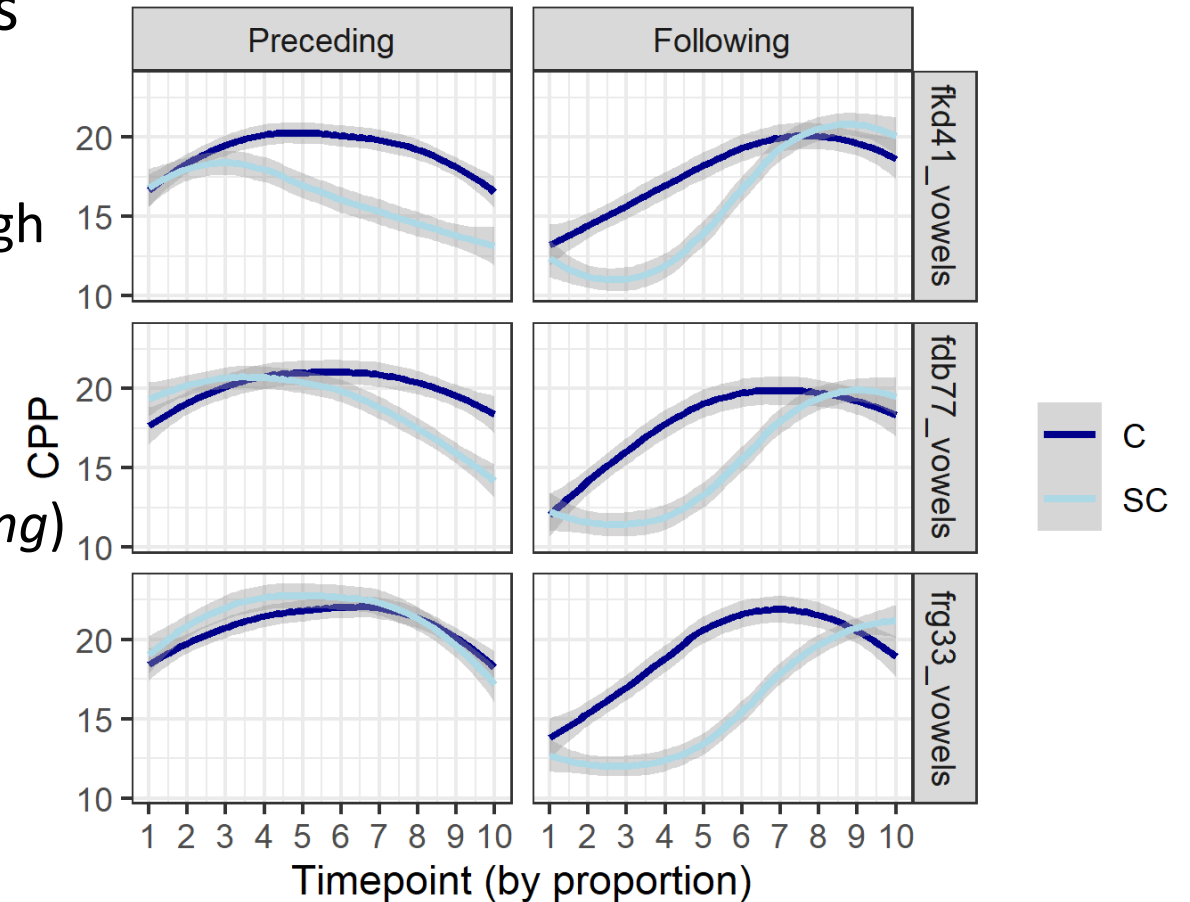
Results: Laryngeal re-alignment

- Speakers fall into several categories

- Early-onset breathiness →
(25% of speakers; by 60% of way through *Preceding*)

- Mid-onset breathiness →
(79% of speakers by the end of *Preceding*)

