Phonetic vs. phonological rounding in Athabaskan languages

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Phonetics vs. phonology

- *Phonetic* *phonological*

  coarticulation assimilation
- Language-internal acoustic evidence

  variability uniformity

  interpolation clear target
- A comparative approach

Study languages

- Deg Xinag
- Babine-Witsuwit’en

Overview

- Rounding Assimilation in Deg Xinag
  - acoustic, video evidence
- Lack of Rounding Assimilation in Babine-Witsuwit’en
- Why (and how) Deg Xinag has developed Rounding Assimilation

C Rounding in Athabaskan

- Secondary articulation
  - velar+[w]: e.g. Babine-Witsuwit’en [k^wa] ‘again’
- C[w] cluster
  - e.g.Tsek’ene [kweh] ‘crater, cave’ [ʔwèdèʔ] ‘always’, [ʔəjwèʔ] ‘scent’
- Neither secondary articulation nor cluster
  - e.g. Koyukon

Deg Xinag

- Stem-initial consonants

p p^h		t t^h t’			k k^h k’	q q^h q’	ʔ
	tθ tθ^h tθ’	ʦ ʦ^h ʦ’	tʂ tʂ^h tʂ’	ʧ ʧ^h ʧ’			
		tɬ tɬ^h tɬ’					
	θ ð	s z	ʂ ʐ	ʃ		χ ʁ	h
		ɬ					
m		n			ŋ		
v		l		j			

Vowels

- Rounding contrast in reduced vowels

full	*reduced*		*full*
		ʊ	
e	ə		o
	ɑ		

- Acoustic study (Hargus 2010)
  - /ʊ/ → [ŏ] adjacent to uvular
  - [e o ŏ] lower-mid: [ɛ ɔ ɔ̆]

“lazy lips”

- Rounding Assimilation

  /ə/ → [ŏ] / ___ {uvular, laryngeal} {ŏ, o}

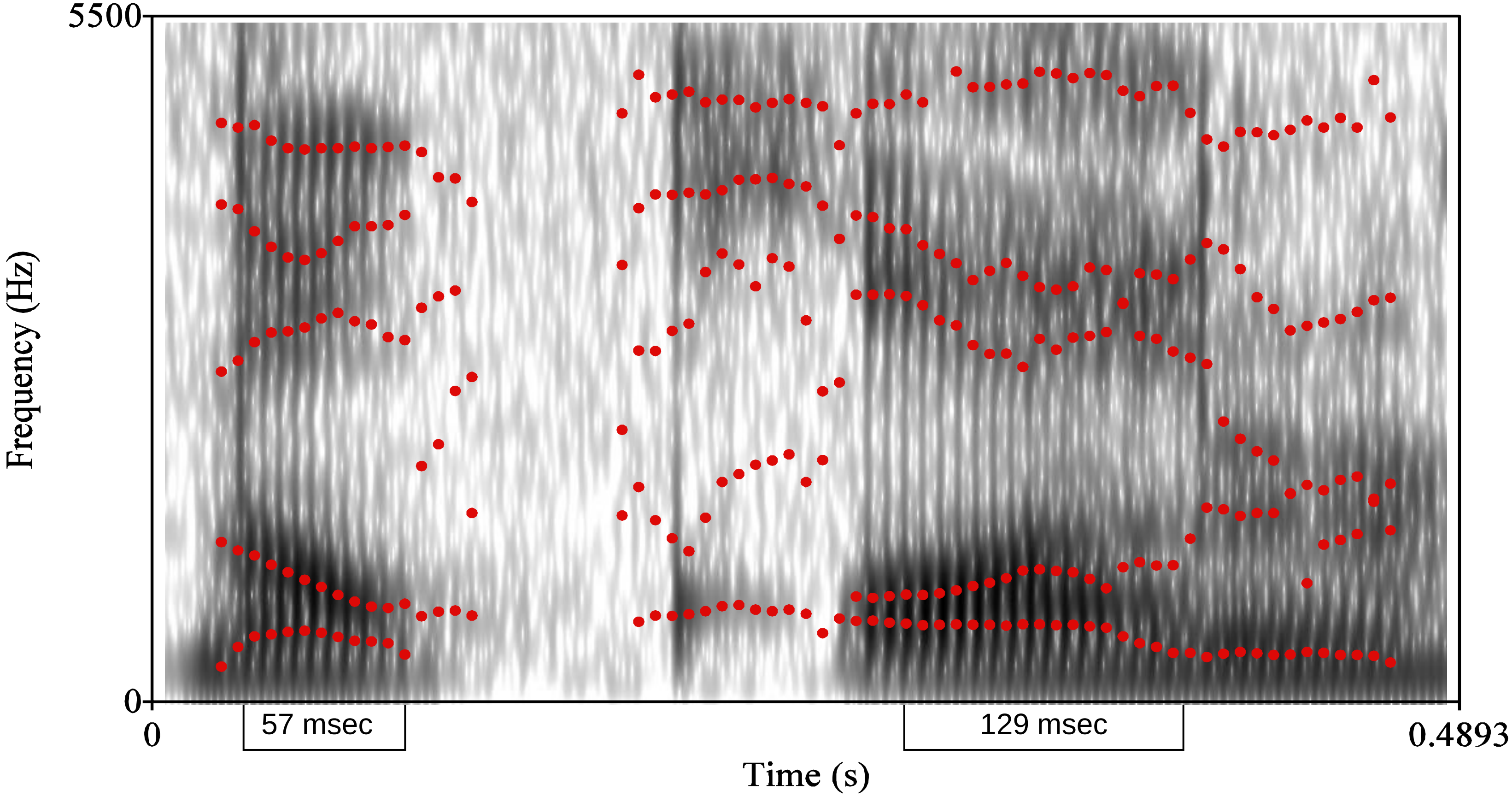
- Alternations in imperfective prefix /ə/-. Some imperfective forms of ‘chew’:

/k-ə-q’ŏʈʂ/	[kŏˈq’ŏʈʂ]	‘he/she is chewing’
/k-ə-s-q’ŏʈʂ/	[kəsˈq’ŏʈʂ]	‘I’m chewing’
/k-χ-ə-q’ŏʈʂ/	[kəχŏˈq’ŏʈʂ]	‘they’re chewing’

Rounding Assimilation in Deg Xinag linguistics

- Not mentioned in Krauss 1962
- Kari 1978 *yixunh* [jŏχŏn̥] ‘you (pl.)’ (<i> = /ə/, <u> = /ŏ/)
- Rock 1998 *Niq'oɬonh Chux Deg Ghihoɬ: The Big Woman Was Walking Along* [nŏq’oɬon̥]~[nq’oɬon̥], [ʁŏhoɬ]
- But <yidoghot> ‘he shakes it’ (Kari 1976-1977: 178) for [jədŏʁot]

[lǒǀq’ǒl] ‘white (object)’



Questions about Rounding Assimilation

- Phonetic?
  - F2 lowering increases towards uvular
- Phonological?
  - not rate-dependent
  - occurs even without surface round trigger

Not rate dependent

- [t^{h}e ðŏq^{h}on̥] ‘there is water (in container)’
  ‘water’ ‘there is (in container)’
  – [t^{h}e ðŏ q^{h}on̥] (LH) (discourse)

Counter-bled by o-Unrounding

- A sentence from *Yixgitsiy Dranh Itltsenh Dong* (Raven made light long ago), recorded by AJ

Vanhtoniy	*nigughun’*	*getiy*	*vugho'* [vŏʁɑʔ]	*dengath.*
ruff	wolf	really	its fur	it’s long

‘It had a wolf ruff with very long fur.’

