

Looking into stops

Phonological representation below the level of the segment

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Overview

- Above and below the segment
- The phonology of stops
- Stops in Q Theory
- Similarities between stops and affricates

- Caveat: *This work is in progress!*

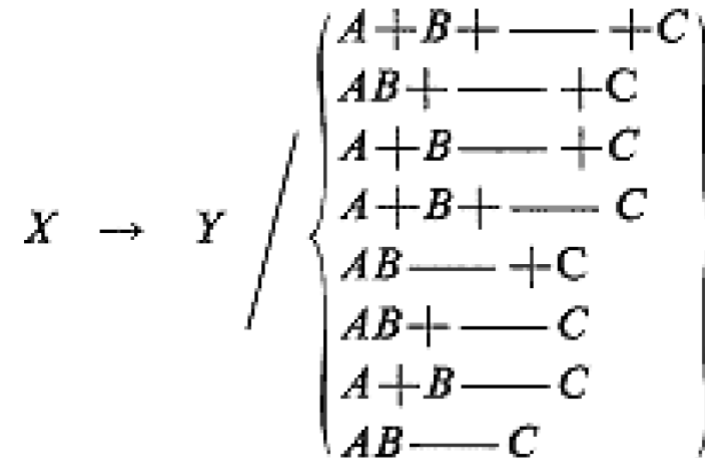
The segment in phonology

- The segment – an *individual speech sound* – has been extremely important in the development of modern phonological theory
 - As the basis of *the phoneme*, which was the focus of much early phonology
- In early American structuralist linguistics, phonology was called “phonemics”
 - → Focus was almost entirely on segmental phonology
- The segment/phoneme was also front and centre of early generative phonology
 - Which focused on the distinctive features of individual speech sounds
- And it makes sense! The segment is extremely useful!

Dresher (2011)

The segment in phonology (SPE)


	(a) <i>inn</i>	(b) <i>algebra</i>
	i n	æ l g e b r æ
consonantal	- +	- + + - + + -
vocalic	0 0	0 + - 0 - + 0
nasal	0 +	0 0 - 0 - 0 0
tense	- 0	- 0 0 - 0 0 -
stress	0 0	0 0 0 0 0 0 0
voice	0 0	0 0 + 0 + 0 0
continuant	0 0	0 0 - 0 - 0 0



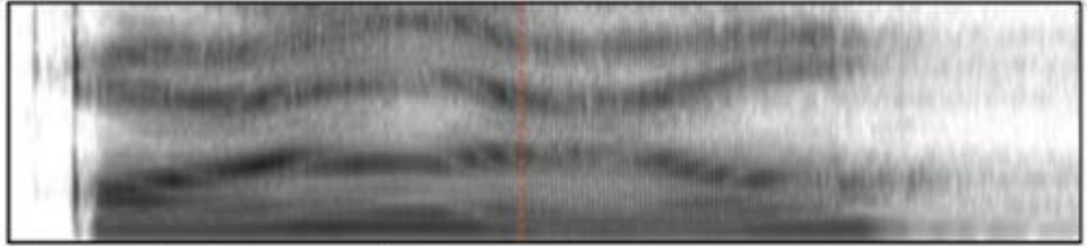
Chomsky & Halle (1968)

The segment in phonology

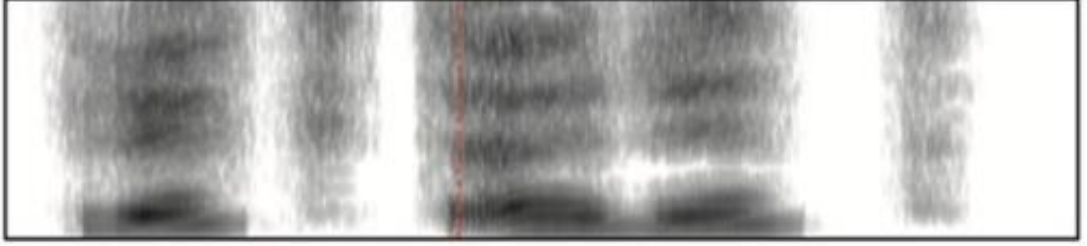
- From a phonetic perspective, speech is near-constant movement, and there's often more information *between* segments than *within* segments
- Still, many phonological generalizations are easier to make if we assume segments
- And imagine describing the phonology of a language without making use of segments...

 **Riccardo Fusaroli** @fusaroli · Sep 25

This Danish peculiarities (aka the grey wall of Danish) makes it arguably harder to process than otherwise comparable languages such as Norwegian Bokmål and Swedish.