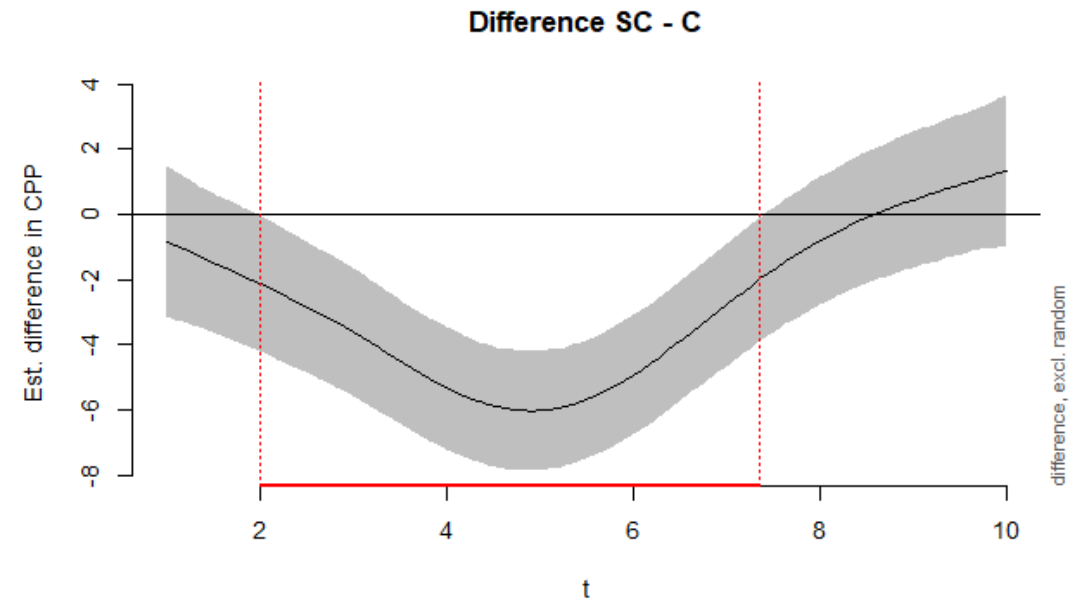
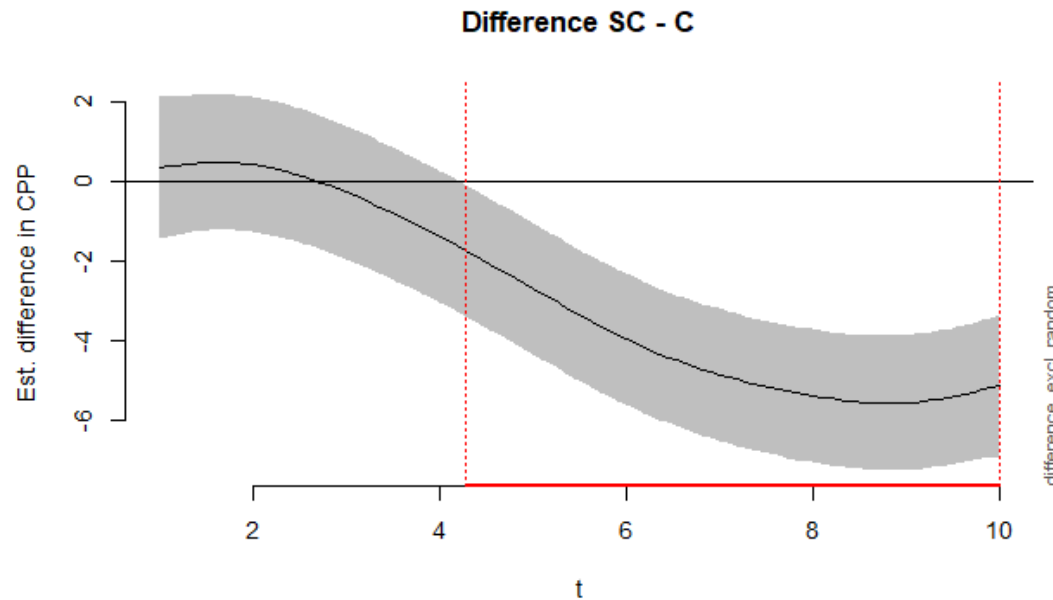
- Late/No pre-closure breathiness →
(21% of speakers)



