24.964

Phonetic Realization

Releases and transitions

Readings for next time:

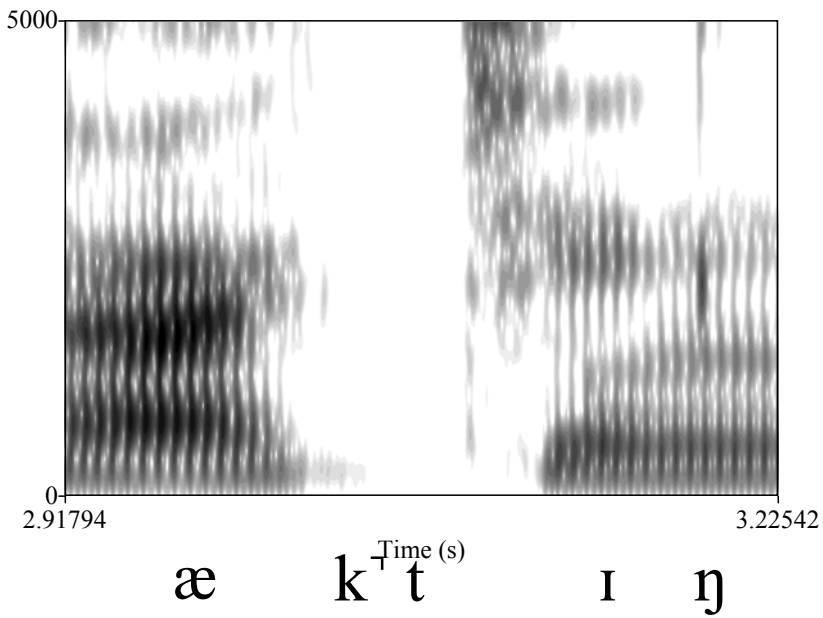
Xu, Yi. "Speech Melody as Articulatorily Implemented Communicative Functions." *Speech Communication* 46 (2005): 220-251.

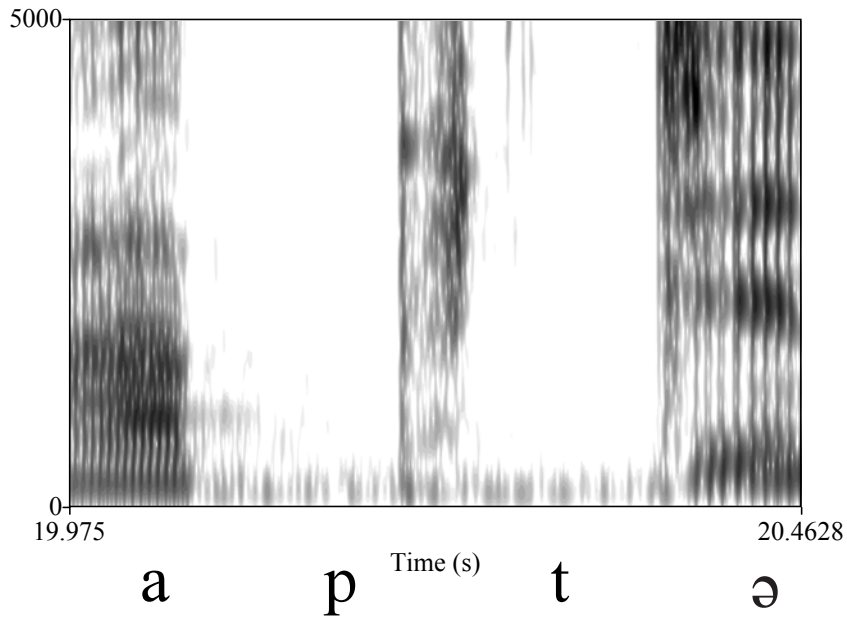
Xu, Yi. "Contextual Tonal Variations in Mandarin." *Journal of Phonetics* 25, no. 1 (January 1997): 61-83.

Myers, Scott. "F0 Timing in Kinyarwanda." *Phonetica* 60, no. 2 (April-June 2003): 71-97.

Consonant releases and transitions

- Languages differ in the realization of consonant clusters.
  - Bloomfield: Close vs. open transition
- English employs close transitions within words.
- Montana Salish employs open transitions between stops.





Consonant releases and transitions

- The nature of the transitions between consonants can have a significant impact on the availability of cues to contrasts.
  - Stop bursts: place, voicing, manner, duration, presence
  - Nasal release: place (Kurowski & Blumstein 1984 argue that the transition from murmur to oral formants provide strongest cues).
  - Open interval can carry formant transitions, aspiration/voicing etc, depending on duration.
- Final stop releases.
- What determines the distribution of open/close transition?