An acoustic study of Rounding Assimilation

- If DX has Rounding Assimilation, how far into vowel does it extend? Are derived round vowels as round as underlying reduced round vowels in prefixes?
- …lips ‘relatively close and protruded (small lip-opening area)…F1+F2+F3 lower than with a larger lip-opening and the same tongue articulation.’ (Fant 1962)
- /ə/ vs. /ŏ/ in Hargus 2010: /ŏ/ significantly lower in normalized F2, higher in normalized F1 than /ə/

Predictions concerning rounding contrasts among reduced vowels in Deg Xinag

a) ŏQ{ŏ,o} vs. əQ{ə,ɑ}: [ŏ] predicted to have significantly lower F2 (Q = uvular)

b) ŏH{ŏ,o} vs. əH{ə,ɑ}: [ŏ] predicted to have significantly lower F2 (H = {ʔ, h})

c) ŏQ{ŏ,o} vs. ŏH{ŏ,o}: predicted not to differ in F2

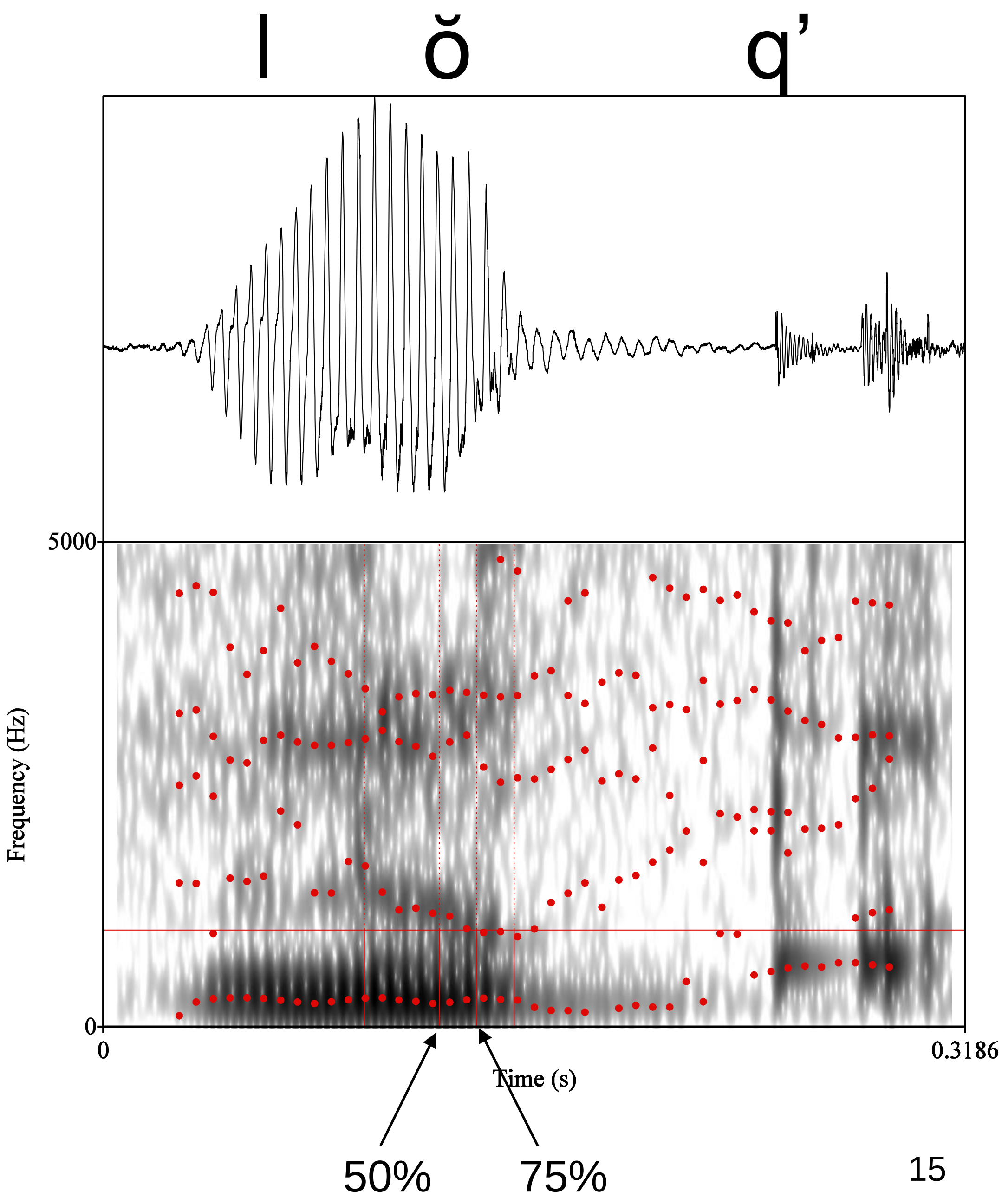
d) ŏQ{ŏ,o} vs. əK{ŏ,o}: [ŏ] predicted to have significantly lower F2

e) ŏQ{ŏ,o} vs. əCQ{ŏ,o}, for C = alveolar: [ŏ] predicted to have significantly lower F2, higher F1

f) ŏQ{ŏ,o} vs. perambulative /q'ŏ/-: predicted not to differ in F2

Methods

- Word list recording
- F1, F2, F3 measured at vowel midpoint and 75% of vowel duration



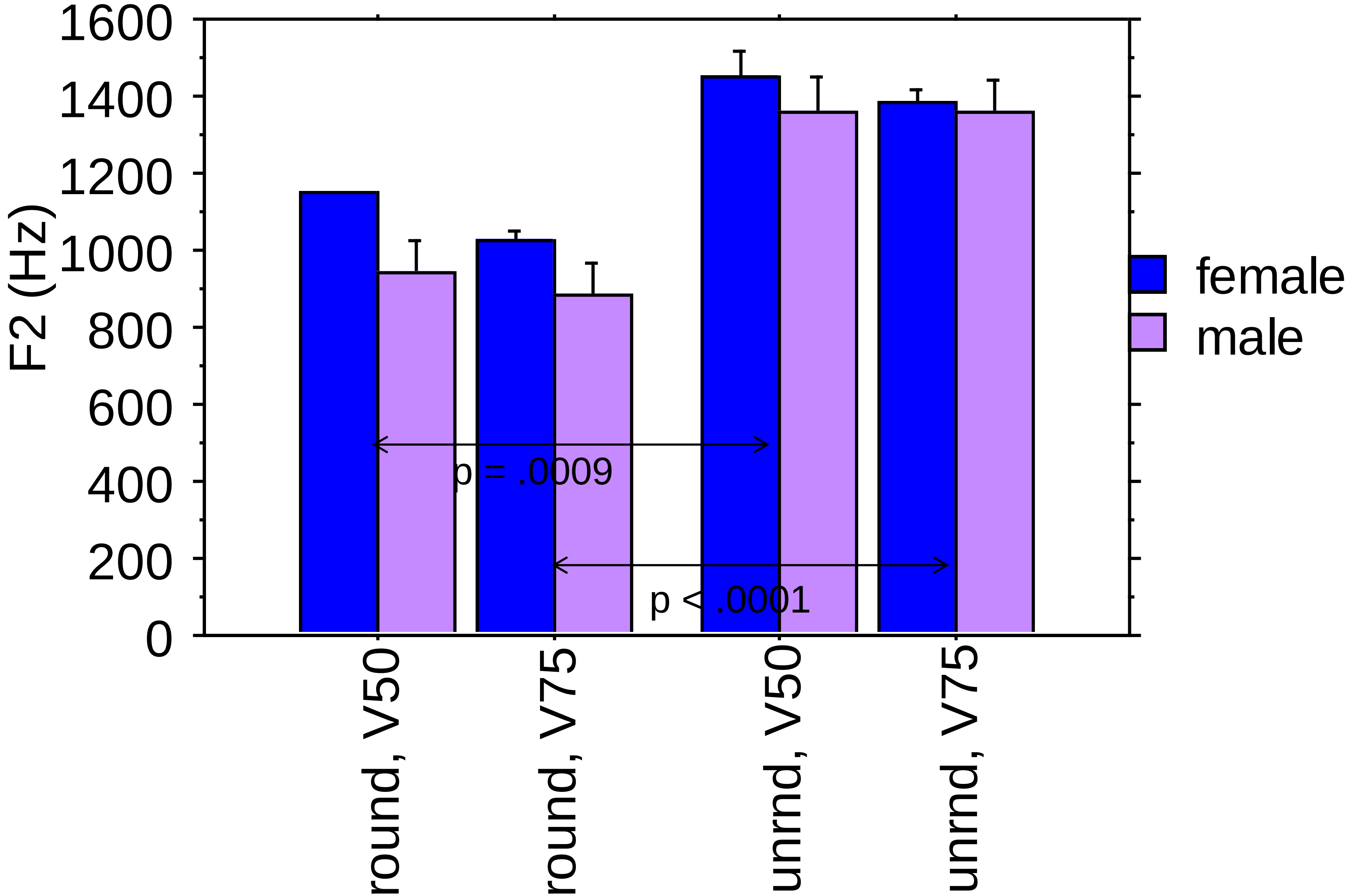
- 5 speakers, 3 male and 2 female
- Place of articulation of Cs immediately preceding and following target vowel balanced (no labial Cs)
- 9-15 comparison pairs per speaker per experiment
- Two repetitions elicited, generally only one measured (loudest)
- F1, F2 reported here (not normalized, as in Hargus 2010)
- Repeated-measures ANOVA for group
- Factorial ANOVA for each individual

