

# THE PERCEPTION AND PRODUCTION OF TWO VOWEL MERGERS IN COWLITZ COUNTY, WASHINGTON

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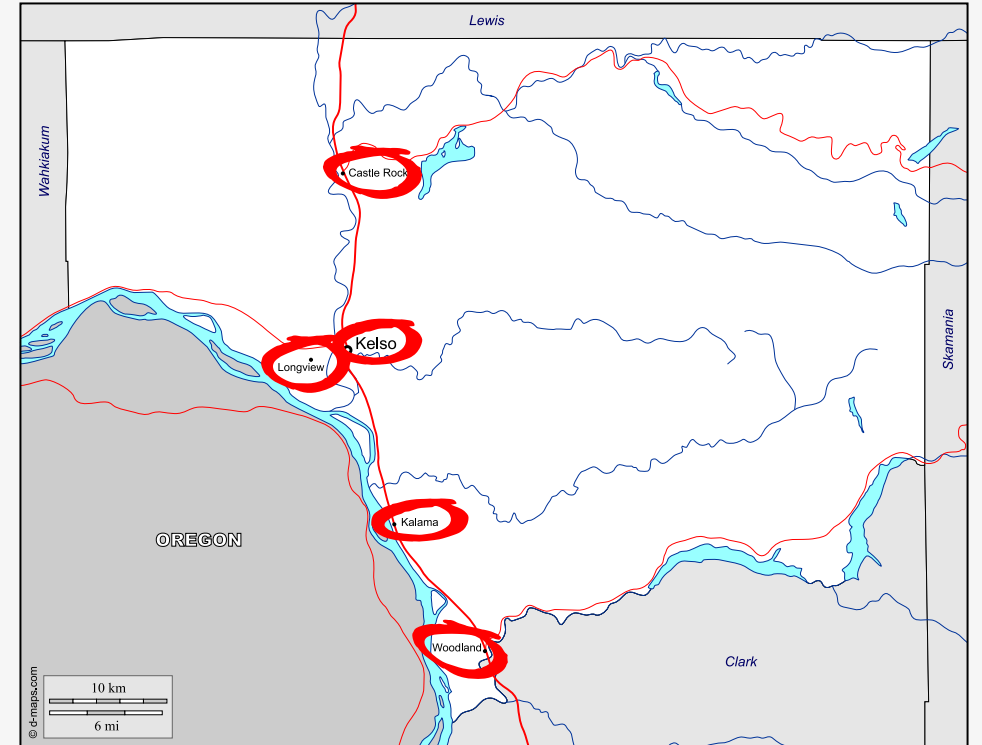
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American Dialect Society Annual Meeting

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# COWLITZ COUNTY, WASHINGTON



# PACIFIC NORTHWEST ENGLISH (CF. STANLEY 2016)

prevelar /e, ε, æ/ raising and merging (Wassink et al. 2009, Freeman 2014, Riebold 2015, etc.)

= MARY-MERRY-MARRY vowels

/u, υ, o/ fronting (Ward 2003, Becker et al. 2013, McLarty & Kendall 2014, etc.)

= POOL-PULL-POLE(-PULP) vowels

*Linguistic Atlas of the Pacific Northwest (LAPNW)*  
(Reed 1952, 1956, 1957, 1961)



# MARY-MERRY-MARRY MERGER

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M/e/ry = m/ɛ/rɹy = m/æ/rɹy (henceforth “pre-rhotics”)

*ANAE*: “This query was not pursued in most areas of the West and Midwest.”

(Labov, Ash, & Boberg 2006:54, note 6)

Change in progress 60 years ago

fully merged (Reed 1952, Thomas 1958, Foster & Hoffman 1966)

yet...

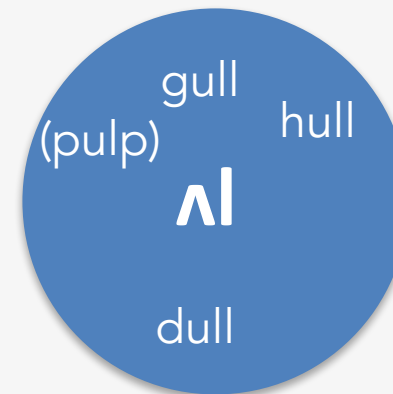
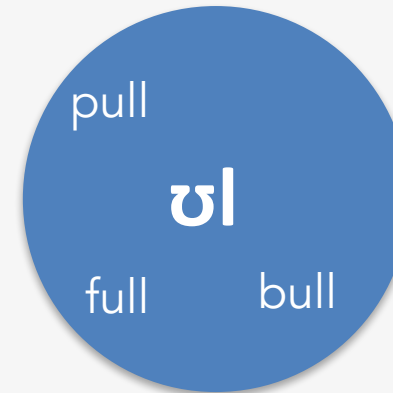
a few older speakers retain /e/ in *Mary* and /æ/ in *marry* (Reed 1961:560)

*chair* “sporadically” as [ɛ<sup>I</sup>] in eastern Washington (561)

near even distribution of [ɛ] and [æ] in *parents* (562)

# "PRE-LATERAL" MERGERS

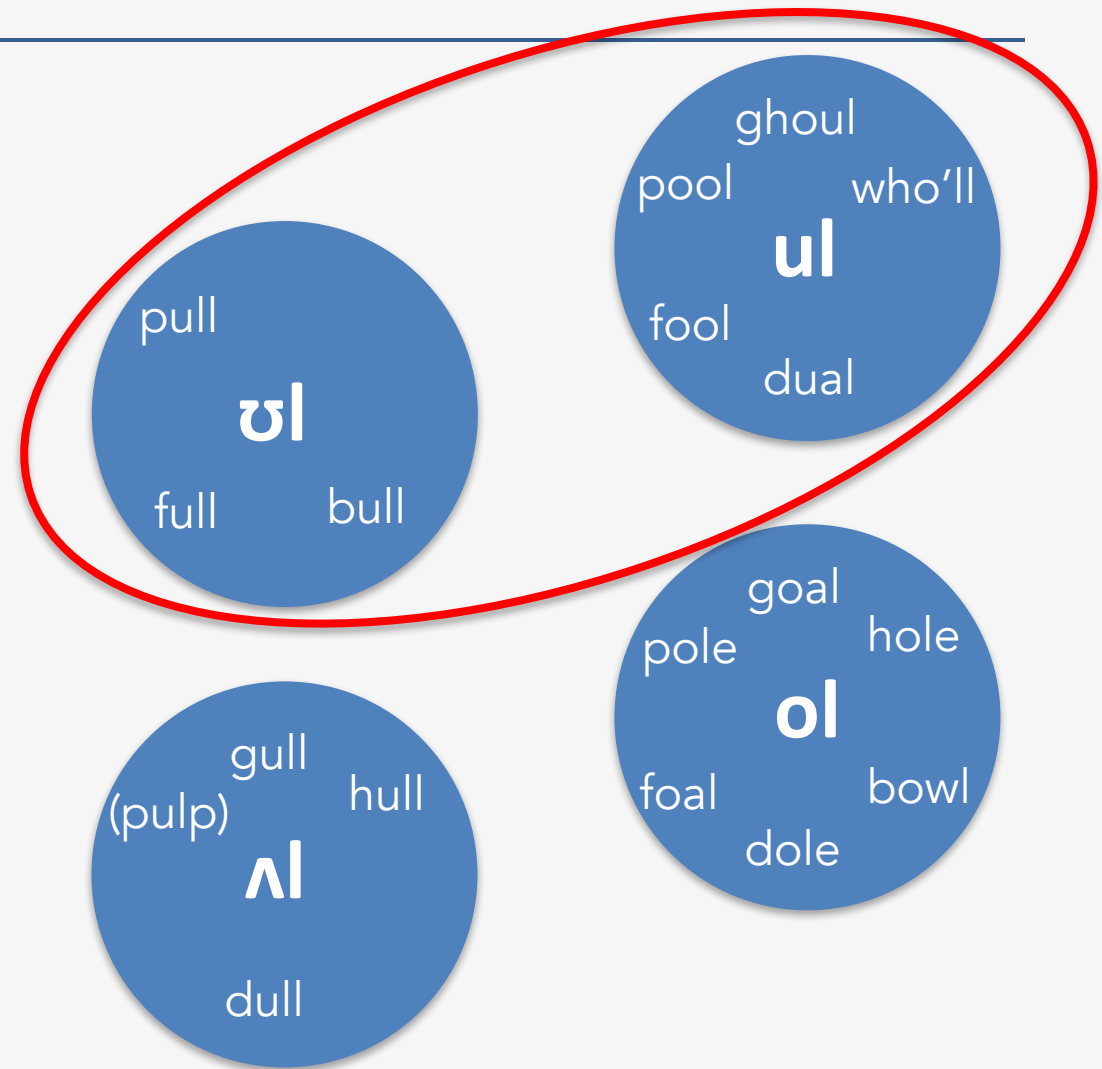
several mergers involving back vowels before  
coda laterals