Gafos (2002)

- An OT analysis of the distribution of open vs. close transitions between consonants in Moroccan Arabic.
- Argument that details of gestural coordination must be represented in phonology - interact with templatic morphology.

- A basic issue: the relative role of articulatory and perceptual considerations in shaping timing relations.

Basic patterns

- Final CC is broken up by schwa: [katəb, taqəb]
  - Heath (1987) treats this as a property of particular morphological templates, although he suggests Ø -> ə/ {full V, C}C_C#
  - E.g. [kəlb] 'dog', [xʊbz] 'bread' lack schwa.
- Initial and intervocalic clusters are not separated by schwa.
  - Not clear what realization of clusters is (do stops get bursts?).
  - Heath p.243: [ə] and its rounded counterpart [ʊ] can usually only appear in:

    CC_C# C_CC# VC_C# (where V is a full V)
  - So schwa can only appear in an initial cluster in words like [kəlb]
  - Schwa is deleted if a vowel follows in the word

fxədˤ fxdˤ -i 'thigh/my thigh' kəlb klb-ək 'dog/your dog'

Final CC is broken up by schwa

- Argues that schwa arises from open transition between consonants - there is no vowel gesture.
  - Where does the voicing come from in [zˤ natˤ ətˤ] etc?
- Analysis: preferred CC coordination is 'open transition'
  - in fact this coordination basically only arises in CC#.
  - assumes CC-COORD is parameterized for different languages.

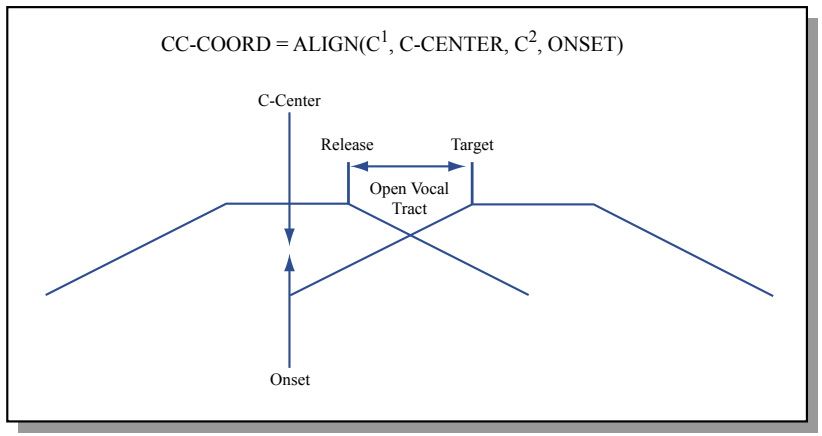


Image by MIT OpenCourseWare. Adapted from Gafos, A. "A Grammar of Gestural Coordination." *Natural Language and Linguistic Theory* 20 (2002): 269-337.

Final CC is broken up by schwa

- Complication: all CC clusters can be broken up by schwa, but according to Gafos's model CC-coord does not result in open transition with homorganic consonants:
  - constriction gesture 2 becomes active at 'release' of constriction gesture 1 and keeps the articulator in the same place.
- Analysis: default coordination is blocked for homorganic gestures by 'OCP':
  - 'overlapping segments with identical oral gestures are prohibited'

Final CC is broken up by schwa

- Adds new landmark: Release offset.
- Release is part of constriction gesture.
- Identical gestures satisfy OCP if onset of one coincides with release offset of the other.
- This coordination is guaranteed to result in an open transition because gesture 2 only begins after release of 1 is complete.