(a) effect of round vs. unround vowel, intervening uvular

<u>ŏ</u>Q{ŏ,o} vs. <u>ə</u>Q{ə,ɑ}: [ŏ] predicted to have significantly lower F2 (Q = uvular)

- ✓ (group) F2 only; $p = .0009$ (50%), $p < .0001$ (75%)

F2 means



F2 (Hz)
1600
1400
1200
1000
800
600
400
200
0
p = .0009
p < .0001
round, V50
round, V75
unrnd, V50
unrnd, V75
female
male

[sŏq’ŏθ] ‘my neck’

- [sŏ]- (50%) [sŏ]- (75%) [q’ŏθ]

1 video frame (29 ms.) advance

(frontal and sagittal views are 2 different productions)

[səqʰɑʔ] ‘my foot’

- [sə̲]- (50%)   [sə̲]- (75%)   [qʰɑʔ]

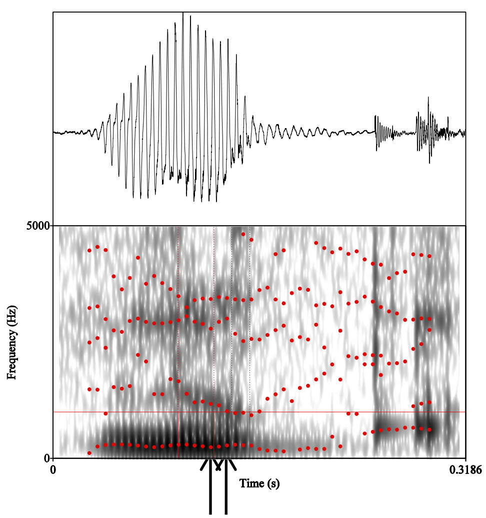
(frontal and sagittal views are 2 different productions)

Is Rounding Assimilation neutralizing?

d) ŏQ{ŏ,o} vs. perambulative /q'ŏ/-: predicted not to differ in F2

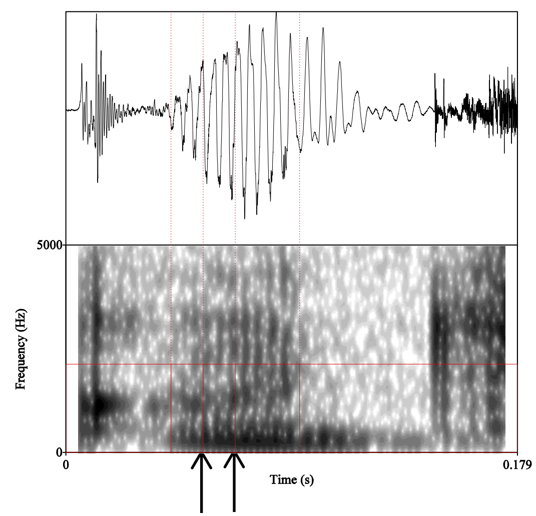
Rounding Assimilation perambulative

l ŏ q'



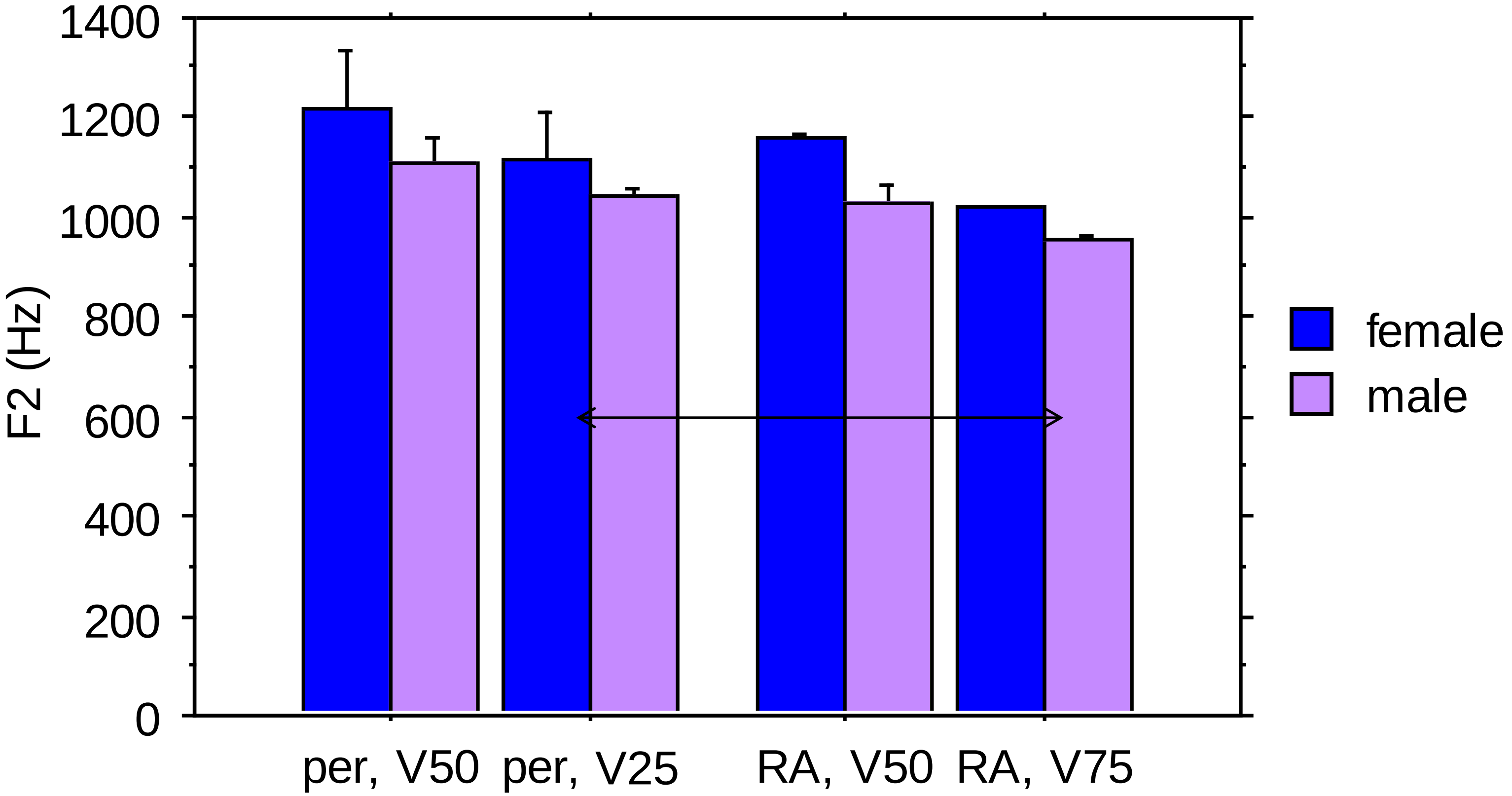
50% 75%

q' ŏ t^h



25% 50%

- no significant F1 differences
- F2
  - significantly lower at 75% in RA context (p = .0148) (before uvular) than at 25% in perambulative context (after uvular)