# "PRE-LATERAL" MERGERS

several mergers involving back vowels before  
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POOL-PULL

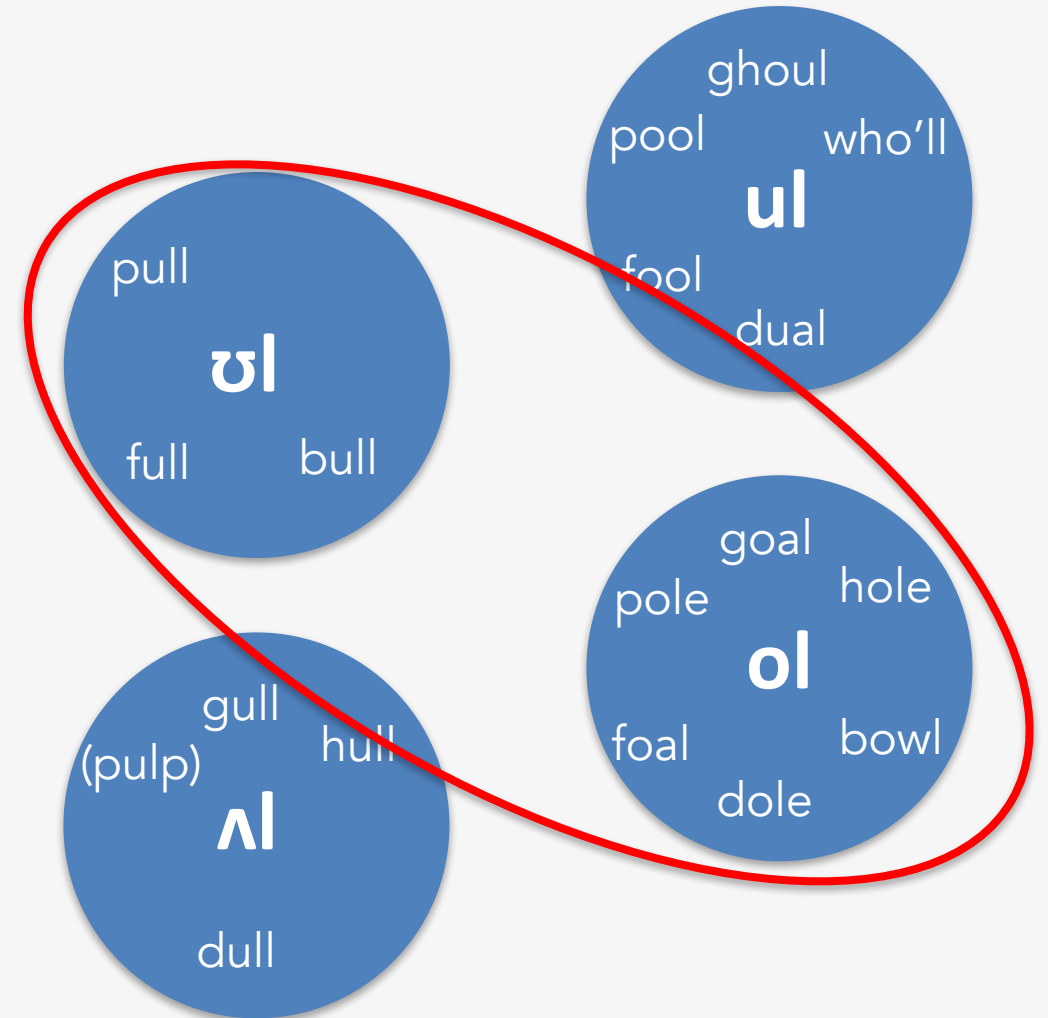


# "PRE-LATERAL" MERGERS

several mergers involving back vowels before  
coda laterals

POOL-PULL

PULL-POLE



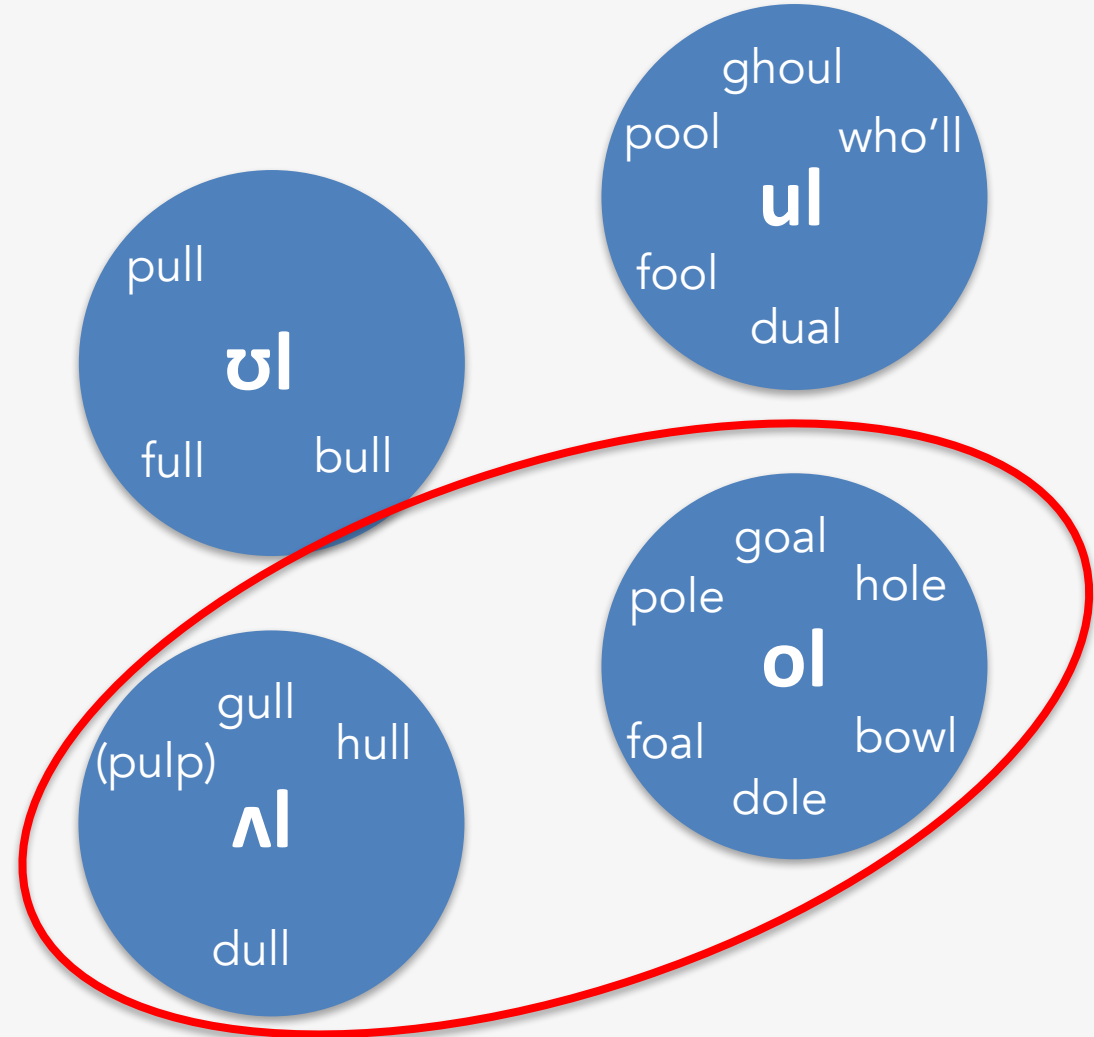
# "PRE-LATERAL" MERGERS

several mergers involving back vowels before  
coda laterals

POOL-PULL

PULL-POLE

HULL-HOLE





# "PRE-LATERAL" MERGERS

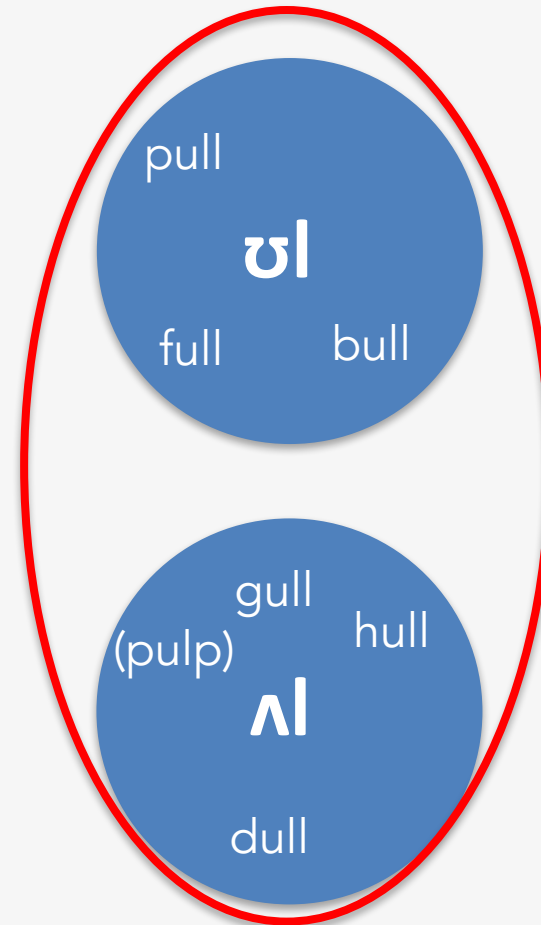
several mergers involving back vowels before  
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POOL-PULL

PULL-POLE

HULL-HOLE

PULL-HULL



# "PRE-LATERAL" MERGERS

several mergers involving back vowels before coda laterals

POOL-PULL

PULL-POLE

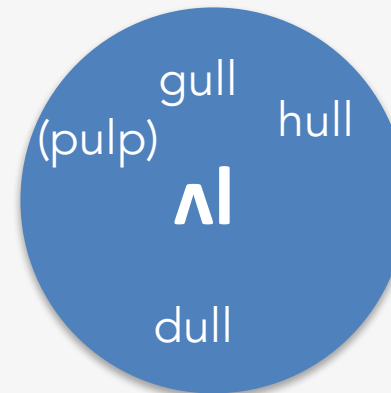
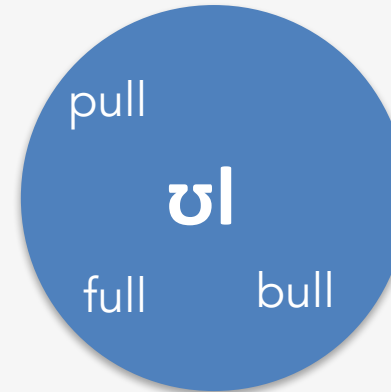
HULL-HOLE

PULL-HULL

"deserve further study" (Labov, Ash, & Boberg 2006: 73)

variable in Maryland (Bowie 2001), Ohio (Arnold 2014), Missouri (Strelluf 2016), and Utah (Baker & Bowie 2010)

*bulk* and *bulge* as [ɫ] or [ʊ], *pull* as [ʊ] (Reed 1961)



# OVERVIEW

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MARY-MERRY-MARRY historically variable, but likely merged today

Status of pre-lateral mergers is unknown, though impressionistically less clear cut

Hypothesis 1: complete *MARY-MERRY-MARRY* merger

Hypothesis 2: separation of POOL, PULL, POLE, and PULP

Hypothesis 3: production/intuition mismatch

# METHODOLOGY

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# DATA COLLECTION

40 natives of Cowlitz County, ages 18–70s

	Number of tokens		
	word list	minimal pairs	total
word list (23) and minimal pairs (14)	376	842	1,218
list in appendix slides	342	509	851
total	718	1,351	2,069