Base: /tVt/			OCP	CC-COORD
A.	/tot/	[tt]	*!	
B. →	/t⇌t/	[tᵊt]		*

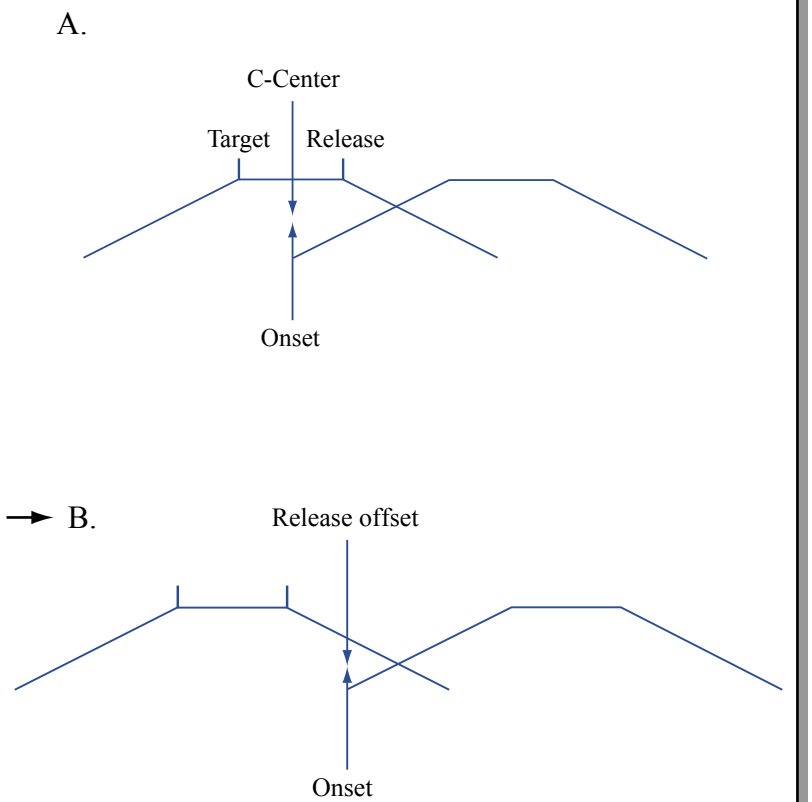


Image by MIT OpenCourseWare. Adapted from Gafos, A. "A Grammar of Gestural Cordination." *Natural Language and Linguistic Theory* 20 (2002): 269-337.

Final CC is broken up by schwa

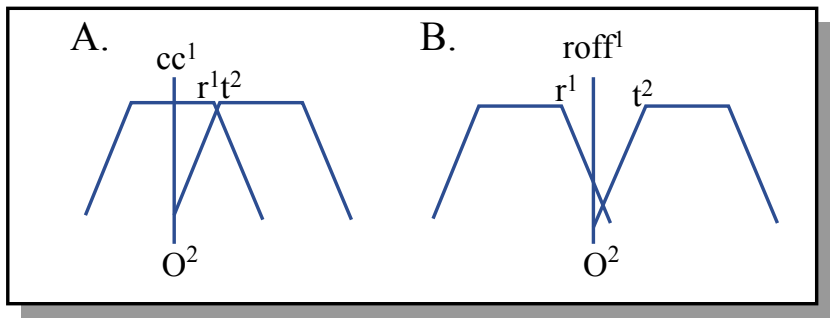
- Would seem simpler to specify open transition as the target rather than derive different patterns of coordination for homorganic vs. heterorganic clusters.
- Justification: Schwa is optionally deleted in C_C# unless C_1 and C_2 are identical, particularly in fast speech.

ʃarˤəb / ʃarˤb	'having drunk'	kanət / kant	'she was'
kwanəb / kwanb	'hicks'	ʁʷlilədˤ / ʁʷlildˤ	'fat (dim.)'
zˤnatˤətˤ / *zˤnattˤ	'tails'	matət / *matt	'she died'

- NB deletion can apply with homorganic clusters - including [nt], which violates the OCP as formulated above.

Final CC is broken up by schwa

- Assuming deletion is a fast speech process the ban on deletion can be derived from the proposed difference in gestural coordination.
- Increased rate is implemented implies increased gesture stiffness. This results in faster closure movements, which can result in absence of open transition.
- If C2 is phased to Release Offset of C1, then open transition is guaranteed.



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Final CC is broken up by schwa

Alternative analysis:

- All final CC# clusters contain schwa - specified acoustically, so present regardless of required gestural coordination.
- Optional deletion, blocked by faithfulness to singleton vs. geminate distinction (cf. Heath), hence only identical consonants block deletion, not all consonants with identical oral gestures.
- Heath observes that schwa may be reduced between identical consonants, but release of C1 is always preserved.

Initial CC is not broken up by schwa

- CCVCC → CCVCəC *CəCVCəC
  - no default coordination in #CC
- Analysis: Prevocalic Cs are all subject to CV-Coord (all want to be aligned to V onset):
  - ALIGN(C, C-center, V, Onset).
- Simultaneity of prevocalic consonants is blocked by RECOVERABILITY (no simultaneous consonants).