Effect of intervening uvular vs. velar

- Triggering consonants: uvulars, laryngeals
- Blocking consonants: all other places

[kəson̥] ‘I’m eating’

[kə̲]- (50%) [kə̲]- (75%) [so̲n̥]

(frontal and sagittal views are 2 different productions)

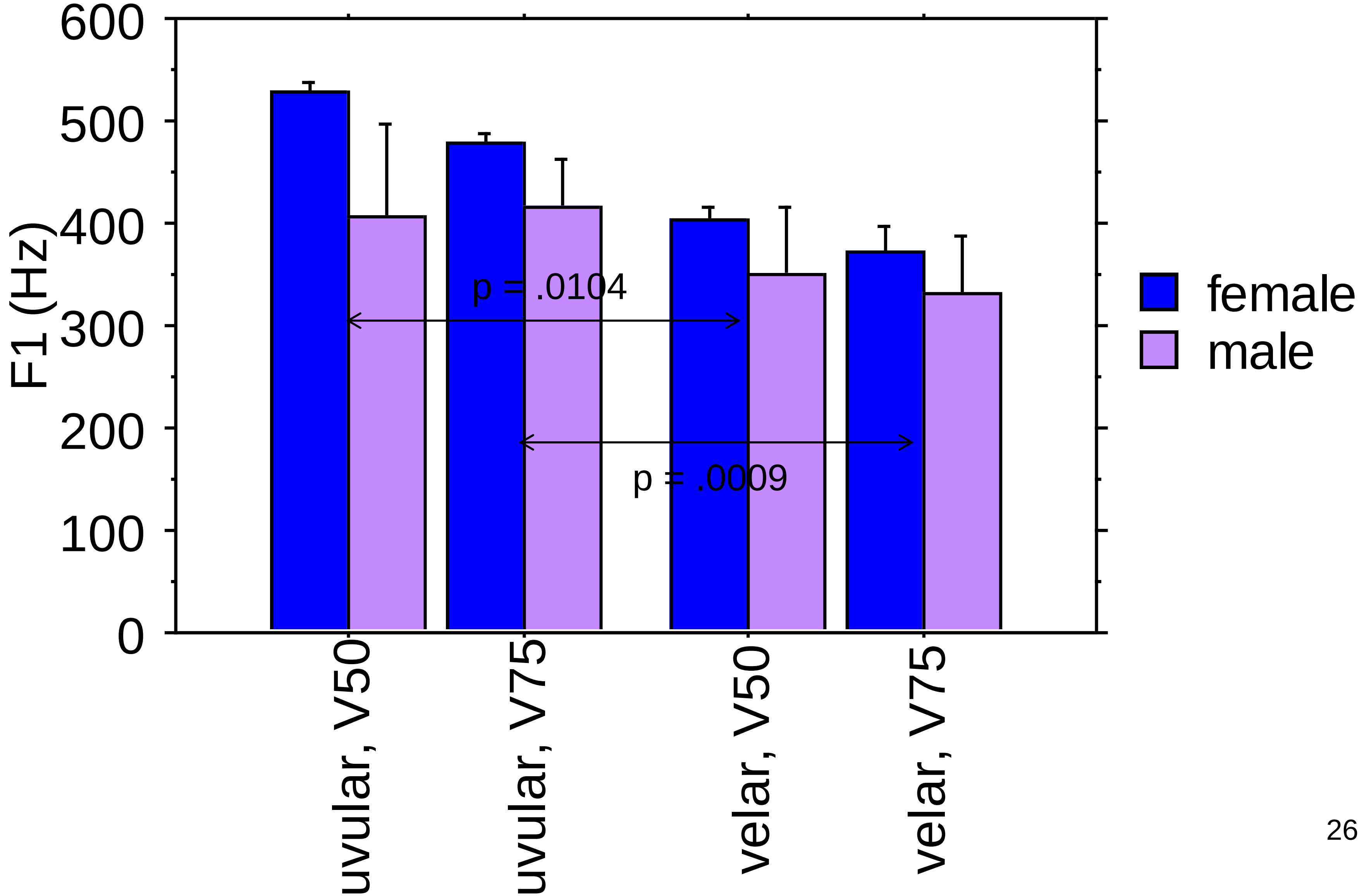
Velars

appear to block Rounding Assimilation

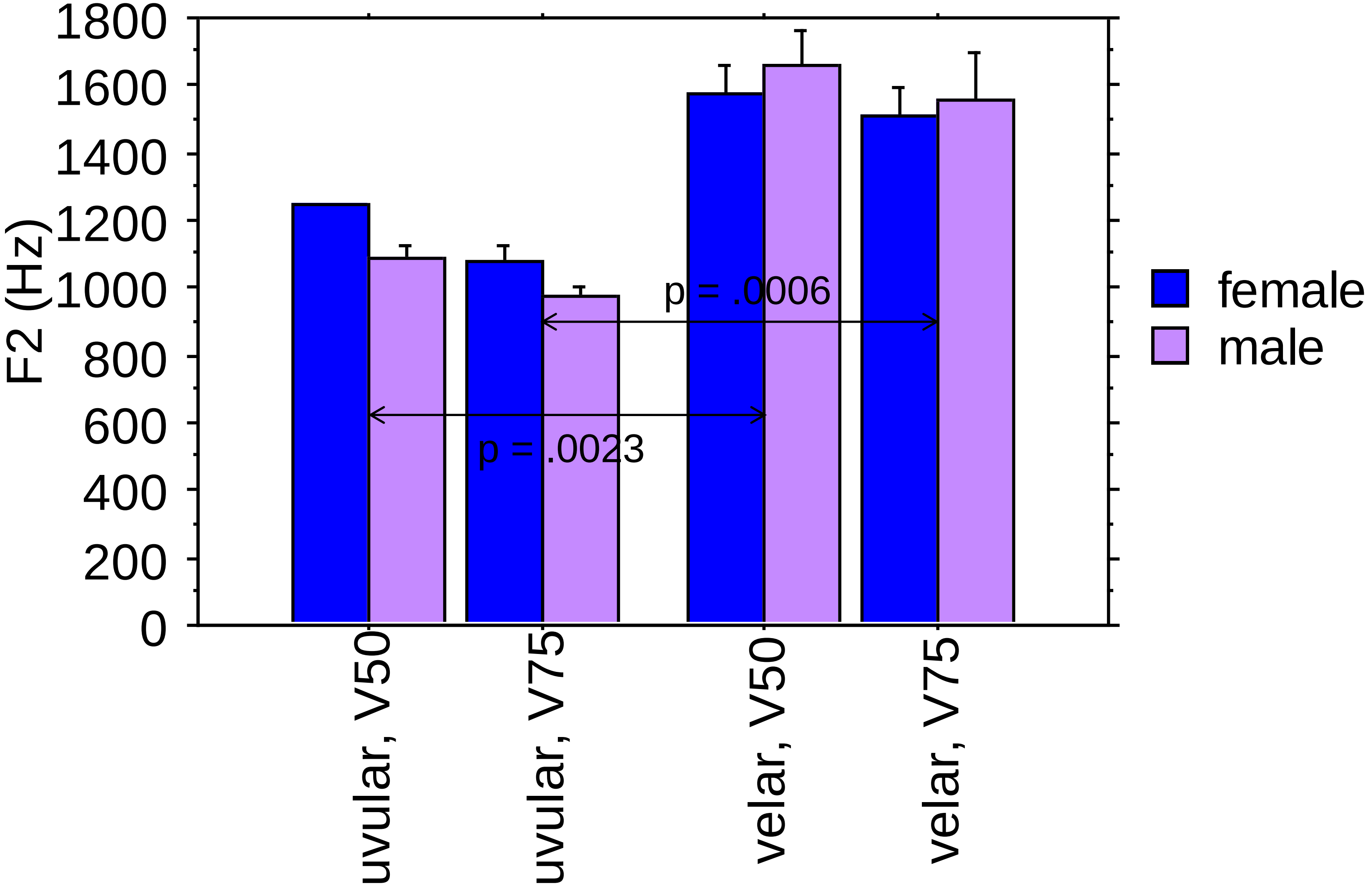
(d) <u>ŏ</u>Q{ŏ,o} vs. <u>ə</u>K{ŏ,o}: [ŏ] predicted to have significantly lower F2