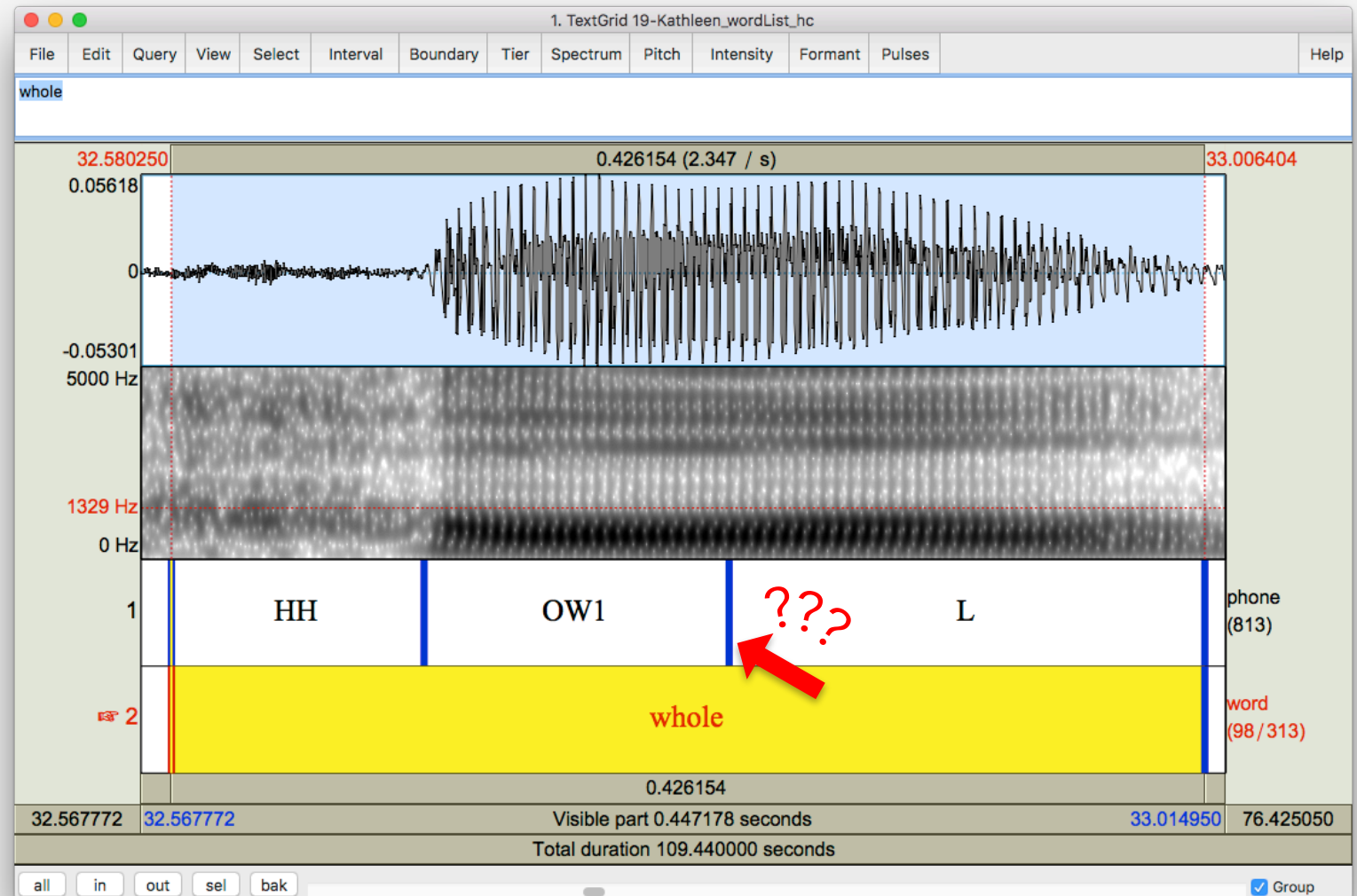
intuition of own minimal pairs

forced aligned with DARLA (Reddy & Stanford 2015), which uses ProsodyLab (Gorman, Howell, & Wagner, 2011) and FAVE (Rosenfelder, Fruehwald, Evanini, & Yuan 2011)

hand-corrected boundaries and extracted formants myself

# FORMANT EXTRACTION

boundaries can be arbitrary



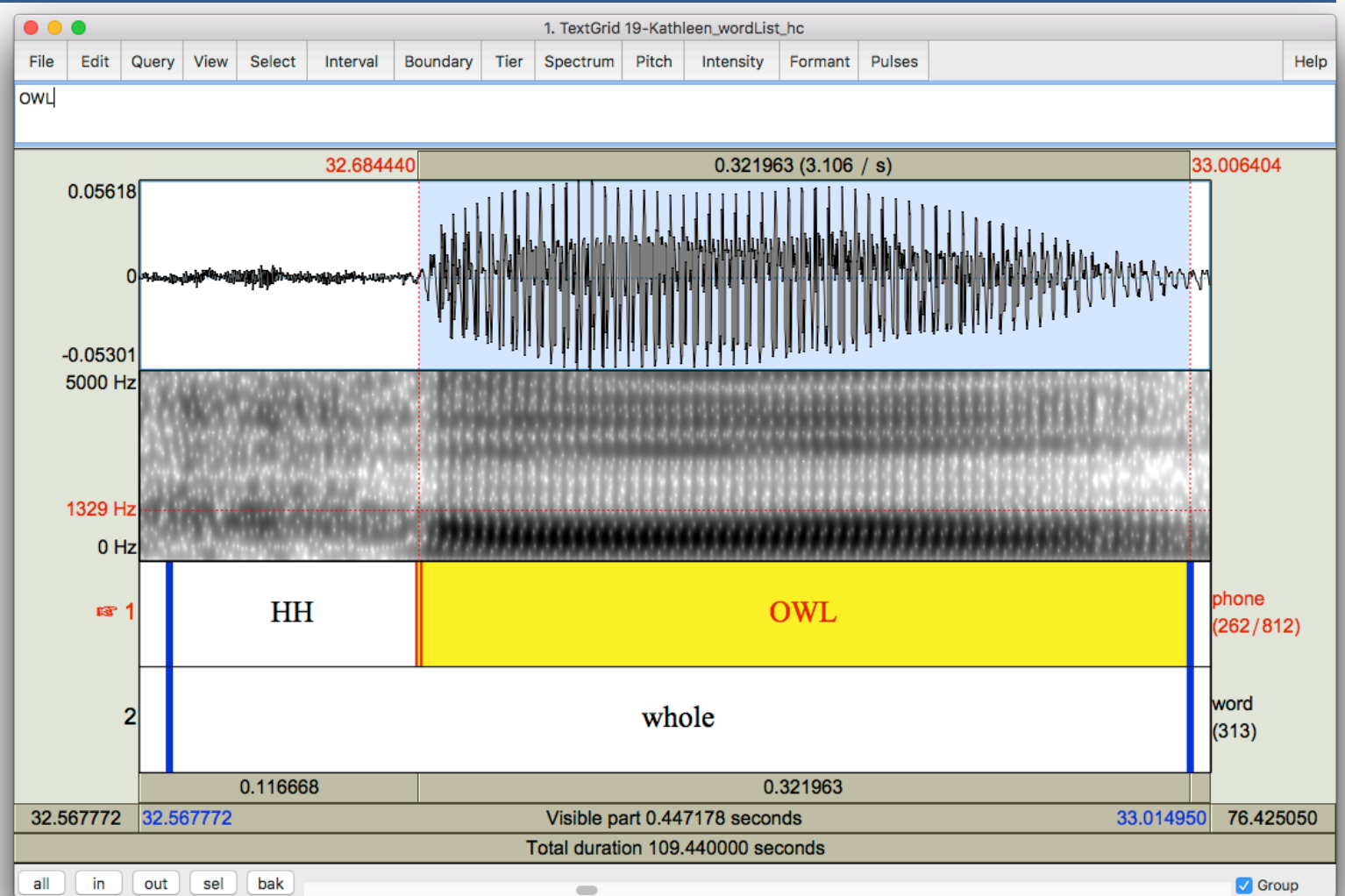
# FORMANT EXTRACTION

boundaries can be arbitrary

formants extracted at 15 points along the vowel+liquid duration

25% point used for now  
(reasoning in appendix slides)

Bark normalized (Traunmüller 1997)  
Lobanov not ideal since not all vowels are present  
(Thomas & Kendall 2007–2015)



# RESULTS

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# PRE-LATERALS: MINIMAL PAIRS

POOL is higher

PULP is lower and fronter

(statistics in appendix slides)

PULL = POLE

(independent two-sided  $t$ -tests)