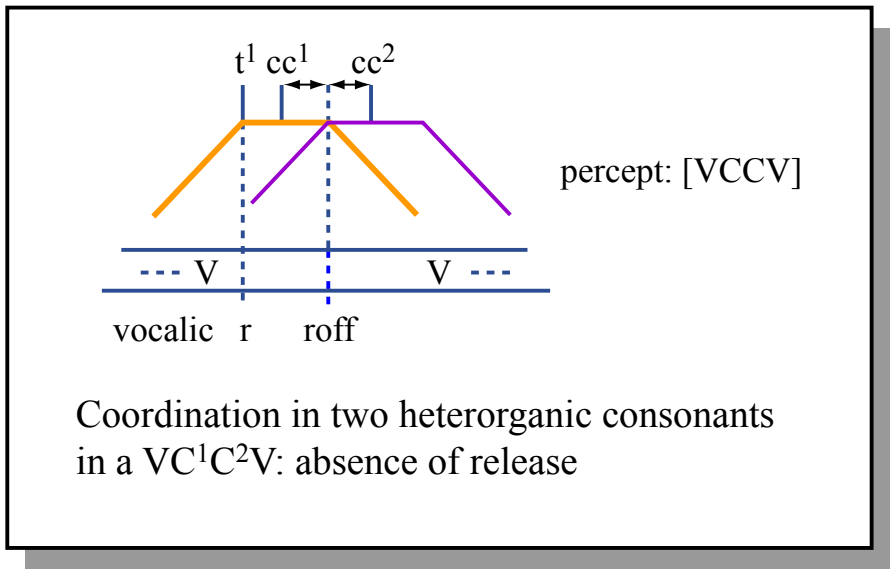
Adjectival diminutive template /CCiCC/; Base /smin/ 'fat', Derived [smimᵊn]; Inferred ranking: RECOV ≫ CV-COORD ≫ CC-COORD

Base: /smin/	RECOV	CV-COORD	CC-COORD
a. /s⊗m i mon/ [m] [mᵊn]	*!		*(sm)
b. → /s●m i mon/ [sm] [mᵊn]		**	*(sm)
c. /s○m i mon/ [sᵊm] [mᵊn]		***!	

Image by MIT OpenCourseWare. Adapted from Gafos, A. "A Grammar of Gestural Cordination." *Natural Language and Linguistic Theory* 20 (2002): 269-337.

Intervocalic CC is not broken up by schwa

- Intervocalic consonants are all subject to CV-coord with respect to following V.
  - 1st C is also coordinated to preceding V.



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Timing interacts with template satisfaction

Argument that gestural coordination is phonological, not phonetic.

- Adjectival dimunitives have template /C^wCiCC/.
- /$C_1C_2VC_3$/ adjective usually maps onto this template /$C_1C_2iC_2C_3$/.

Gloss	Adjective	Diminutive
'hot'	sxun	→ $s^wxix^ən$
'big'	kbir	→ $k^wbib^ər$
'crazy'	Hməq	→ $Hmim^əq$
'fat'	smin	→ $smim^ən$
'cross-eyed'	Hwəl	→ $Hwiw^əl$

Image by MIT OpenCourseWare. Adapted from Gafos, A. "A Grammar of Gestural Cordination." *Natural Language and Linguistic Theory* 20 (2002): 269-337.

- But where C_2=C_3, a glide is used to fill C_3 of diminutive

'few'	qlil	→ $q^wliw^əl$, $q^wliy^əl$
'new'	ž̆did	→ ž̆diy^{ə}d
'thin'	rqiq	→ $rqiy^əq$

Image by MIT OpenCourseWare. Adapted from Gafos, A. "A Grammar of Gestural Cordination." *Natural Language and Linguistic Theory* 20 (2002): 269-337.

Timing interacts with template satisfaction

Analysis:

- Glide epenthesis serves to avoid violation of CC-coord that would be required if identical consonants fill adjacent positions C_3C_4:

Base: /Hməq/		OCP	CC-COORD	DEP	INTEGRITY
a. →	/Hmimoq/ [mᵊq]				*
b.	/Hmiyoq/ [yᵊq]			*!	
c.	/Hmiq⇌q/ [qᵊq]		*!		*
d.	/Hmiqoq/ [qq]	*!			*

Image by MIT OpenCourseWare. Adapted from Gafos, A. "A Grammar of Gestural Cordination." *Natural Language and Linguistic Theory* 20 (2002): 269-337.

- Heath analyzes this pattern as avoiding the creation of geminates.
  - Still must rule out separating the identical consonants with schwa.

Chitoran et al (2002): ‘Gestural overlap and recoverability’

- Studied stop-stop clusters in Georgian (S. Caucasian).
- Tested two hypotheses derived from the idea that gestures are coordinated so as to ensure the availability of acoustic cues to the presence and nature of the gestures:
  - Word-initial stop-stop sequences will be less overlapped than like word-internal sequences.
  - Stop-stop sequences with a back-to-front order of constriction location (coronal-labial, dorsal-labial, dorsal-coronal) will evidence less gestural overlap than stop-stop sequences with a front-to-back order.
- Two speakers.