- ✓ F2, p = .0023 (50%), = .0006 (75%)
- F1, p = .0104 (50%), = .0009 (75%)

F1 means


F1 (Hz)
600
500
400
300
200
100
0
p = .0104
p = .0009
uvular, V50
uvular, V75
velar, V50
velar, V75
female
male

F2 means


F2 (Hz)
1800
1600
1400
1200
1000
800
600
400
200
0
p = .0006
p = .0023
uvular, V50
uvular, V75
velar, V50
velar, V75
female
male

- [səŋon̥] ‘my mother’

[sə̲]- (50%) [sə̲]- (75%) [ŋon̥]

(frontal and sagittal views are 2 different productions)

Deg Xinag discussion

- Support for Rounding Assimilation
  - significantly lower F2 before a round vowel (intervening uvular, laryngeal)
    - even at vowel midpoint
    - F2 as low as underlying reduced rounded vowel, even lower at 75%

Consonant effects

- Rounding Assimilation takes place across a single uvular or laryngeal C
- RA blocked by all other places of articulation
  - alveolars
  - velars
  - [v]

[χəvon̻] ‘their mother’

[χə̲] [v] [on̻]

(frontal and sagittal views are 2 different productions)

Effect of uvulars on vowel quality

Babine-Witsuwit'en	Story 1984	auditory	Proto-Athabaskan high vowels lower to mid before uvulars
Quechua (e.g. Cuzco dialect)	Rose 1950	auditory	*[qi], *[iq] ([qe], [eq] only), *[qu], *[uq] ([qo], [oq] only)
Deg Xinag	Hargus 2010	acoustic	preceding/following uvulars raise F1, lower F2; greater effect of uvular following vowel
Palestinian Arabic	Card 1983	acoustic	lowered F2
Jordanian Arabic	Zawaydeh 1997	acoustic	lowered F2, raised F1
Moses-Columbian, Coeur D'Alene (Interior Salish)	Bessell 1998b, Bessell 1998a	acoustic	lowered F2, raised F1
Klallam	Montler 1998	acoustic	no effect
Nuuchahnulth	Wilson 2007	auditory, acoustic	preceding uvular raises F1 of /i/ but not /a/, /u/ (F2 not reported)

Uvulars and labials

- Card 1983: ‘it is interesting to note that emphasis and labialization both cause lowered second formants’
- Cairo Egyptian Arabic (Lehn 1963). articulation of emphatic Cs ‘is defined by the cooccurrence of the first and one or more others of the following articulatory features: … (3) slight lip protrusion or rounding (labialization), …’
- Jakobson, Fant, and Halle 1976: ‘peoples who have no pharyngealized consonants in their mother tongue, as for instance, the Bantus and the Uzbeks, substitute labialized articulations for the corresponding pharyngealized consonants of Arabic words’

Uvulars and Rounding Harmony

- Blocking/triggering Cs in RH
  - Kaun 2004 survey of doesn't mention
  - Labials block RH in Nawuri (Casali 1995)
- Why don't uvulars come up in Rounding Harmony lit?
  - Uvulars areally limited (Maddieson 2005)
  - Rounding Harmony also rare

Deg Xinag summary

- Rounding Assimilation as a phonological process
  - applies even in slow speech
  - applies even without surface round trigger (AJ)
  - lack of variability (F2 lowering in uvular and laryngeal contexts, $p < .0001$ for each individual)
  - neutralizing (difs with perambulative prefix are predictable from position of uvular C)

Still…

- Are there any lg-independent aspects of DX Rounding Assimilation?
- If a language has /ə/-Q-round vowel, can we expect anything like RA?
- Enter Babine-Witsuwit’en

Babine-Witsuwit’en

- Consonants

p p’	t t^h t’	c c^h c’	k^w k^{wh} k^{w}’	q q^h q’	ʔ
	t͡s t͡s^h t͡s’				
	t͡ɬ t͡ɬ^h t͡ɬ’				
	s z	ç		χ ʁ	h
	ɬ				
m	n				
w	l	j			

- Vowels

full	*reduced*	*full*
i		u
e	ə	o
ɛ	a	

Babine-Witsuwit’en vs. Deg Xinag

- B-W has innovative ‘fortis’ vs. ‘lenis’ C classes, affect quality (mostly F1) of following V (Story 1984, Hargus 2007)
  - fortis: ejectives, ʔ, vls aspirates, vls fricatives
  - lenis: vls unaspirates, vd fricatives, sonorants

Questions about B-W

- Perhaps Babine-Witsuwit'en has something like Deg Xinag Rounding Assimilation on a subphonemic level and fieldworkers like myself have trained themselves not to hear it because rounding is not contrastive in the reduced vowels.
  - [səq^{h}oj] 'he/she vomited'
  - [təquz] 'it's friable'

a) əQ{u,o} vs. əQə: predicted not to differ in F2

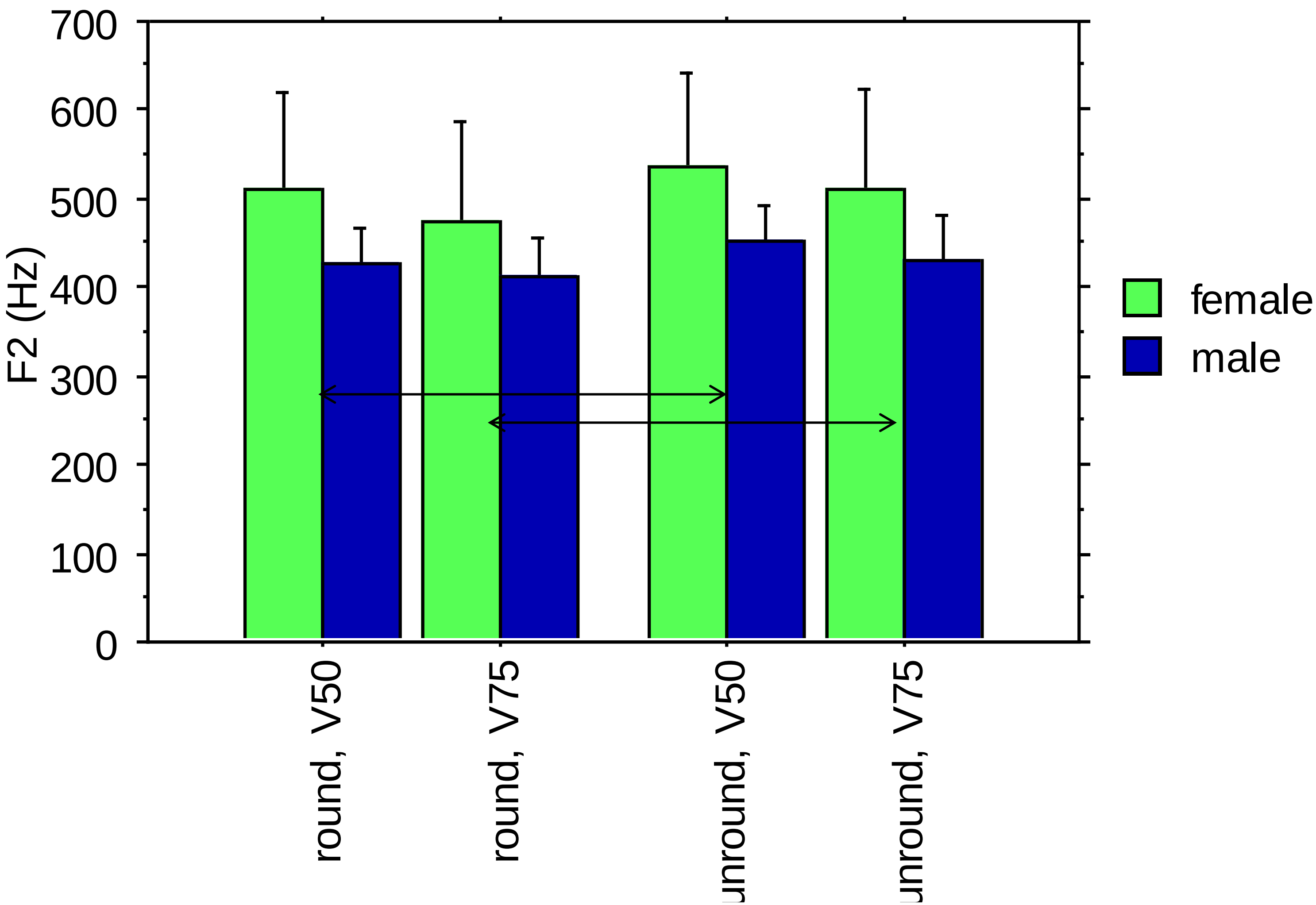
b) əK^{w}ə vs. əQə: F2 before labio-velar predicted not to be significantly lower than before uvular