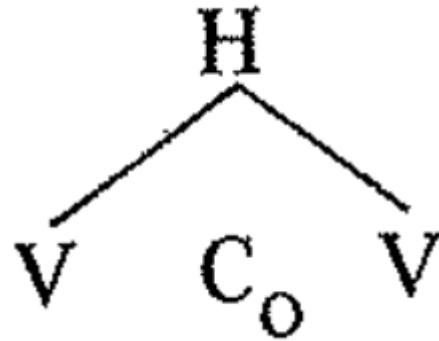
Danish sentence: Røget ørred



Norwegian sentence: Røkt ørret

Beyond the segment in phonology

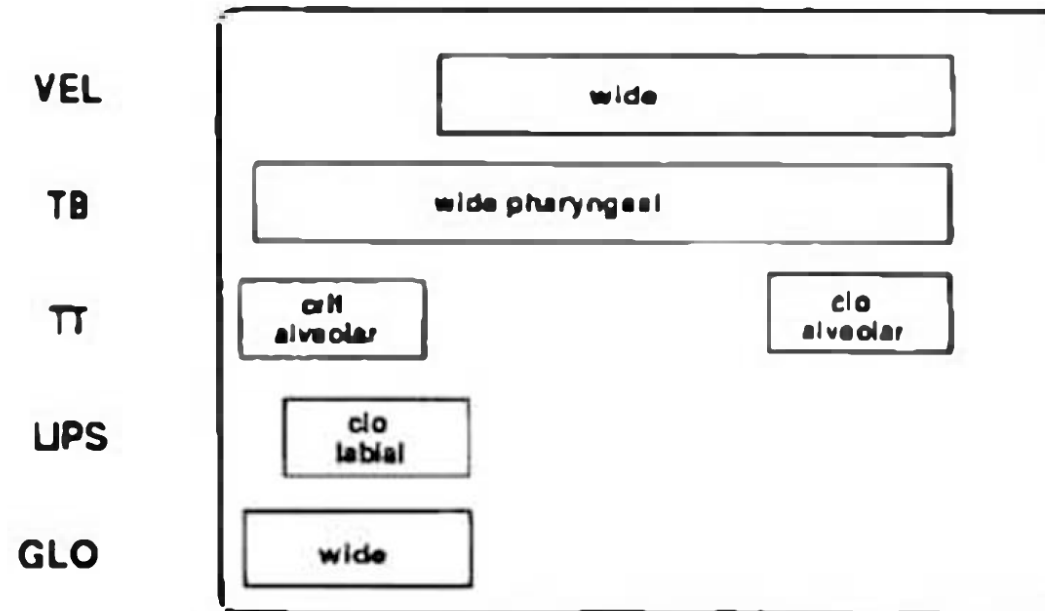
- Much of modern phonology is not organized around segments
- Autosegmental Phonology has popularized the notion that phonological features need not attach directly to segments



van der Hulst & Smith (1982); Dresher (2011)

Beyond the segment in phonology

- Articulatory Phonology drops the notion of segment altogether
 - In this framework, articulatory gestures are the main units of phonology



Browman & Goldstein (1992)

Beyond the segment: Q Theory

- A recent framework, Q Theory, suggests that phonological features apply below the segment
- In Q Theory, traditional segments are exploded into a number of subsegments
 - The original version of the theory assumes all traditional segments (Q) consist of three subsegments (q q q) which are ordered in time
 - "Later" papers have assumed that subsegments can vary between 1 and 5, and that this variation can account for phonological length and weight, etc.

Inkelas & Shih (2017); Garvin et al. (2018); Schwartz et al. (2019); Shih & Inkelas (2019)

Beyond the segment: Q Theory

- Q Theory is especially practical for representing contour segments

$$\hat{Q}_{\check{a}} = \begin{bmatrix} q \\ L \\ +\text{back} \\ -\text{high} \\ \dots \end{bmatrix} \begin{bmatrix} q \\ H \\ +\text{back} \\ -\text{high} \\ \dots \end{bmatrix} \begin{bmatrix} q \\ L \\ +\text{back} \\ -\text{high} \\ \dots \end{bmatrix}$$

$$C(n^1 \ t^2 \ f^3)$$

$$C(t^1 \ f^2 \ h^3)$$

$$V(\underset{\sim}{e}^1 \ a^2 \ \underset{\sim}{i}^3)$$

$$V(\grave{a}^1 \ \acute{a}^2 \ \grave{a}^3)$$

The phonology of stops

- In distinctive feature terms, (oral) stops are usually classified as being [-cont]
 - In SPE, this feature is shared with nasal stops
- They also usually carry **place features** and **laryngeal features**
 - Place features distinguish e.g. /p ~ t ~ k/
 - Laryngeal features distinguish e.g. /b ~ p ~ p^h/

Jakobson et al. (1952); Chomsky & Halle (1968)

Laryngeal features

	b_1	b	p	p_k	b^h	p^h	δ	$?b$	$p?$
spread glottis	-	-	-	+	+	+	-	-	-
constricted glottis	-	-	-	-	-	-	+	+	+
stiff vocal cords	-	-	+	-	-	+	-	-	+
slack vocal cords	-	+	-	-	+	-	-	+	-

Halle & Stevens (1971); Lombardi (1995)

Laryngeal features

	voice	gl	asp
voiceless			
voiced	+		
voiceless aspirated			+
voiced aspirated	+		+
voiceless glottalized		+	
voiced glottalized	+	+	

Lombardi (1995)

Aperture Theory

- In a precursor to Q Theory, Donca Steriade suggested that stops have two "feature anchors", and other types of sounds have only one

Regular stop

A_0 A_{\max}

Affricate

A_0 A_{fric}

Prenasalized stop

A_0 A_{\max}

|

[nas]

Stop with nasal release

A_0 A_{\max}

|

[nas]