(low CPP = more breathy)

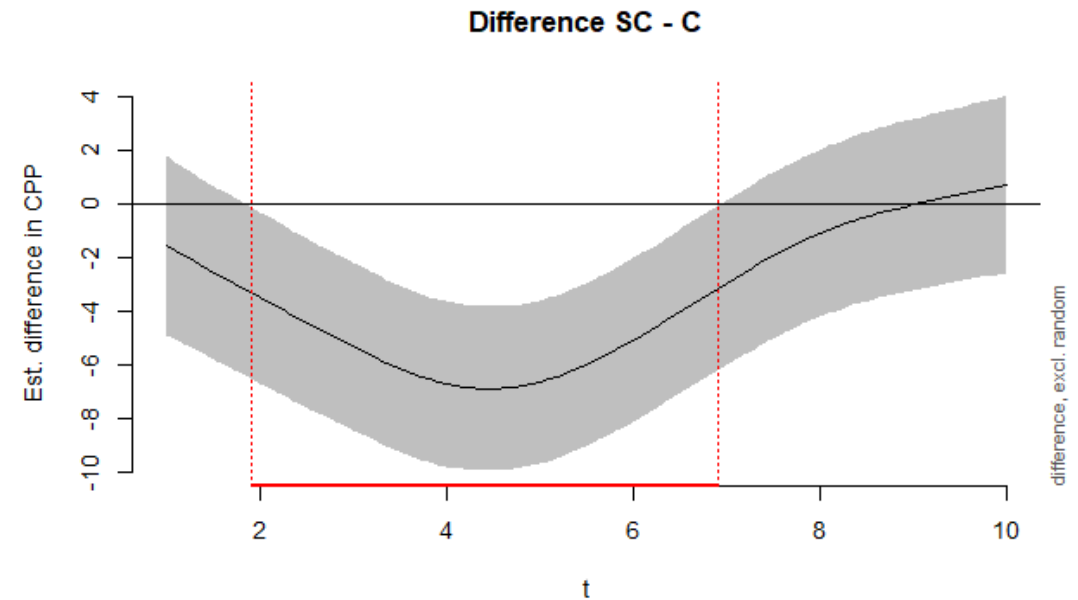
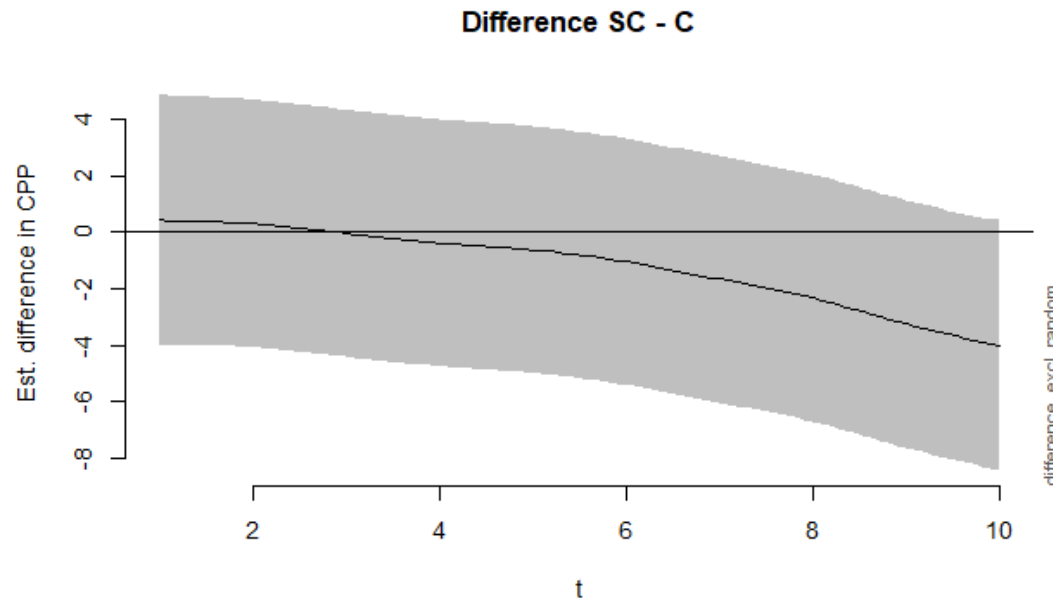
Results: Laryngeal re-alignment (C-SC)