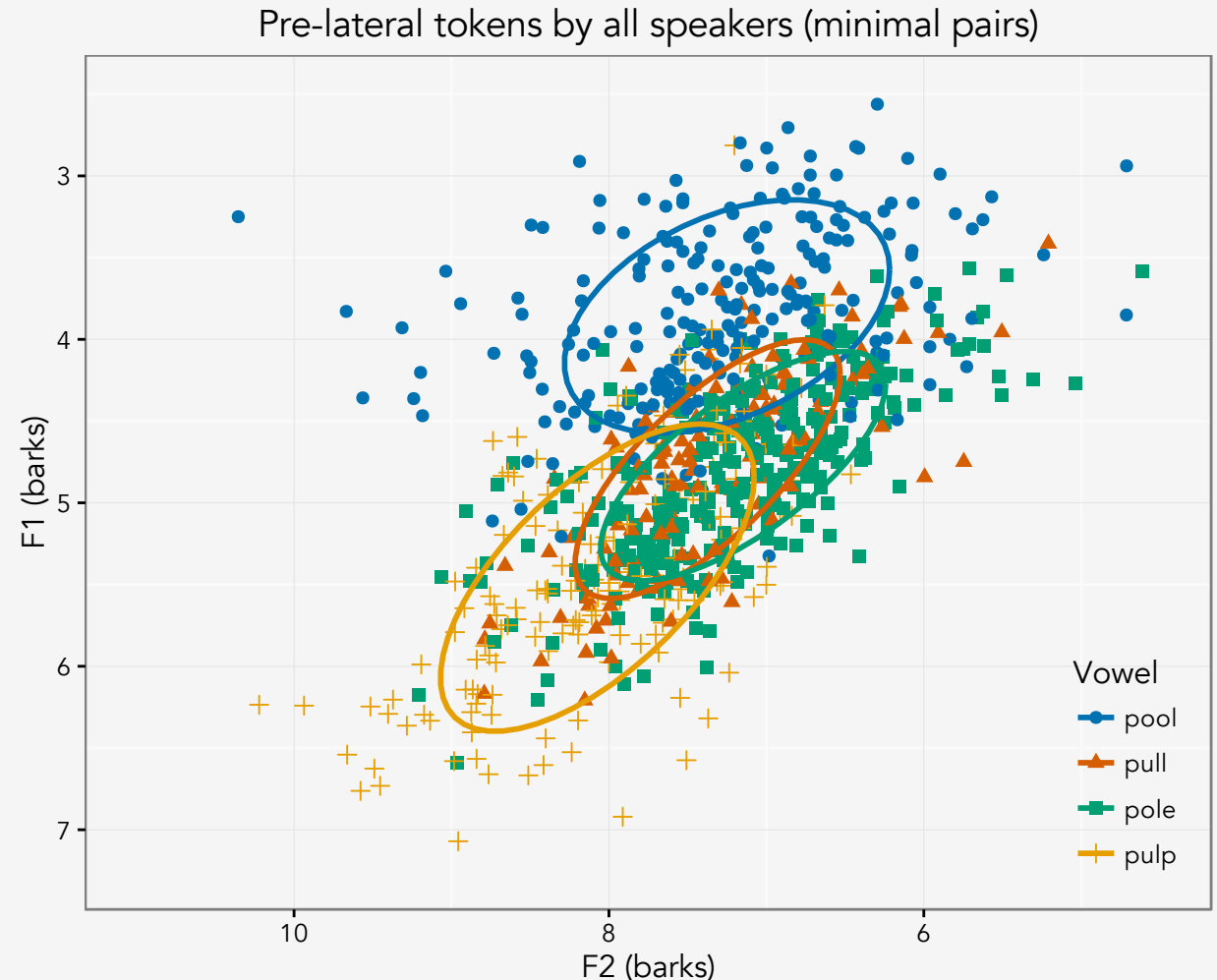
F1:  $t_{(215.15)} = 0.13, p = 0.89$

F2:  $t_{(253.56)} = 2.50, p = 0.01$

Pillai score: 0.02 (cf. Hay, Warren, & Drager  
2006, Hall-Lew 2010, Nycz & Hall-Lew 2013)

Bhattacharyya's affinity: 0.97

(cf. Bhattacharyya 1943, Calenge 2006, Johnson 2015)



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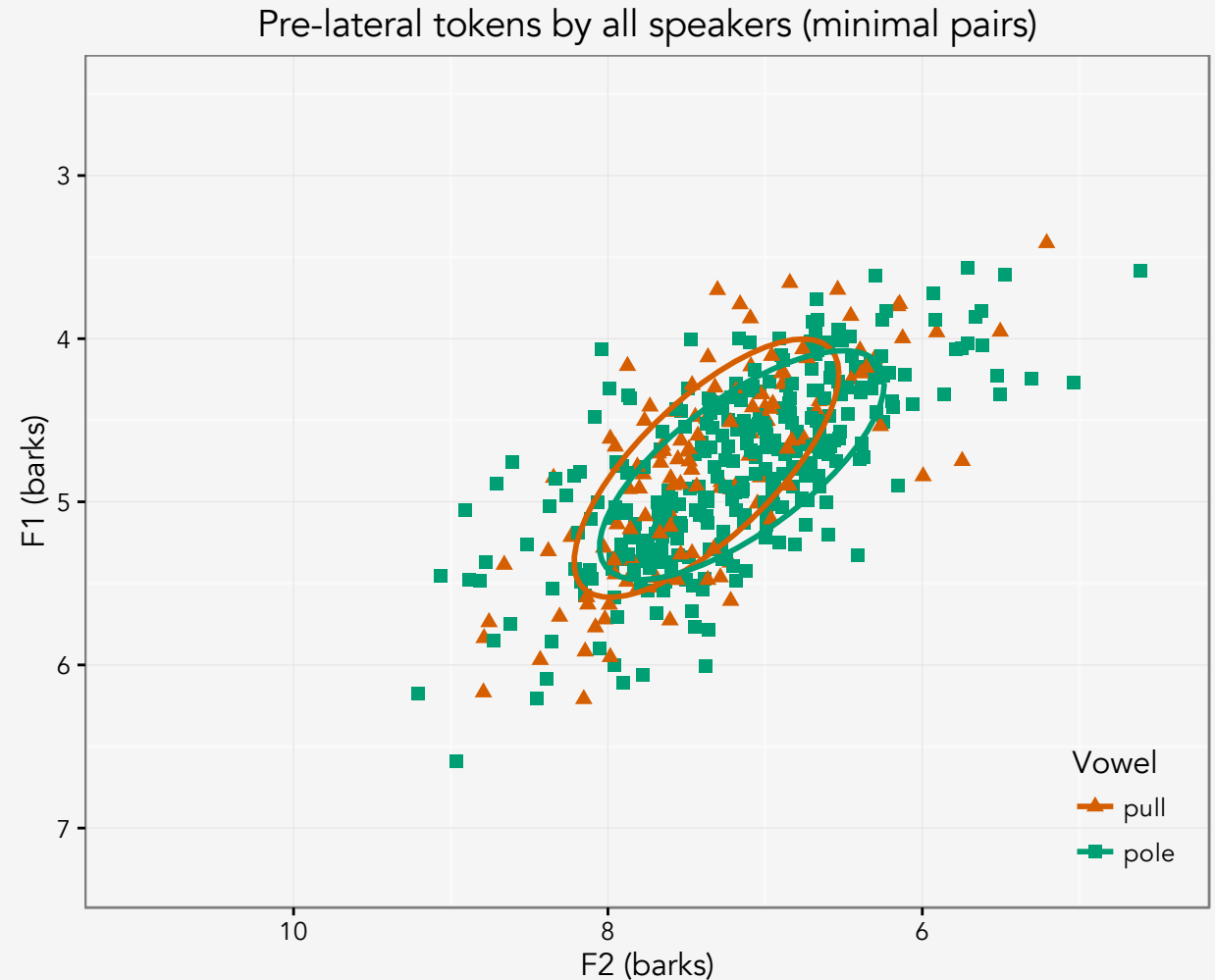
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(cf. Bhattacharyya 1943, Calenge 2006, Johnson 2015)