Methods

- Word list recording
- C before target vowel
  - Place controlled for (alveolar)
  - ‘Fortis’ vs. ‘lenis’ balanced
- 9 speakers (5 female, 4 male)
- 10-15 comparison pairs per speaker

F2 results

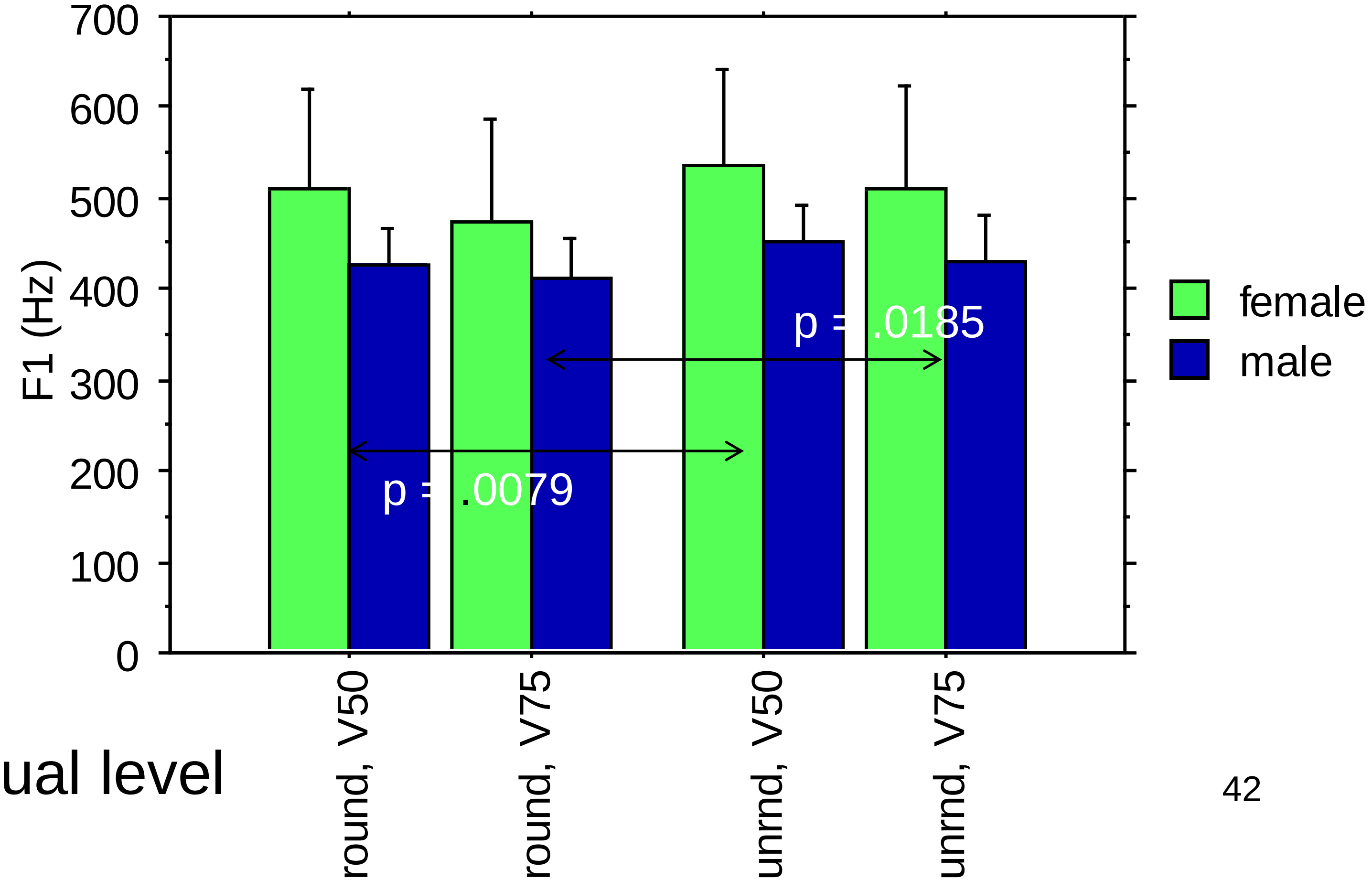
- n.s. (group)



individuals: 1 speaker has DX pattern (p = .0407 at 75%)

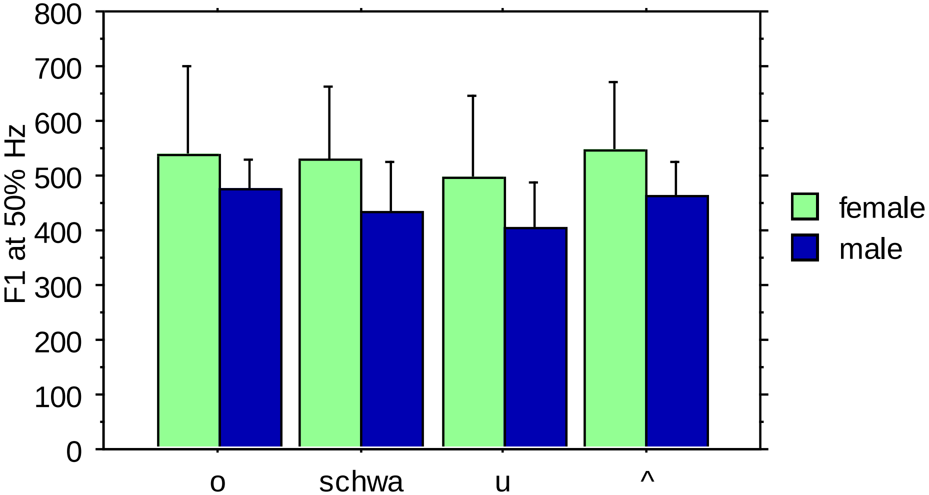
F1 results

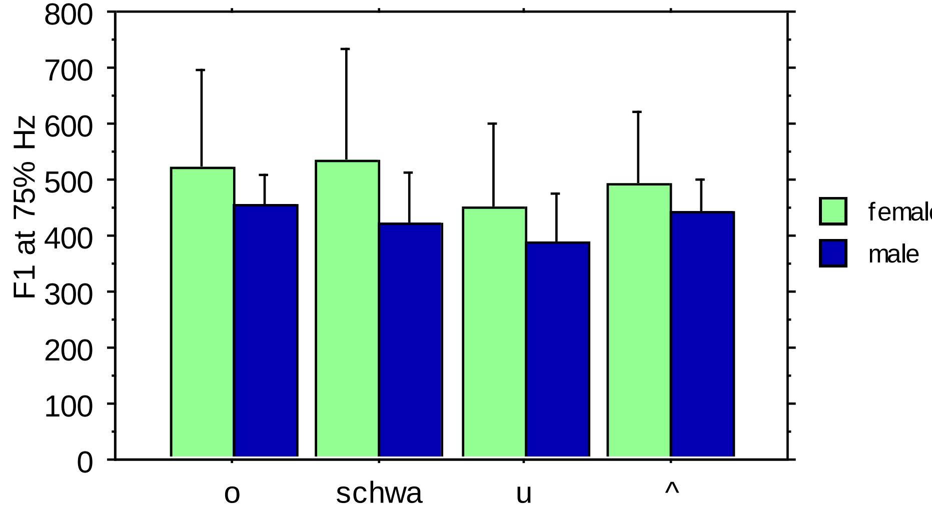
- F1 significantly lower before round vowels