- **Early starters:** significant difference in C vs. SC curve preceding and following stop closure



Results: Laryngeal re-alignment (C-SC)

- **Late starters:** significant difference in C vs. SC curve following stop closure; no significant difference preceding stop closure



Results: Laryngeal re-alignment

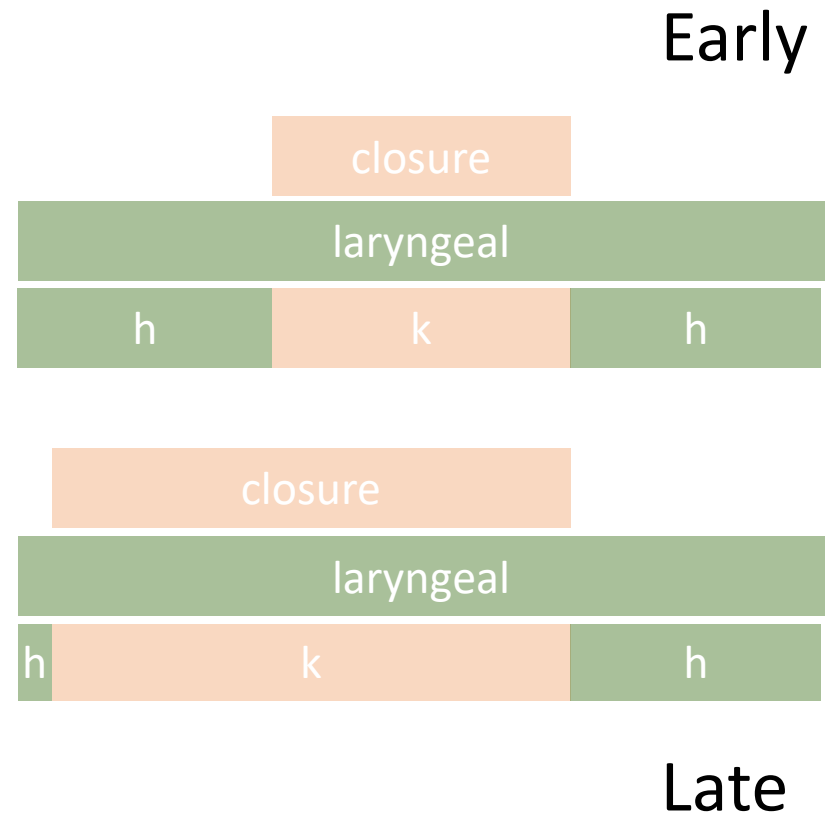
- Are differences in groups possibly explained by differences in **closure duration** in /sC/ words?
- Sevillian has gemination of consonant following /s/, when /s/ reduces

/pasta/ → [pa(h)t(:)(h)a]

- Occurs diachronically before metathesis (Ruch & Harrington 2014), and also operates **synchronously** (e.g., Torreira 2006; Ruch & Harrington 2014)