# PRE-LATERALS: WORD LIST

PULL = POLE

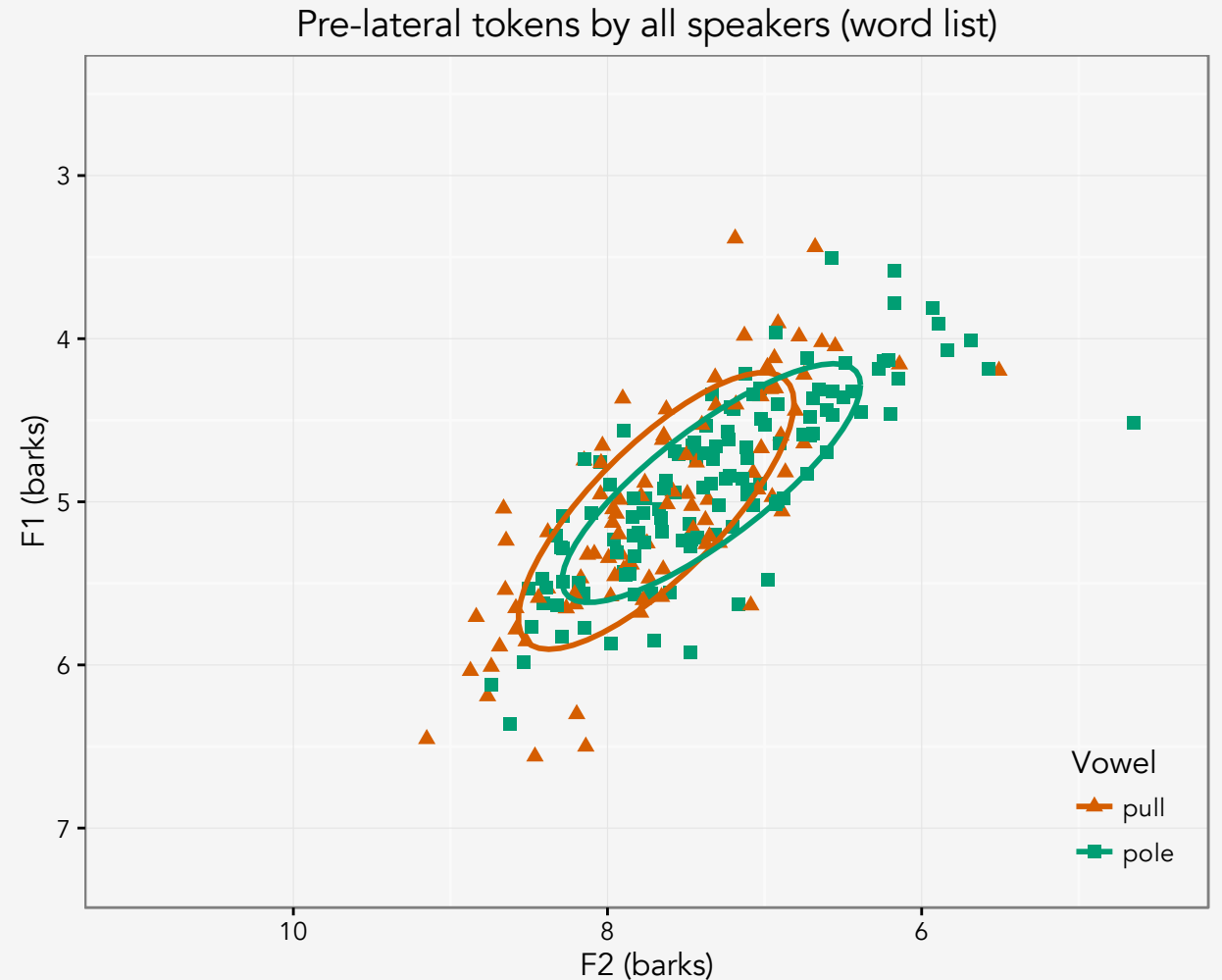
(independent two-sided  $t$ -tests)