F1 n.s. at individual level

F1 and following vowel



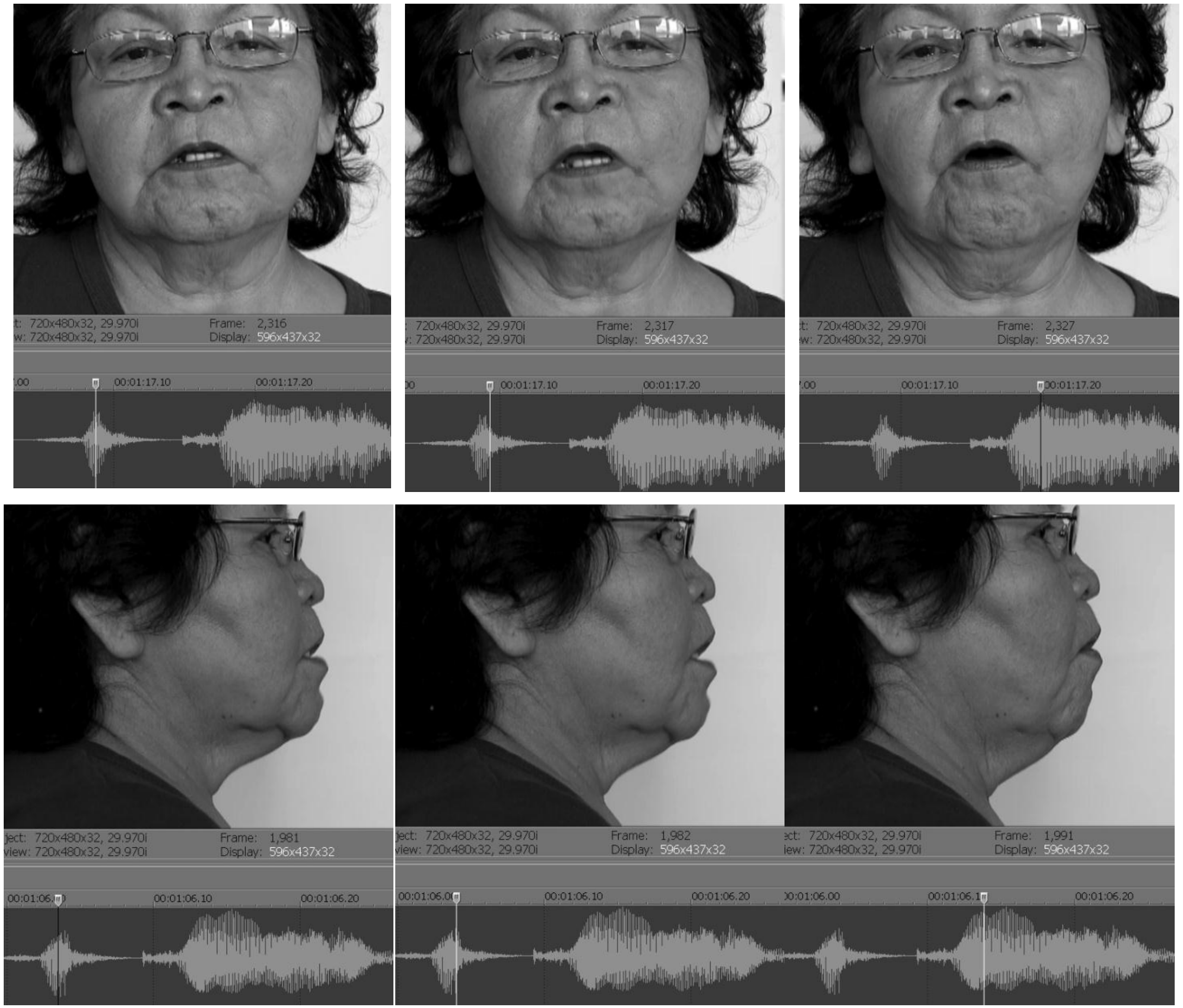


The likely culprit is fortis vs. lenis class of following uvular:

[səˡqʰɔj] [səˡqəs] [təˡquz] [ɬəˡqʰʌt]

- Lip positions on the vowels of [səq^{h}oj] ‘he/she vomited’

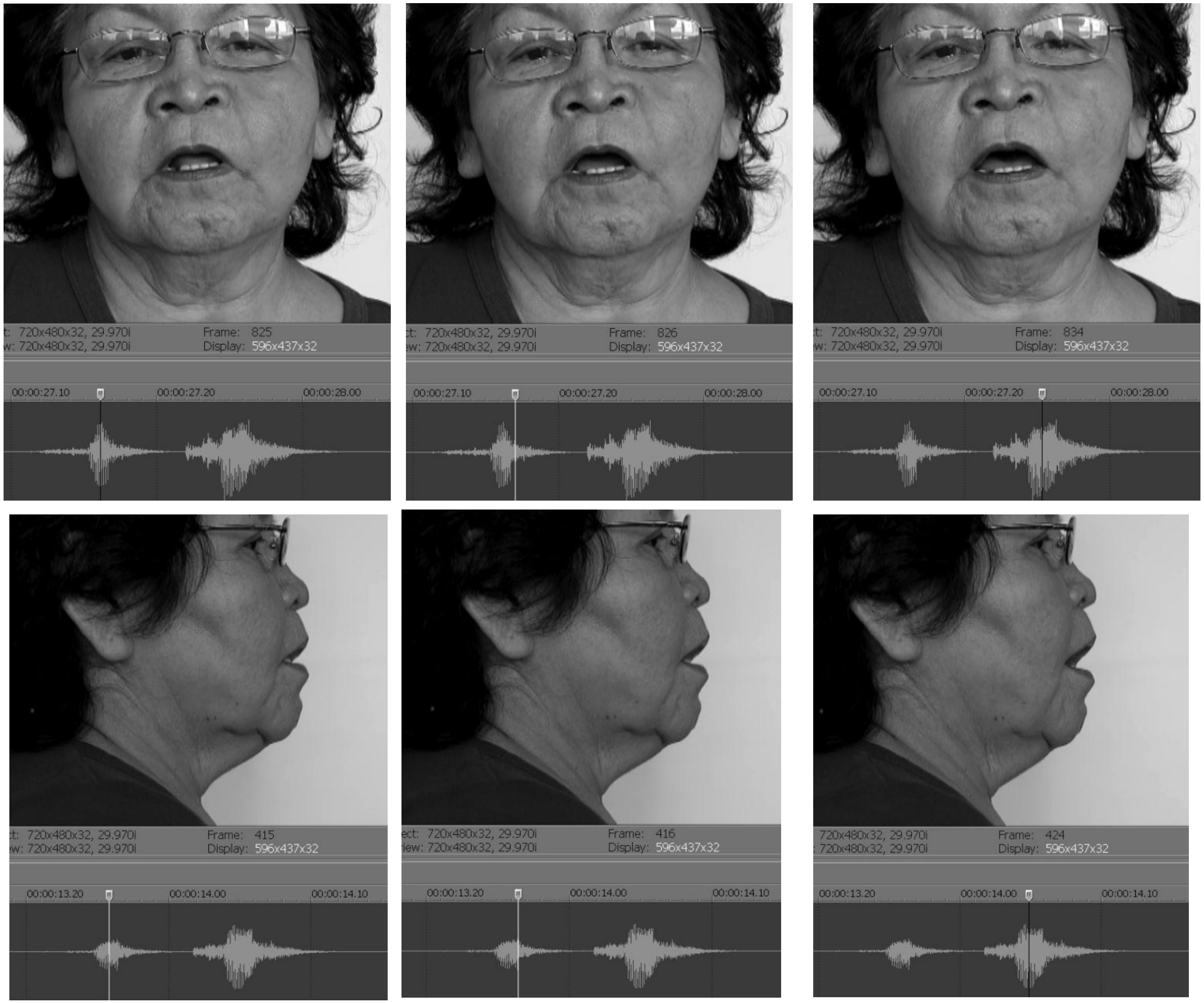
[sə̲] (50%) [sə̲] (75%) [q^{h}oj]



(frontal and sagittal views are 2 different productions)

- Lip positions on the vowels of [ɬəq^{h}ət] ‘he/she is clapping’

[ɬə̲] (50%) [ɬə̲] (75%) [q^{h}ət]



(frontal and sagittal views are 2 different productions)

Babine-Witsuwit'en discussion

- Lacks F2 lowering seen in DX Rounding Assimilation
  - except one speaker, at 75% of vowel duration

Why does Deg Xinag have Rounding Assimilation while Babine-Witsuwit'en does not?