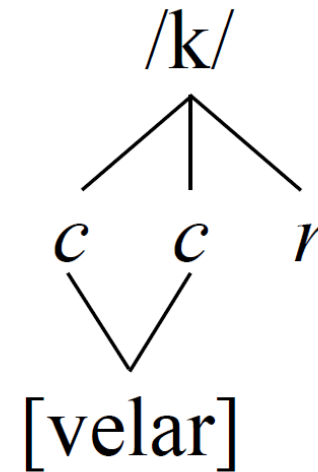
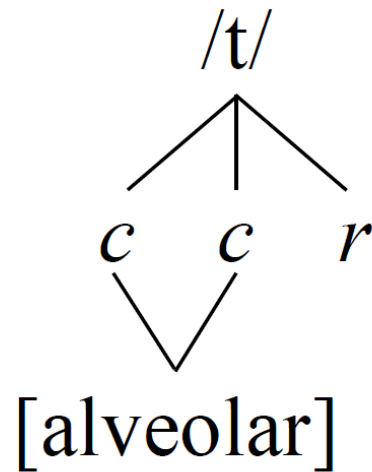
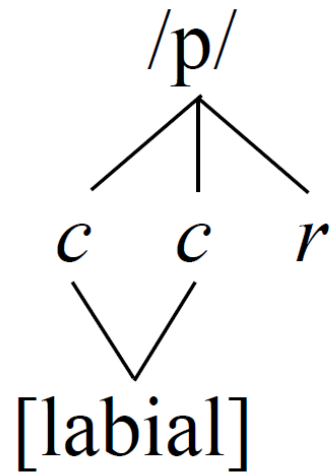
Steriade (1993), Shih & Inkelas (2017)

Stops in Q Theory

- I assume:
 - Feature changes within a segment are temporally ordered (this goes against e.g. Lombardi 1990)
 - Many laryngeal contrasts can come down to subsegmental structure
 - Subsegments are either *closures* or *releases*
 - Glottal closure or glottal release is not specified for place
 - The phonological representation is relatively phonetically rich
 - The representations must adhere to articulatory and perceptual principles. This accounts for a lot of potential overgeneration.
 - Empty space in the phonological representation is often filled in due to coarticulation

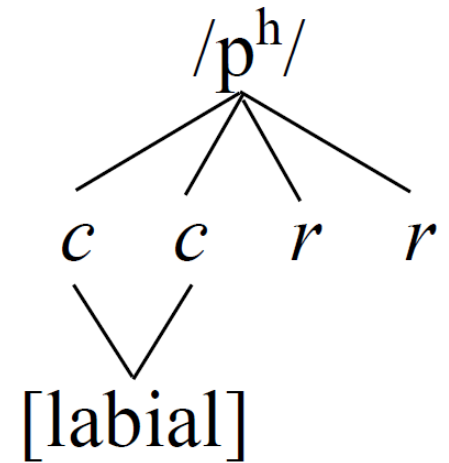
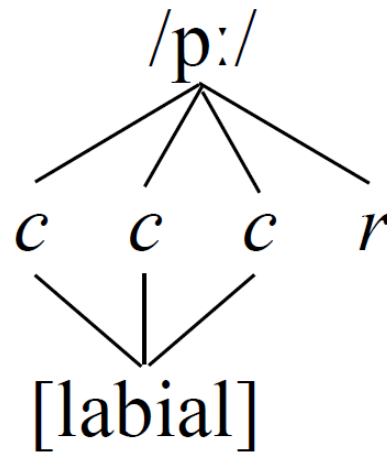
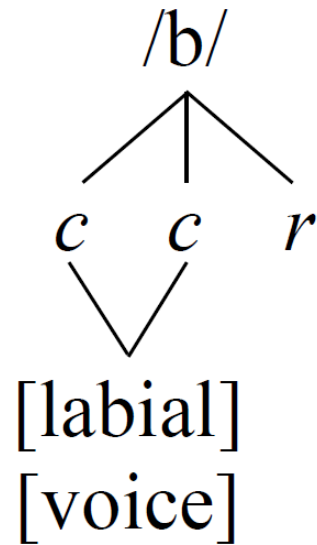
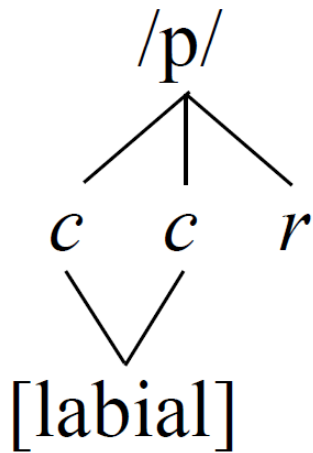
Stops in Q theory

- This is a normal set of voiceless stops
 - Don't worry too much about the place features!