F1:  $t_{(191.45)} = 2.06, p = 0.04$

F2:  $t_{(212.96)} = 3.88, p < 0.001$

Pillai score: 0.07

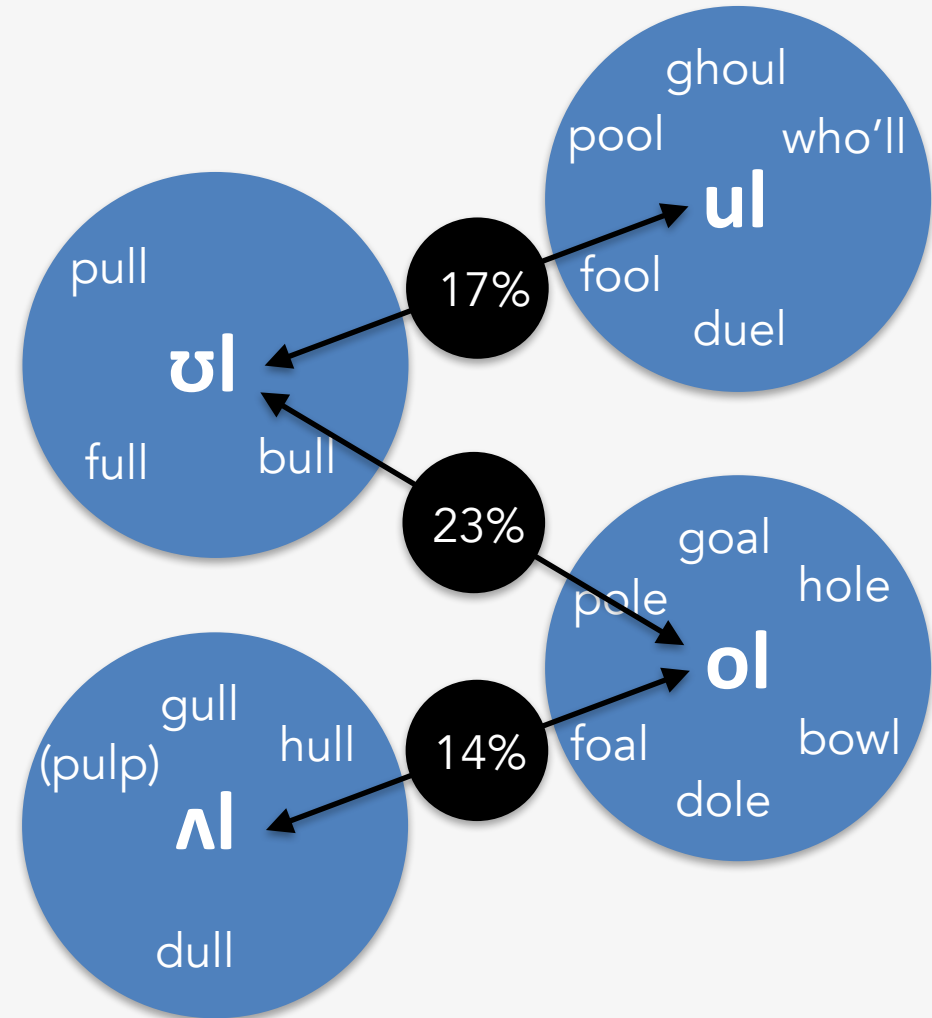
Bhattacharyya's affinity: 0.95



# PRE-LATERALS: PERCEPTION

% = pairs reported merged

hesitant responses



# PRE-RHOTICS: WORD LIST

MERRY = MARRY—no doubt about it

MARY slightly higher than M{E,A}RRY

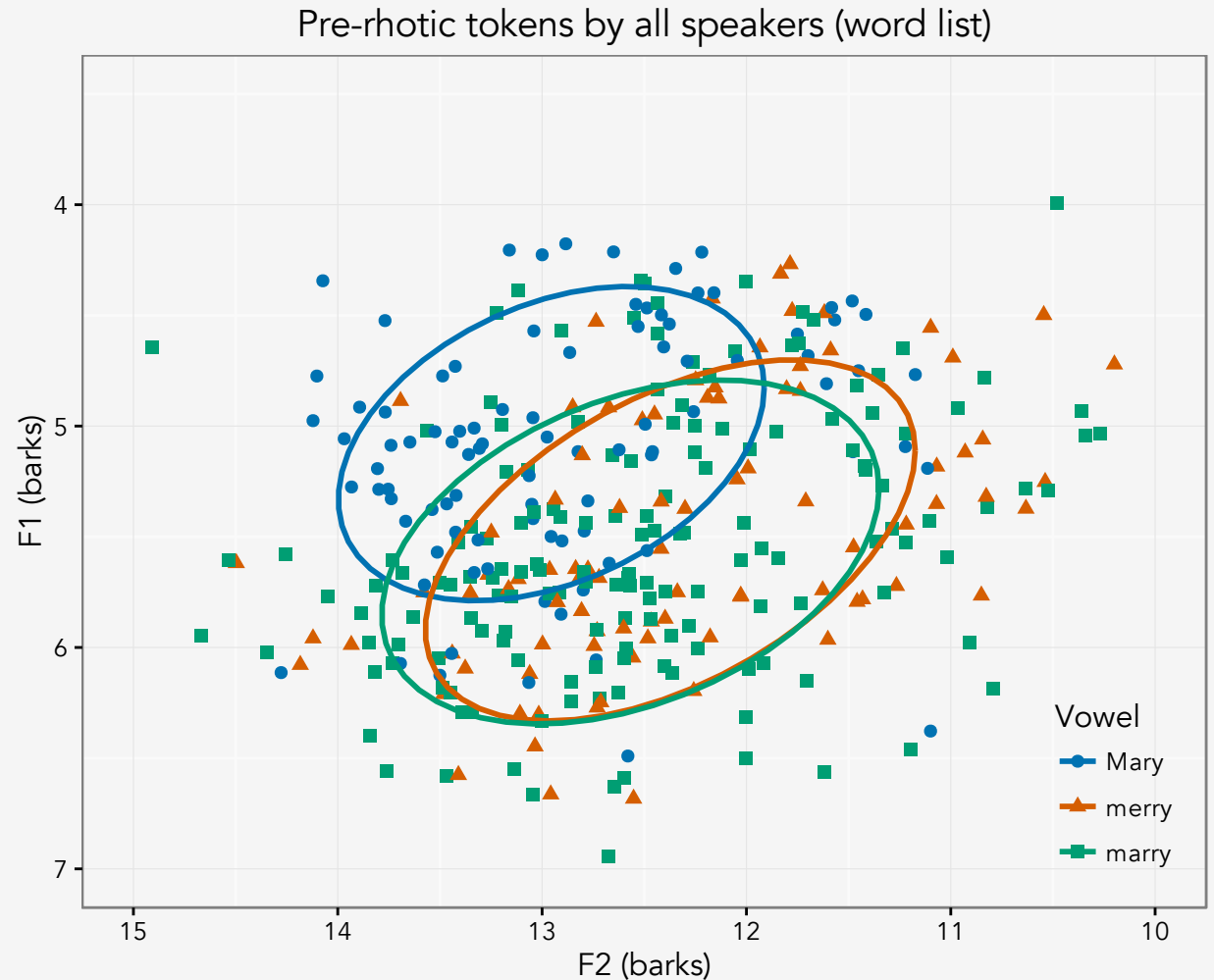
(independent one-sided  $t$ -tests)