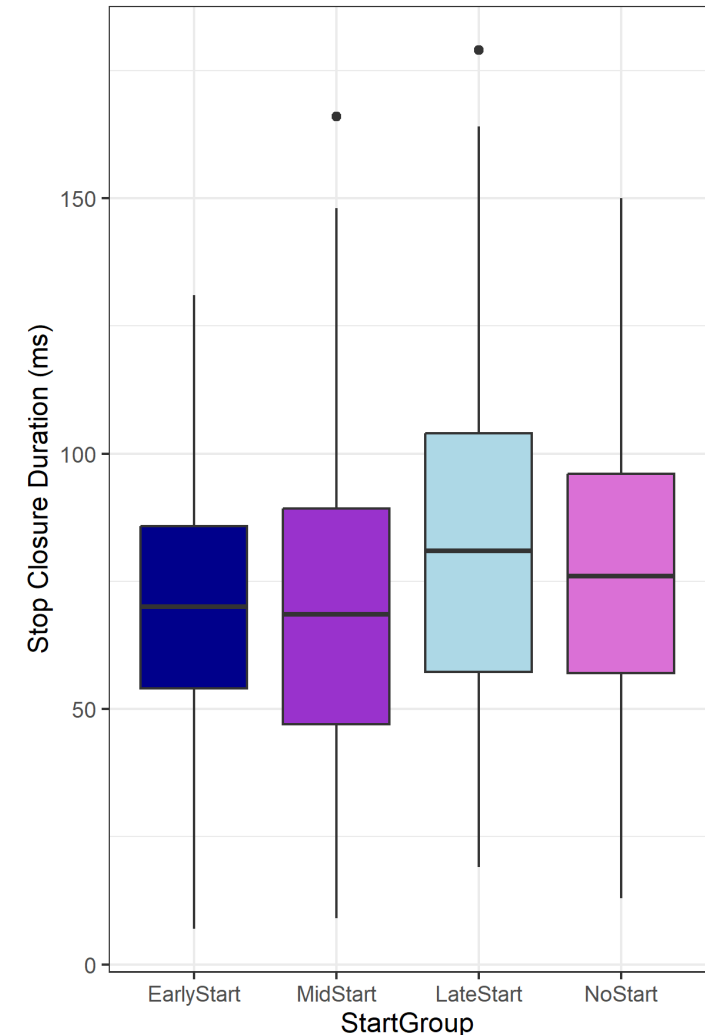
Results: Laryngeal re-alignment

- Are differences in groups possibly explained by differences in **closure duration** in /sC/ words?
- If so, early starter group should have shorter closure durations than later starter groups (more of laryngeal visible on surface, assuming stable duration of laryngeal)