Chitoran et al (2002)

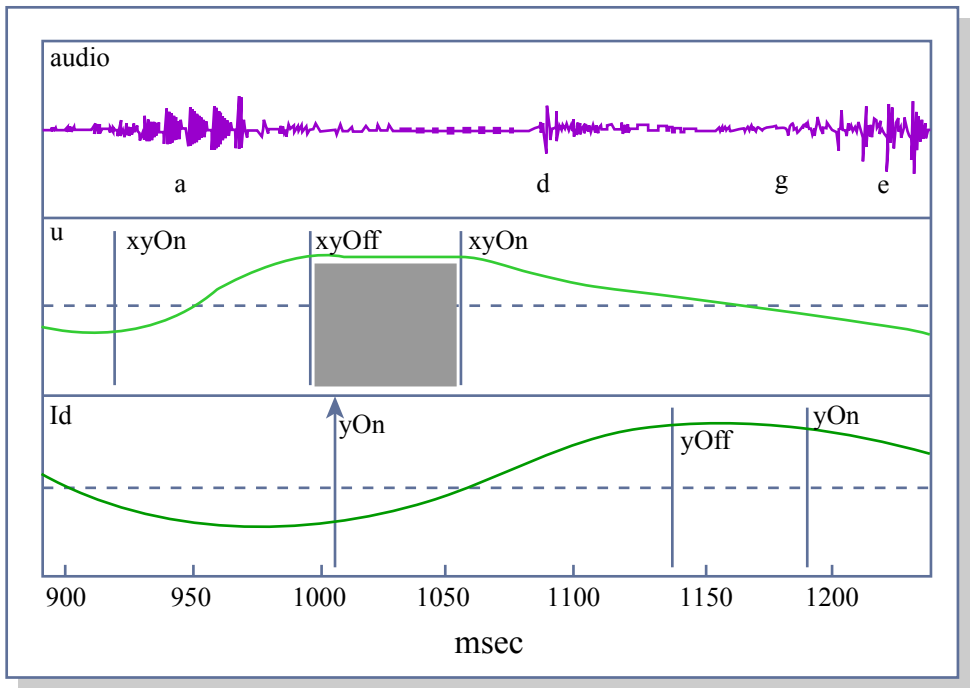
- Materials (frame: sit'q'va _ gamoit^{h}k^{h}mis ordʒer '*word _ is pronounced twice*').

Consonants		Word-initial Sequences		Word-internal Sequences	
C1	C2				
Front-to-back					
b	g	bgera	'sound'	abga	'saddle bag'
p^{h}	t^{h}	p^{h}t^{h}ila	'hair lock'	ap^{h}t^{h}ar-i	'hyena'
d	g	dg-eb-a	's/he stands up'	a-dg-eb-a	's/he will stand up'
Back-to-front					
g	b	g-ber-av-s	's/he is inflating you'	da-gbera	'to say the sounds'
t^{h}	b	t^{h}b-eb-a	'it is warming up'	ga-t^{h}b-a	'it has become warm'
g	d	gd-eb-a	'to be thrown'	a-gd-eb-a	'to throw smth. in the air'

Image by MIT OpenCourseWare. Adapted from Chitoran, I., L. Goldstein, and D. Byrd. "Gestural Overlap and Recoverability: Articulatory Evidence from Georgian." In *Laboratory Phonology 7*. Edited by C. Gussenhoven and N. Warner. New York, NY: Mouton de Gruyter. 2002, pp. 419-447.

Chitoran et al (2002)

- Collected movement data using EMMA (ElectroMagnetic Mid-saggital Articulometer) with pellets near tongue tip, back of tongue body, and an intermediate point.
- Quantified overlap in terms of the 'percentage of the interval between target achievement and release for first stop at which movement onset for the second stop is initiated'



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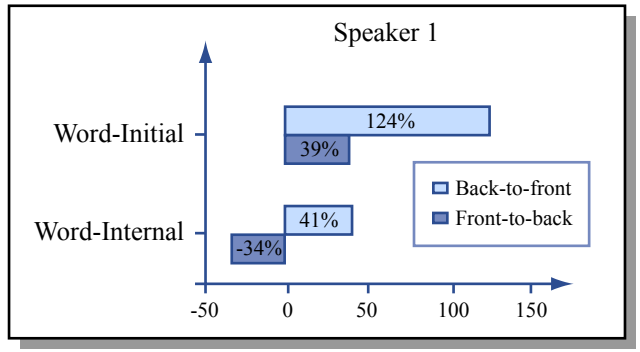
Chitoran et al (2002)

- More overlap medially than initially.
- More overlap in front-to-back clusters in initial position (both speakers).
- Also medially for speaker 1.
- Labial+coronal [$p^h t^h$] are least overlapped. Related to aspiration?