Stops in Q theory

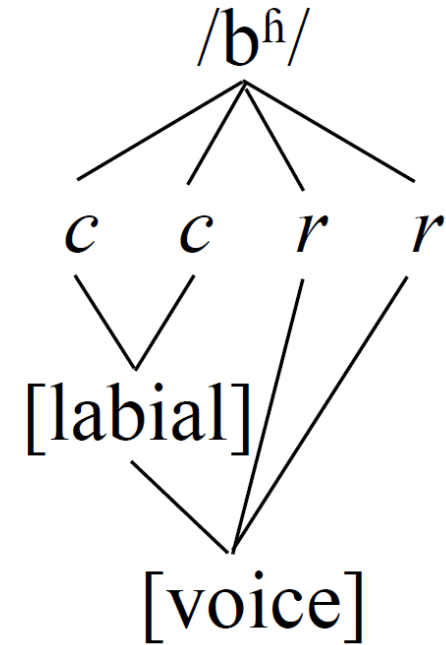
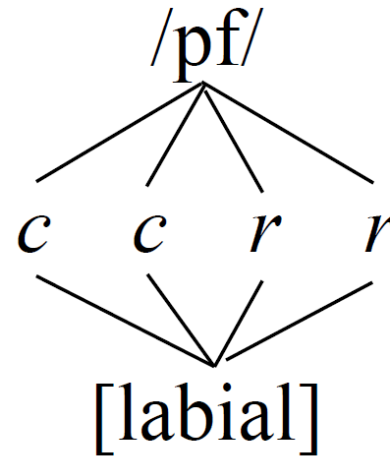
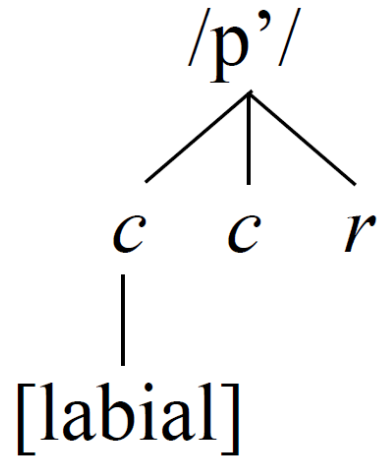
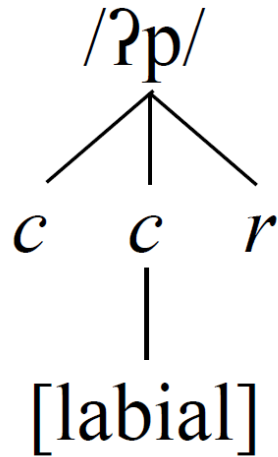
- This shows how a number of laryngeal (etc) contrasts can be treated



Puggaard et al. (2019), Grijzenhout et al. (2020)

Stops in Q Theory

- Continued



Stops in Q Theory: Implosives

- Implosives remain a problem, but implosives also remain a problem for other analyses
- For example, Lombardi's solution is to use [+voice, +gl], which is problematic for a number of reasons
 - Implosives are not necessarily voiced
 - These features do nothing to indicate glottis lowering and ingressive airflow
 - It is not clear that [voice] and [gl] are articulatorily compatible at all
- In my opinion, a good solution will need to specify the ingressive airflow

Ladefoged & Johnson (2015)

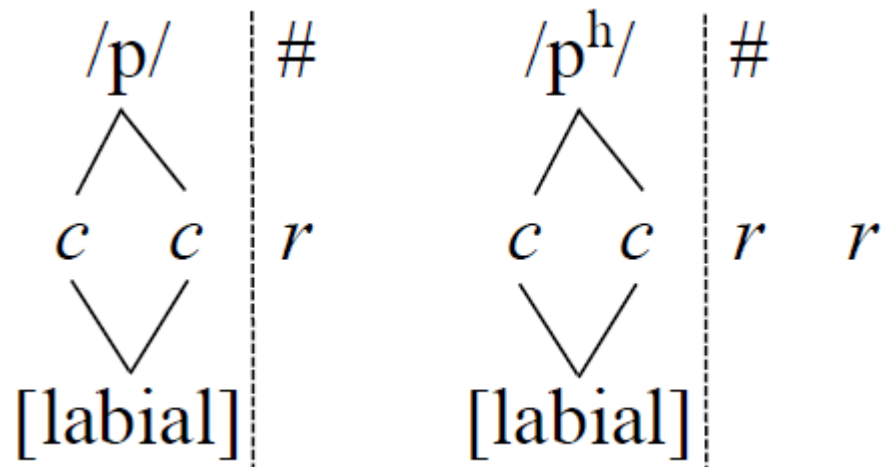
Stops in Q Theory: Proposed advantages

- We retain the feature [voice], which does a lot of phonological work
- We lose the feature [spread glottis], which does mostly surface phonetic work
 - Due to the Q Theory architecture, this surface phonetic work is still easy to represent
- The feature [gl. ~ c.gl] is also structurally derived
- The framework allows a lot of gradience in representing patterns of phonetic realization