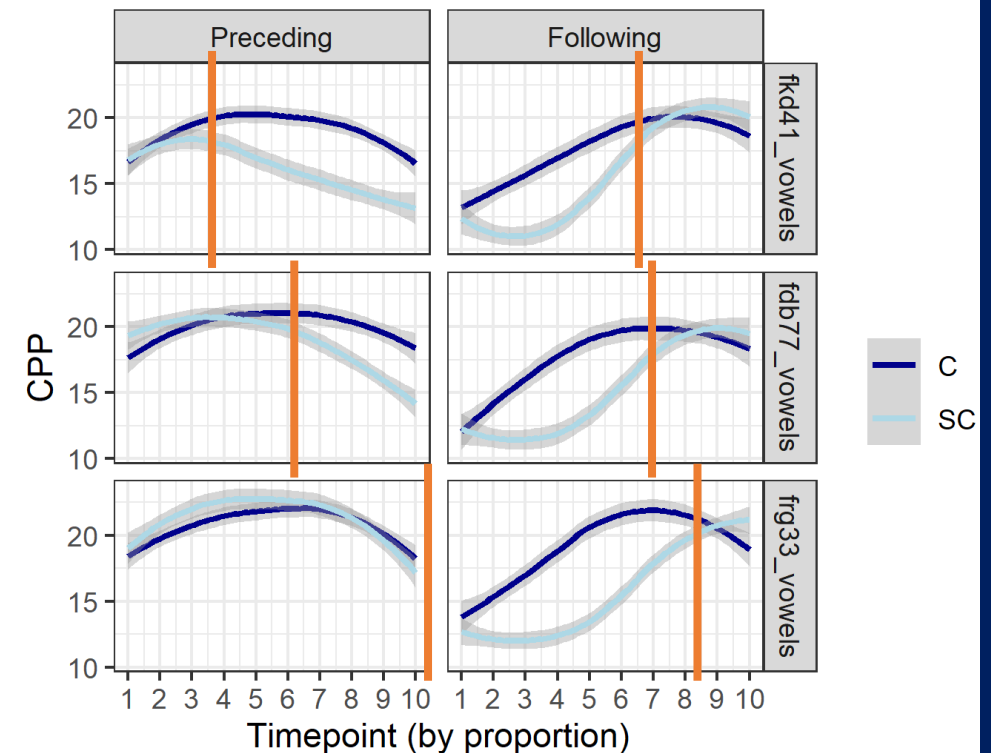
Results: Laryngeal re-alignment

- Are differences in groups possibly explained by differences in **closure duration** in /sC/ words?
 - Groups have similar closure durations; no correlation with how early breathiness appears to start preceding closure
 - But, difference between groups not just due to shifting closure gesture
 - May differ in total duration of laryngeal



Results: Laryngeal re-alignment

- Are differences in groups possibly explained by differences in **closure duration** in /sC/ words?
 - Groups have similar closure durations; no correlation with how early breathiness appears to start preceding closure
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Results summary

- Sevillian metathesis is often phonetically incomplete
 - Easily explained as gestural realignment: phonetically and articulatorily gradual
- Laryngeal is variably, and loosely, timed in relation to stop closure
 - Speaker-specific patterns: some tend to metathesize (almost) completely; others tend to split [h] across the stop
 - Not explained by differences in closure duration
 - Within-speaker variability: important next step (ideas welcome!)

Stop-laryngeal and laryngeal-stop sequences

- Investigation of laryngeal timing in Sevillian sets stage for cross-linguistic comparison of stop-laryngeal and laryngeal-stop sequences
 - Laryngeal contrasts defined by presence *and timing* of laryngeal gestures (Browman & Goldstein 1992; Dutta 2007), so timing must be represented somehow
 - Laryngeal-stop and stop-laryngeal sequences arise from different hypothesized representations

Stop-laryngeal and laryngeal-stop sequences

- Laryngeal-stop and stop-laryngeal sequences arise from different hypothesized representations

Proposed representation	Language	Example	Other similar languages (not comprehensive)
(Post)Aspirated	German	[t ^h a:k ^h] ‘day’	Mandarin, Thai, Hindi, English
[h] is contrastive feature of stop contrast (pre vs. post determined by position)	Faroese	[klɔ hp ^h] ‘gap’ (Helgason 2002)	Icelandic, Scottish Gaelic, Saami languages
[hC] and [Ch] are clusters	Finnish	saat-han ‘you do get, don’t you’ (Suomi et al. 2008)	(many)
	Sevillian	/pasta/: [pa (h)t(h) a]	Potentially: Khmer
[h] is optional correlate of a stop contrast	Italian	/fat:o/: [fa ht :o] ‘done’ (Stevens & Reubold 2014)	English varieties, Central Standard Swedish

Stop-laryngeal and laryngeal-stop sequences

- Comparing Sevillian with similar sequences that come from different representations frames broader questions about segmenthood:
 - Are these different representations reflected...
 - in phonetic detail?
 - in coarticulation patterns?
 - in how the sequences respond to changes in speech rate and planning?
 - in how the sequences are affected by word and morpheme boundaries?
 - in how listeners treat them in perception? (e.g., cue weighting, processing)
 - Do we need segmental representations to reflect differences in phonetics, articulatory organization, or speaker behavior?

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