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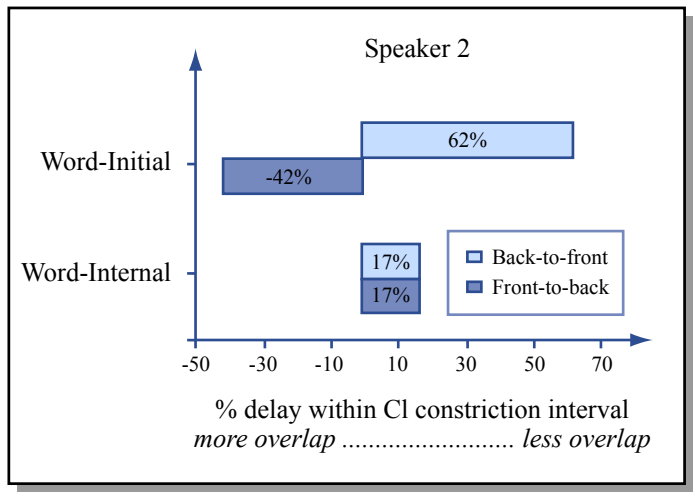

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Chitoran et al (2002)

- Analyze positional variation in overlap in terms of two potentially conflicting constraints:
  - Maximize rate of transmission of information (favors overlap).
  - Recoverability: Maximize cues to the presence and identity of gestures (cf. maximize the distinctiveness of contrasts).

- However Chitoran & Goldstein (2006) also found less overlap in back-to-front stop-liquid sequences
  - kr vs. pr, kl vs. pl

Grammar of stop release

- Russian (Kochetov and Goldstein 2005) also allows initial and medial stop-stop clusters.
- Recorded three speakers using EMMA.

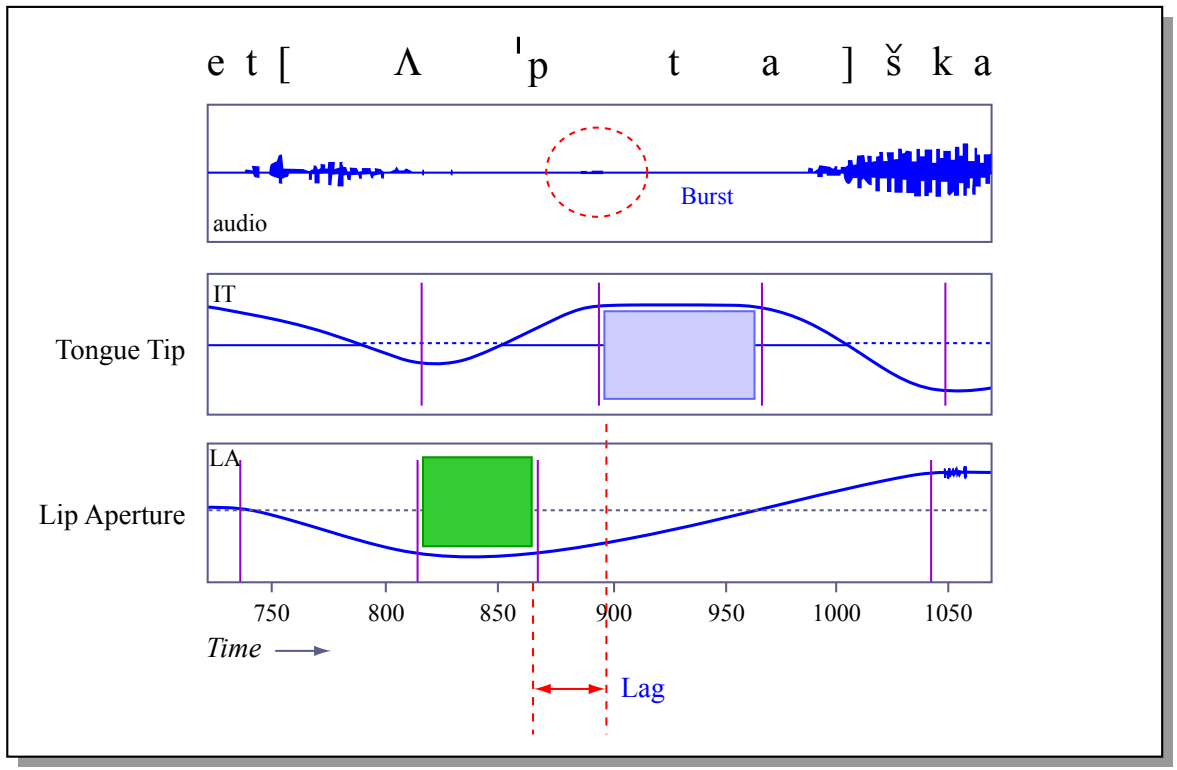
- Russian words with stops clusters in word-initial and word-medial positions; 5 repetitions per stimulus in a carrier phrase "eto ____ opjat".