- Dorsal consonants
  - Deg Xinag: /k q/
  - Witsuwit'en: /c k^w q/
- F2 lowering on preceding vowel makes it easier to distinguish uvulars and velars (next to round vowels)

A possible scenario for historical change

- Proto-Athabaskan (much work by Jeff Leer)
- Pre-Proto-Athabaskan (“a more hypothetically reconstructed stage of the language previous to certain important phonological and structural changes”, Leer 1979)

PA	*ʊq	*qʊ
PPA	*/əq^{w}/	*/q^{w}ə/

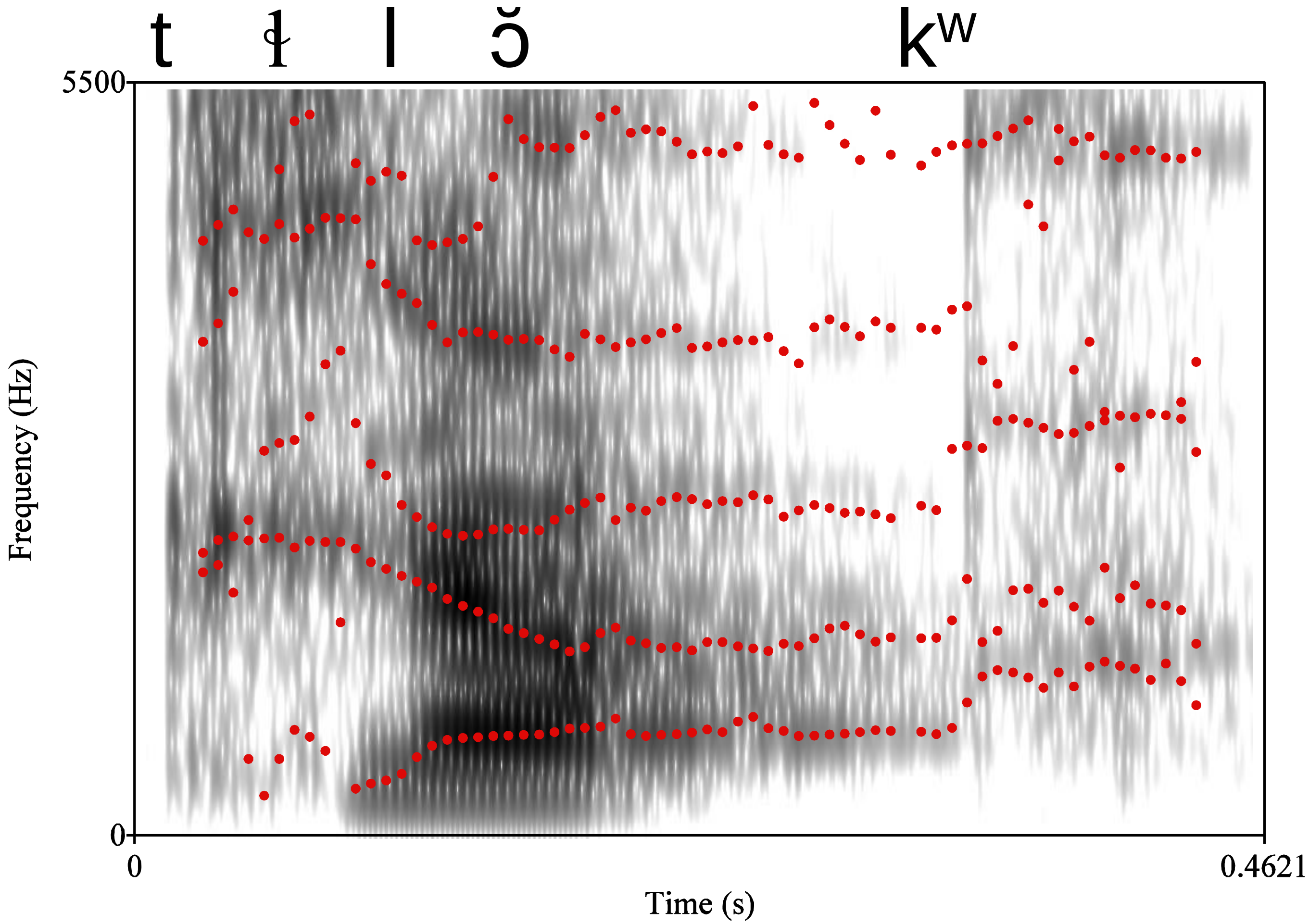
Another look at Proto-Athabaskan

PPA	*/əqʷ/	*/qʷə/
PA	*ʊq [ʊqʷ]	*qʊ [qʷə]~[qʊ]

Development of PA *qʊ in Babine-Witsuwit’en

PA	*ʊq		*qʊ	
	[ʊq^{w}]		[q^{w}ə]~[qʊ]	
		*nə-ɬ-tʊ̉q’		*q^{h}ʊ̉n’
		‘become crammed…’		‘fire’
B-W	/ək^{w}/		/k^{w}ə/	
	[ŏq^{w}] /[ŏk^{w}]		[k^{w}ə]	
		[niztŏq^{w}]		[k^{h}wən]
		‘it’s spherical’		‘fire’

• /tətɬ^{h}ək^{w}/ ‘it’s wet’ (female speaker LM)



How Deg Xinag developed Rounding Assimilation

PPA	*/əq^{w}/	*/q^{w}ə/	
PA	*ʊq	*qʊ	
	[ʊq^{w}]	[q^{w}ə]~[qʊ]	
DX	[ŏq]	[qŏ]	[ŏqŏ]
			(RA)
	*-[tɬʊ̉q’] ‘laugh’	*q^{h}ʊ̉n’ ‘fire’	
	-[tɬŏq]	[q^{h}ŏn’]	[sŏq^{h}ŏn’]
	‘laugh’	‘fire’	‘my fire’

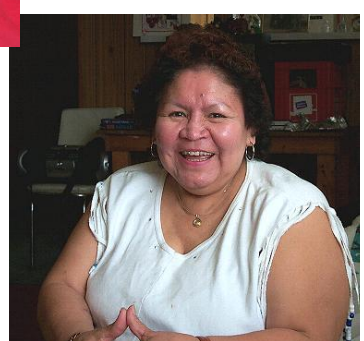
Conclusions

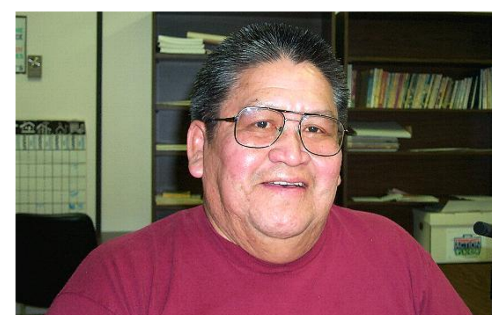
- Lip rounding exists before uvular+round vowel in Deg Xinag, probably to enhance velar-uvular contrast
- Comparison with Babine-Witsuwit’en
  - helps separate phonological and phonetic aspects of DX Rounding Assimilation
  - provides insights into how RA may have developed in DX

Thanks to

- Funding agency: NSF (DEL-0651853)
- Ian Maddieson, Gunnar Hansson, Richard Wright, Jennifer Haywood, Dan McCloy
  - for comments
- Russell Hugo
  - for assistance with video

Thanks to Witsuwit’en speakers





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