F1:  $t_{(175.87)} = -6.44, p < 0.001$

F2:  $t_{(188.15)} = 4.36, p < 0.001$

Pillai score: 0.20

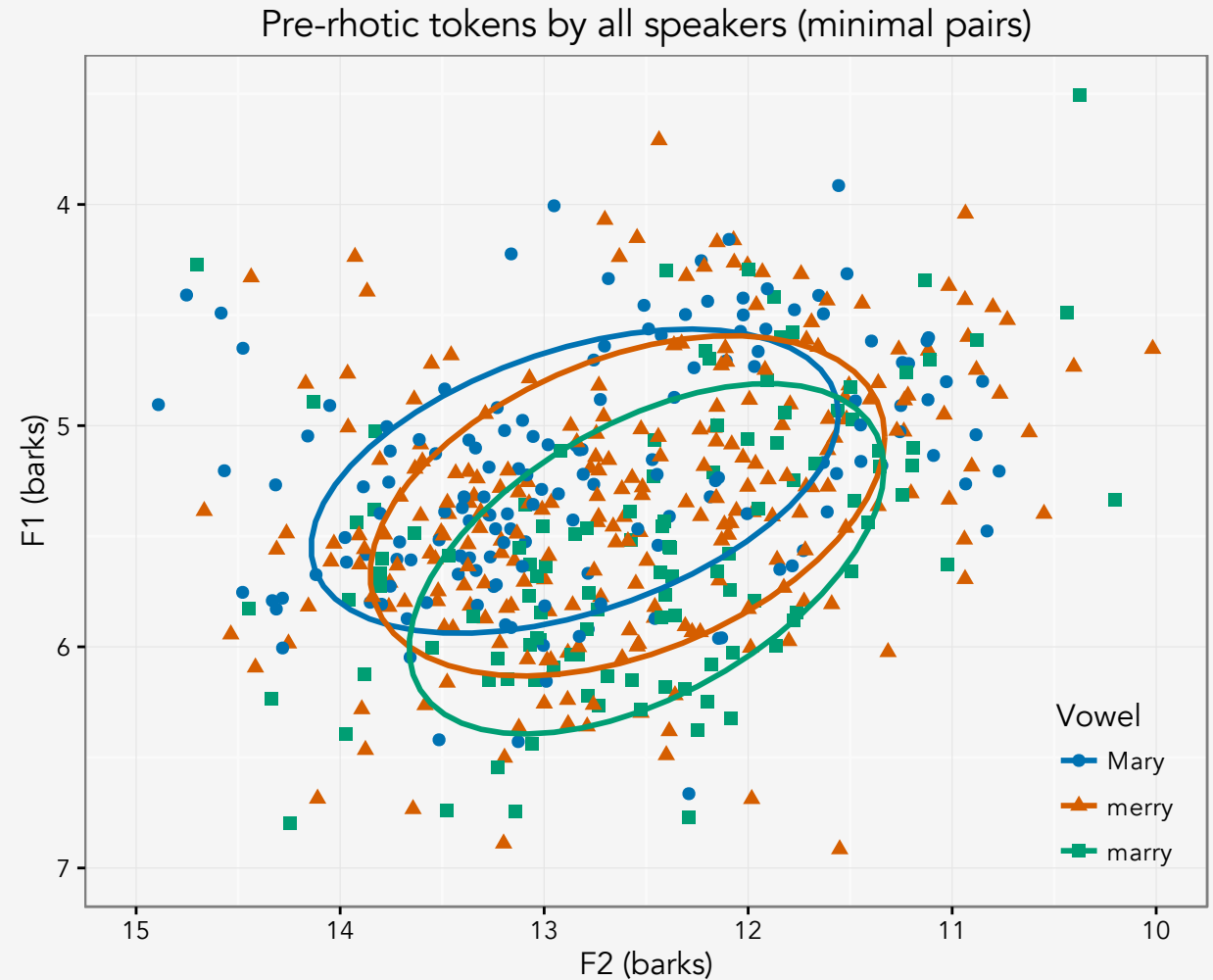
Bhattacharyya's affinity: 0.90



# PRE-RHOTICS: MINIMAL PAIRS

(near-)complete merger

hint of a three-way distinction



# PRE-RHOTICS: MINIMAL PAIRS

(near-)complete merger

hint of a three-way distinction

slight MARY~MARRY distinction

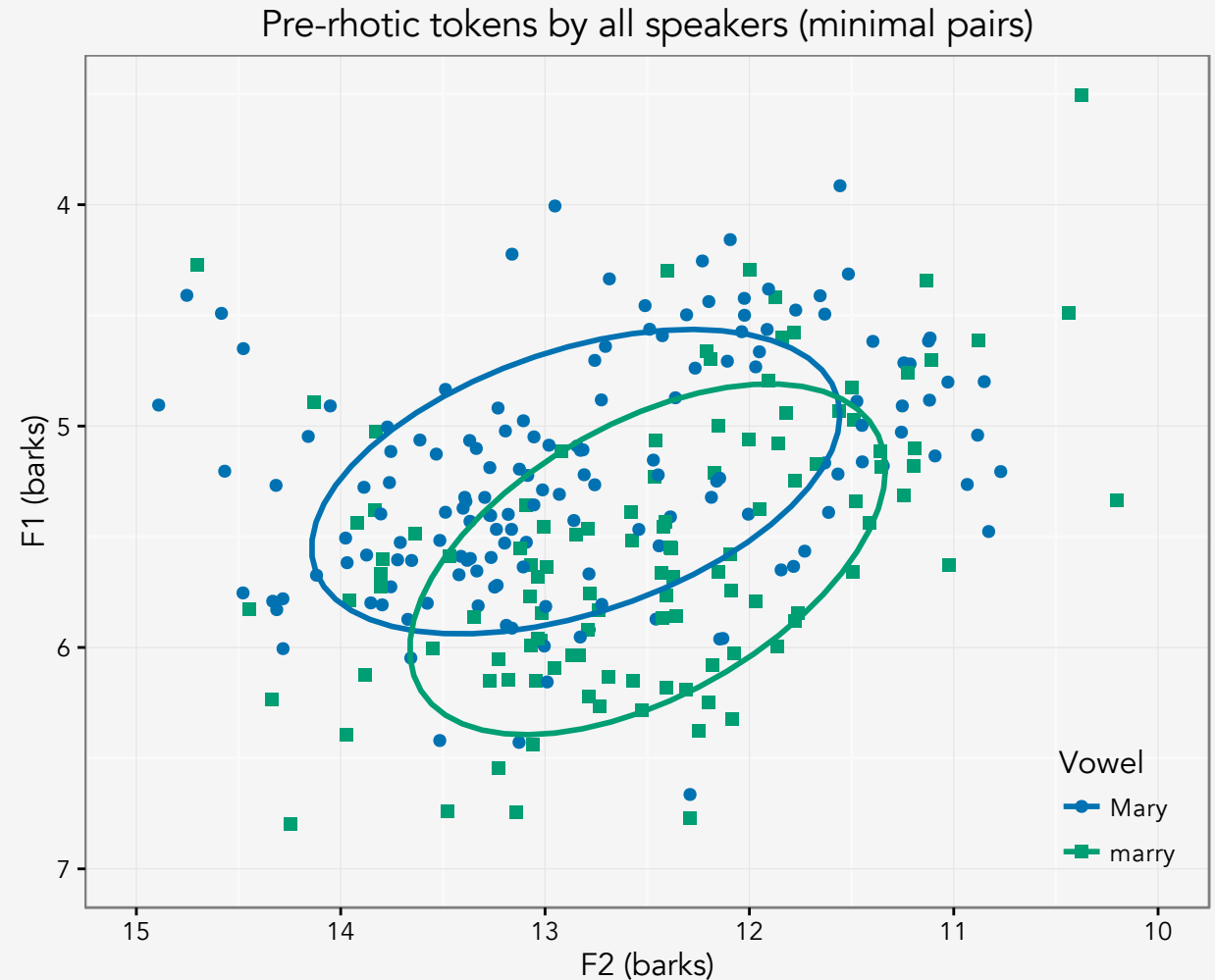
(independent one-sided  $t$ -tests)

F1:  $t_{(212.07)} = -4.11, p < 0.001$

F2:  $t_{(257.82)} = 2.67, p = 0.004$

Pillai score: 0.13

Bhattacharyya's affinity: 0.94



# PRE-RHOTICS: MINIMAL PAIRS

(near-)complete merger

hint of a three-way distinction

slight MARY~MARRY distinction