	Word-initial	*Word-medial*
C1 labial:	[pt]aska 'bird' aim.	la[pt]a 'bat'
C1 coronal:	[tk]ac 'weaver' [tm]a 'darkness'	s ka[tk]a 'from a rink' xo[db]a 'walking'
C1 dorsal:	[kp]ape' 'to the dad' [kt]o 'who' a clitic + word boundary cluster	bio[kp]ost 'post' o[kt]ava 'octave'

Image by MIT OpenCourseWare. Adapted from Kochetov, Alexei, and Louis Goldstein. "Position and Place Effects in Russian Word-initial and Word-Medial Stop Clusters." Poster at Acoustical Society of America annual meeting, Vancouver, BC, Canada, May 17, 2005.

Grammar of stop release

- Measured lag from release of C1 to closure of C2 (identified from articulatory record).



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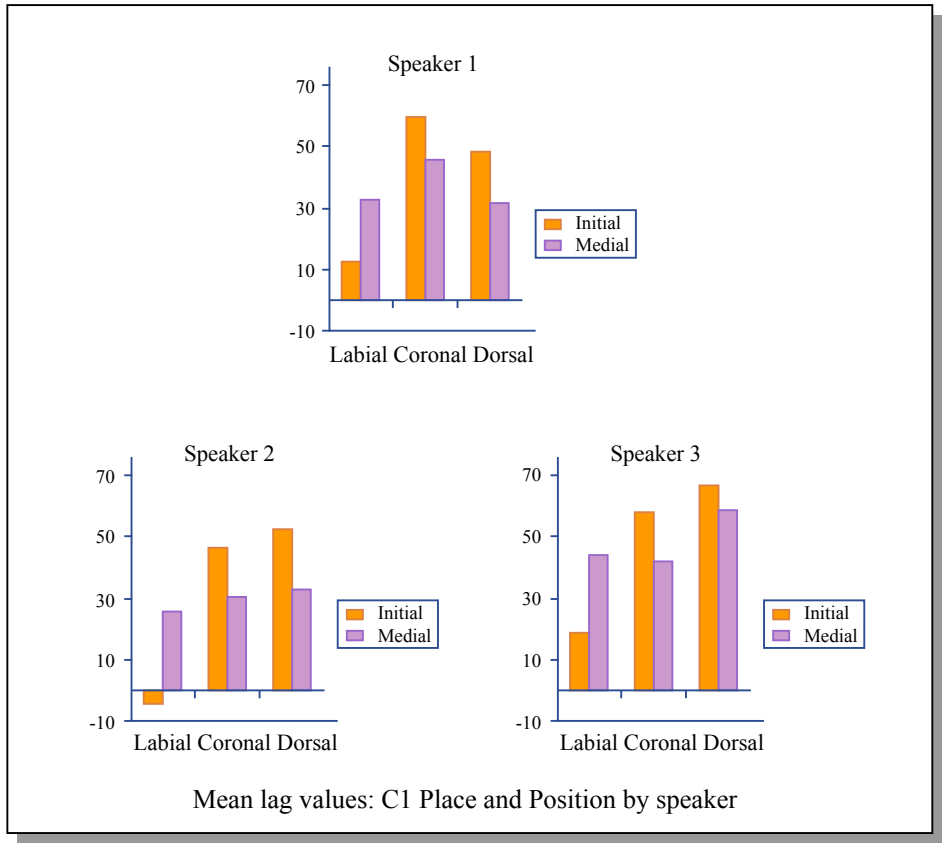
Grammar of stop release

- Lag is greater in initial position than in medial position for coronal, dorsal C1.
- Pattern is reversed for labial initial clusters.
- It may be easier to generate a burst from an overlapped labial (compared to dental, velar) since the labial closure is front of C2 closure.
- Labial shaping of C2 release transitions?
- Visual cues are available.