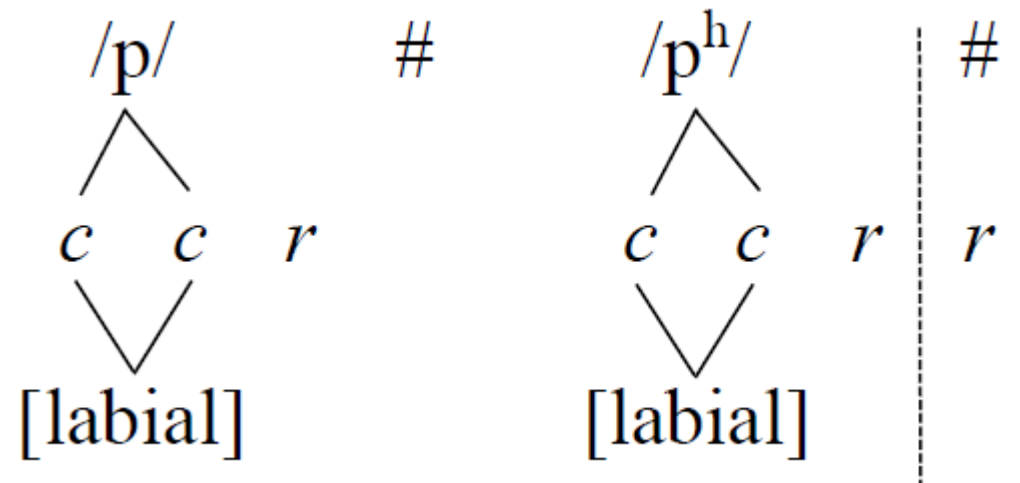
Final neutralization

- The framework is well-suited for representing final neutralization
 - *r[∅-place] #, *r[∅-place]_{n+1} #
 - This also accounts for the frequent lack of syllable-final /h/

No release



Audible release (e.g. German)

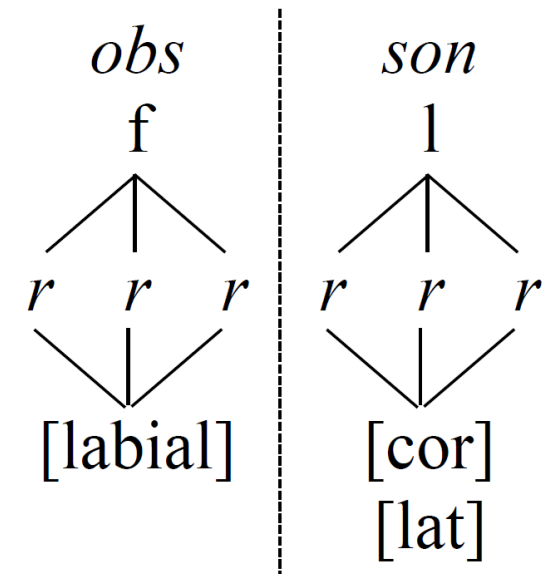
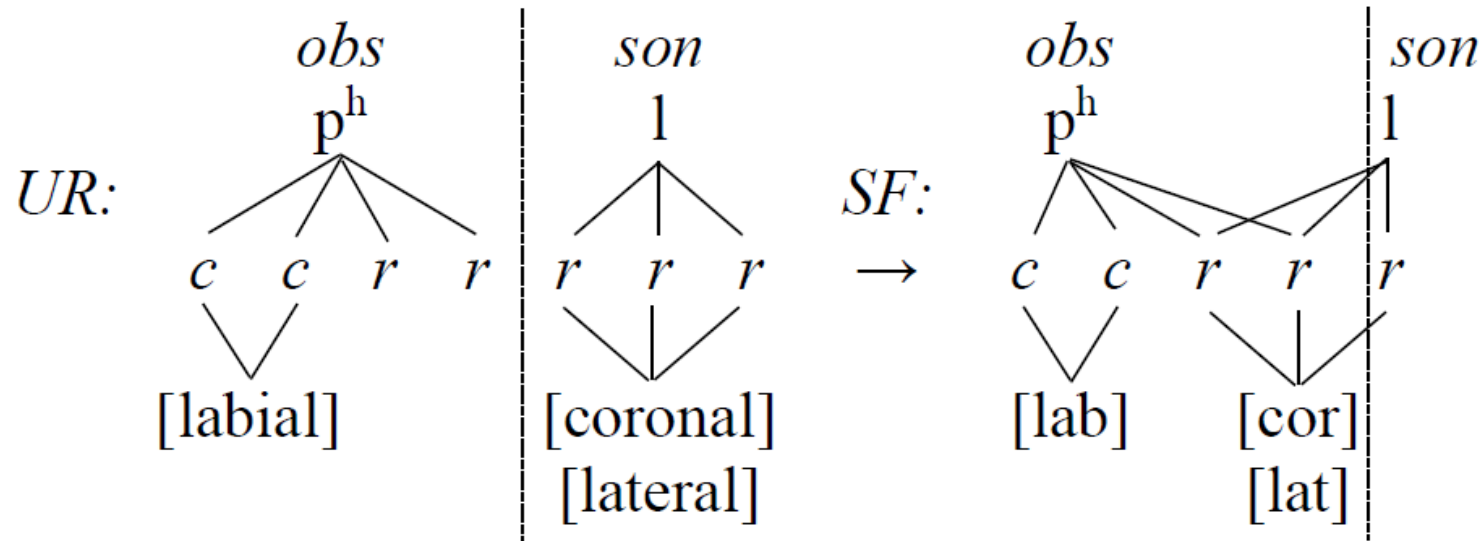


Liquid devoicing

- [spread glottis] has been proposed to attach to entire onsets
 - This accounts for e.g. liquid devoicing
 - The process where /p^hl/ → [p̚l̚], /fl/ → [f̚l̚]
- Phonetic studies find that liquid devoicing is gradient in English, and depends on the nature of the preceding obstruent
 - Only negligible devoicing after fricatives
 - Approx. 2/3 devoicing after plosives
 - In other words, it *does not apply to the whole segment*
- Research suggests that there is even less liquid devoicing in Danish

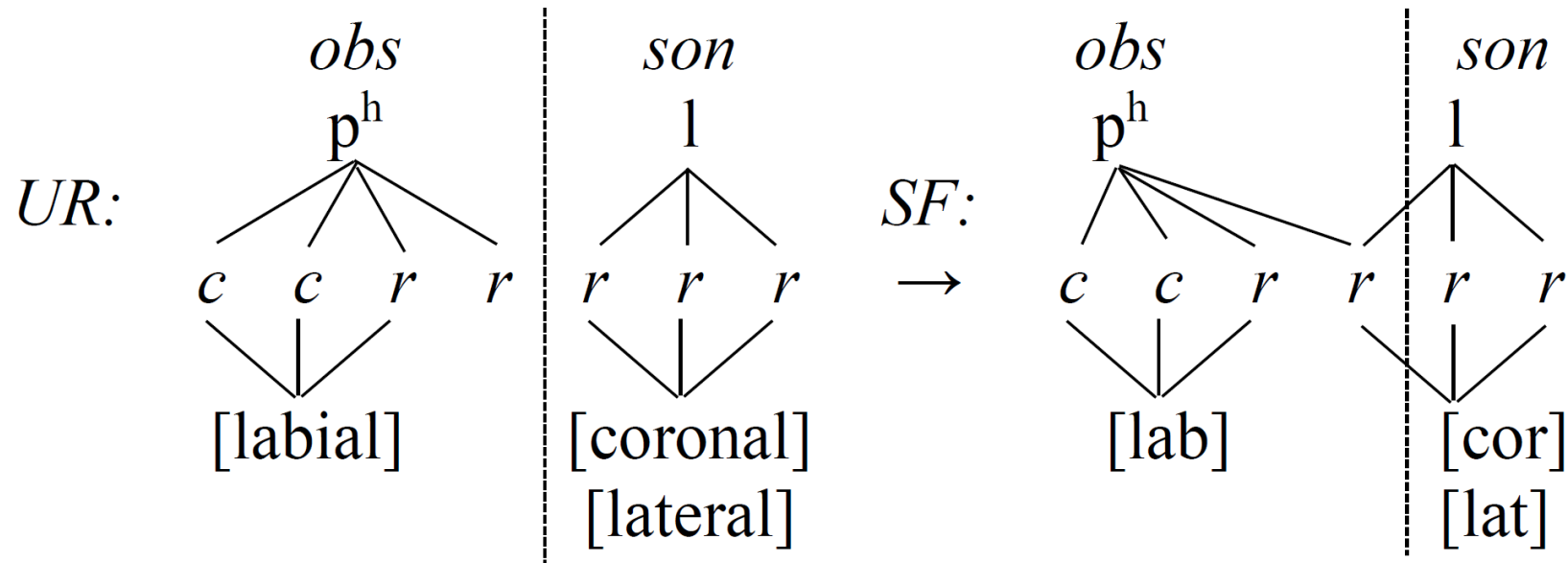
Kehrein & Golston (2004); Tsuchida et al. (2000); Juul et al. (2019)

Liquid devoicing in English



Liquid devoicing in Danish

- I suggest (on the basis of phonetic investigations) that place features are present through at least one of the release subsegments in Danish aspirated stops
 - This can account for the lower degree of liquid devoicing in Danish



Puggaard (2020a); Juul et al. (2019)

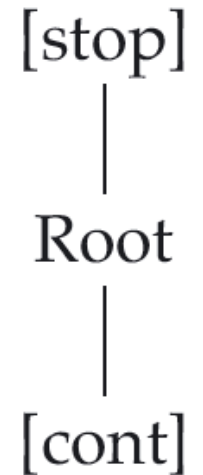
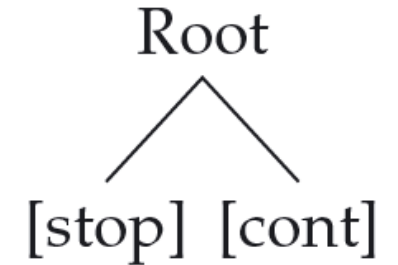
The phonology of affricates

- *The stop approach*

- Affricates are stops with an extra feature, e.g. [+strident]

- *The complex segment approach*

- Contour segments
- Either with internal temporal ordering (Sagey) or not (Lombardi)
- Internal ordering predicts edge effects
- No internal ordering is neutral towards edge effects, predicts anti-edge effects



Lin (2011); Jakobson et al. (1952); Sagey (1986); Lombardi (1990)

Edge and anti-edge effects

- Edge effects

- $A \rightarrow B / _ [stop, affricate]$

- $A \rightarrow B / [fricative, affricate] _$

- Anti-edge effects

- $A \rightarrow B / _ [fricative, affricate]$

- $A \rightarrow B / [stop, affricate] _$

Q Theory and edge effects

- Having temporally ordered features within segments, Q Theory is great at handling all kinds of edge effects
- An example from Karitiâna:
 - Nasalization spreads from the nasalized edge of pre-nasalized stops, i.e. /ambo/ → [ãmbo], cf. /amaŋ/ → [ãmãŋ]