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Montana Salish

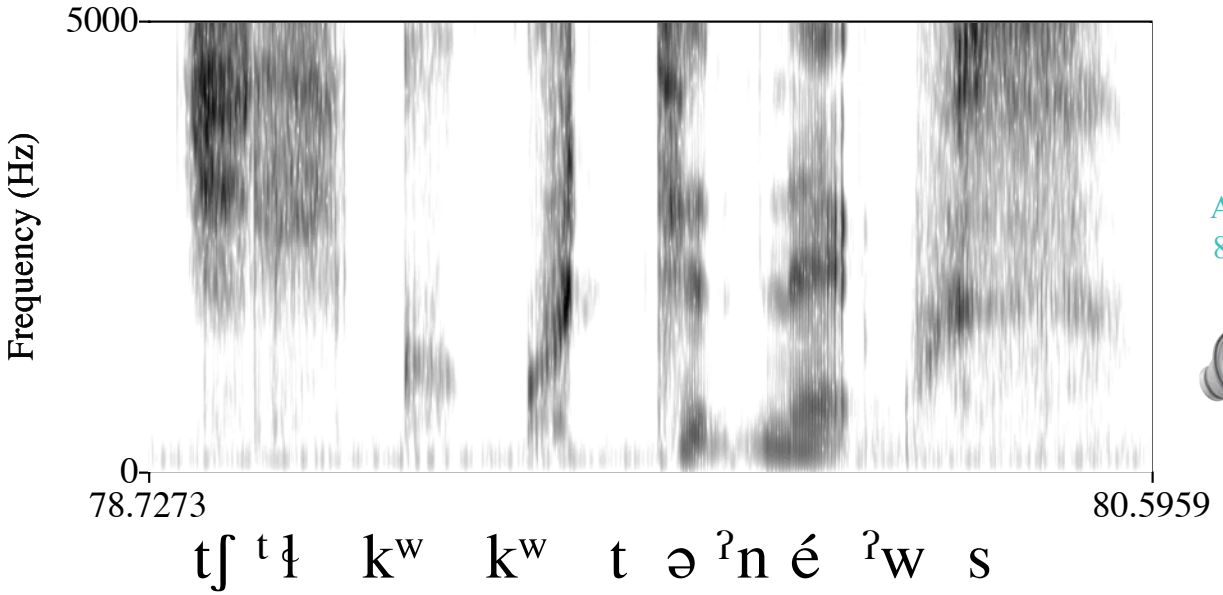
- Patterns of consonant coordination are often manner dependent.

Montana Salish (Flemming, Ladefoged & Thomason 2006)

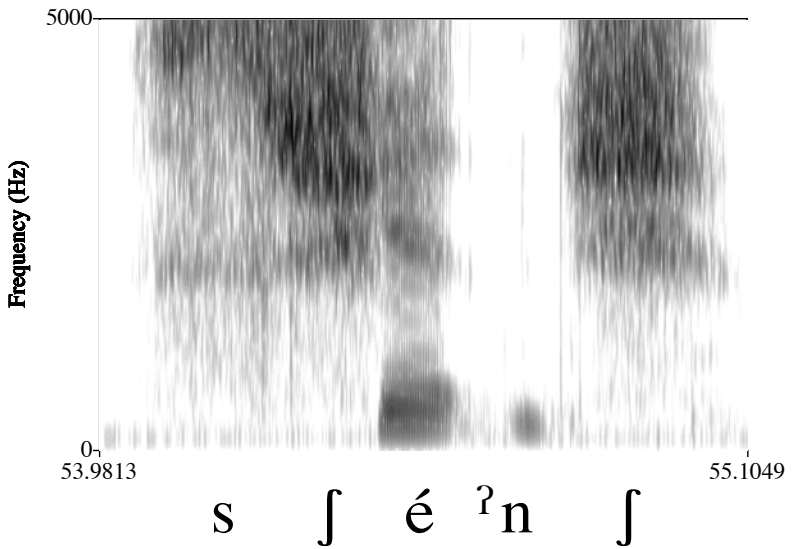
- Stops and ejectives are strongly released in all positions.
  - open transition in Stop+C
- Fricatives form close transitions with following obstruent, preceding sonorant, fricative.
- All sonorants (glottalized and plain) are preceded by schwa.
  - except in sequences of identical sonorants (modulo glottalization)
  - some variation in fricative-nasal sequences.

Montana Salish

- Stops and ejectives are strongly released in all positions.
- Fricatives form close transitions with following obstruent, preceding sonorant, fricative
- All sonorants are preceded by a vowel.



Audio: 8_salish1.wav



Audio: 8_montana2.wav

Sound files courtesy of the UCLA Phoenetics Lab (Peter Ladefoged, PI).
Source data: http://archive.phonetics.ucla.edu/Language/FLA/fla_record_details.html

Montana Salish

- Manner dependent coordination makes sense in terms of realization of cues:
- Stop bursts provide place/laryngeal/presence cues
- Fricatives have good internal cues to place/manner/presence, so open transition is not as important.
- Preceding vowel for sonorants may be needed for clear realization of plain vs. pre-glottalized contrast.

- Is there an articulatorily-based interpretation?

Unreleased stops

- What favors unreleased stops, given the perceptual advantages of released stops?
- Chitoran et al propose a ‘parallel transmission’ constraint - overlap increases rate of realization of contrasts.
- But what about word-final (pre-pausal) stops?
- Stop releases may be confusable with (reduced) vowels.
- Stop releases may be perceived as adding a syllable (in languages that allow reduced vowels).

References

Chitoran, I. (1998) Georgian harmonic clusters: Phonetic cues to phonological representation. *Phonology* 15:2. 121-141

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Heath. J. (1987). *Ablaut and Ambiguity: Phonology of a Moroccan Arabic Dialect*. SUNY Press, Albany.

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