Garvin et al. (2018)

Q Theory and anti-edge effects

- Anti-edge effects in affricates should be very problematic for Q Theory
- But actually, the anti-edge effects mentioned by Lombardi can all be explained with our current assumptions

- In Basque,

- $T \rightarrow \emptyset / _ \# T$

- $TS \rightarrow S / _ \# T$

a. *Stop + stop:*

/bait naiz/	bai naiz	'since I am'
/oroit + men/	oroimen	'remembrance'
/guk pitzu/	gu piztu	'we light'
/ardiek nituen/	ardie nituen	'we had sheep'
/bat paratu/	ba paratu	'put one'
/bat traban/	ba traban	'one stuck'
/bat kurri/	ba kurri	'run one'

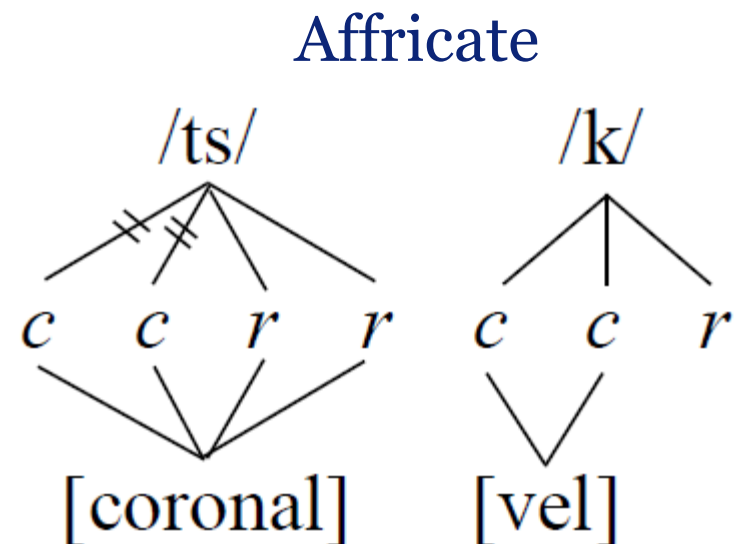
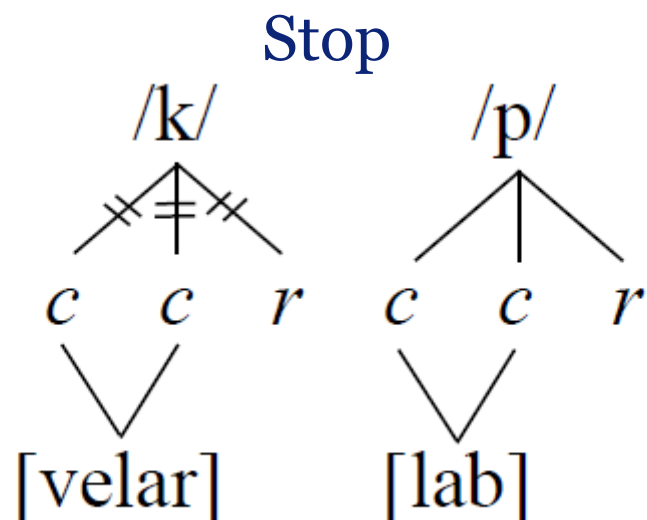
b. *Affricate + stop:*

/hitz + tegi/	hiztegi	'dictionary'
/hitz + keta/	hizketa	'conversation'
/haritz + mendi/	harizmendi	'oak mountain'
/haritz + ki/	harizki	'oak wood'
/hotz + tu/	hoztu	'a cold'

Lombardi (1990)

Anti-edge effects

- This is actually fine!
 - It just requires a rule that deletes c 's in the context $/ _ r_n c_n$
 - r with no place is not realized syllable-finally, but we already need such a rule in many languages
 - This accounts for both patterns

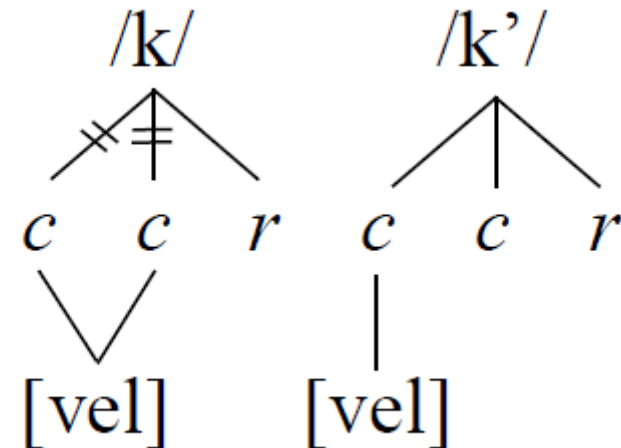


Anti-edge effects

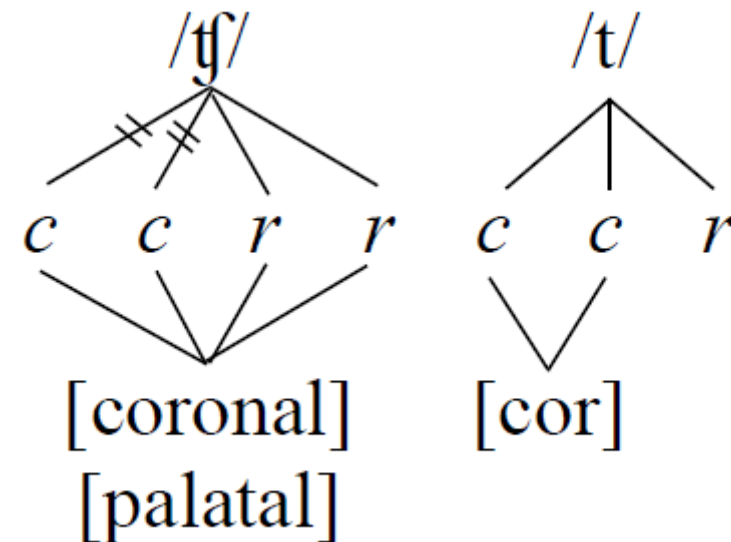
- This is even clearer in Yucatec Maya, where
 - Coda stops → /h/ before other stops
 - Ex. /kolik k'aaf/ → [koleh k'aaf]
 - Coda affricates → fricatives before stops
 - Ex. /hoʔotʃ tik/ → [hoʔof tik]
- The same holds for Yucatac Maya as for Basque:
 - $c \rightarrow \emptyset / r_n c_n$
 - Only in Yucatec Maya, r with no place is maintained

Lombardi (1990)

Stops



Affricates



Conclusions

- Subsegmental structure can account for a number of distinctions usually handled with features
- Subsegmental structure can neatly explain a number of phonological processes and coarticulation phenomena
- Both stops and affricates are contour segments in this representational framework
 - They can be subject to similar processes. Proposed anti-edge effects are unproblematic.
- As mentioned previously, this is work in progress. Questions and comments are very welcome!

Collaborators

Janet Grijzenhout



Bert Botma



- And Yonatan Goldshtein, with whom I toyed with using this framework to represent the very complex patterns of phonetic and phonology variation in Jutlandic Danish! (Puggaard & Goldshtein 2020)

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Tak for jeres opmærksomhed!

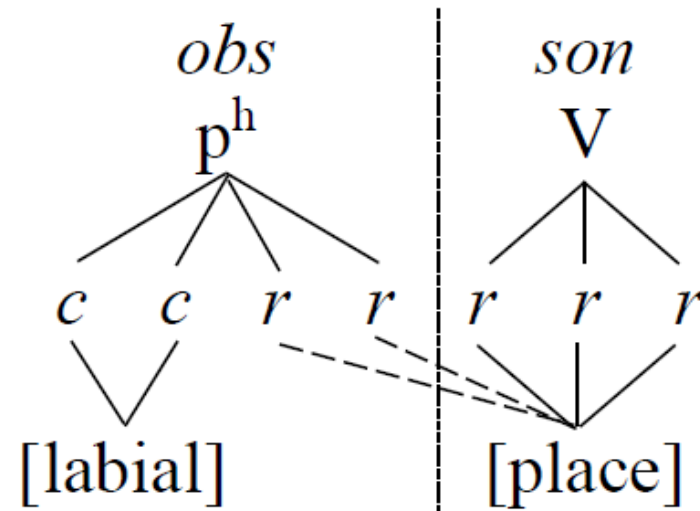


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Bij ons leer je de wereld kennen

Bonus: Why not vowel devoicing then?

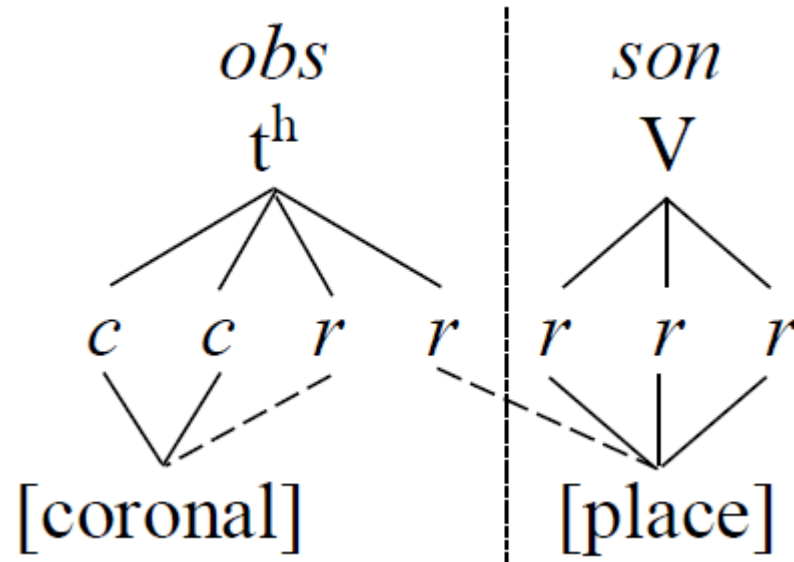
- This incorporation of *release* subsegments depends on the place features in question being inductive to voicelessness
- [cor,lat] are; vowel features less so
- As a result, vowel features *spread* rather than *merge*



Maddieson & Emmorey (1984)

Why not vowel devoicing then?

- The nature of this spreading is language-specific
- In Danish, r1 takes its place cues from the closure, and r2 takes its place cues from the vowel



Puggaard (2020b)