(independent one-sided  $t$ -tests)

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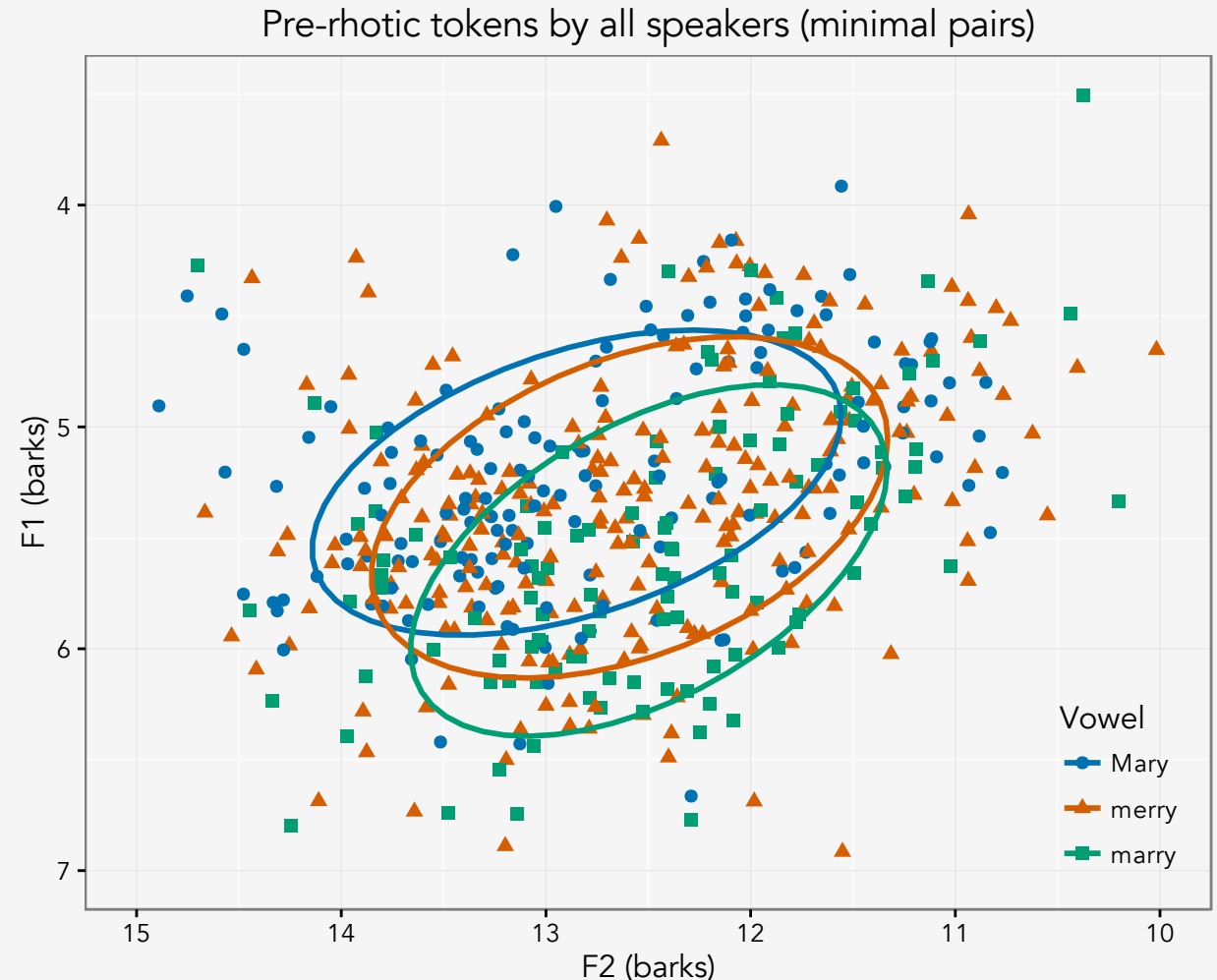
F2:  $t_{(257.82)} = 2.67, p = 0.004$

Pillai score: 0.13

Bhattacharyya's affinity: 0.94

"phoneme continuum"?

(see appendix slides)





# PRE-RHOTICS: PERCEPTION

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confidently answered

MARY (/e/) = MERRY (/ɛ/): 98%

MARY (/e/) = MARRY (/æ/): 99%

MERRY (/ɛ/) = MARRY (/æ/): 97%

# OVERVIEW

	PULL vs. POLE		MARY vs. MERRY/MARRY	
	word list	minimal pairs	word list	minimal pairs
production	"merged"	merged	distinct	phoneme continuum
speaker intuition	23% reported merged		98% reported merged	

clear case of "near-merger" (Labov *et al.* 1972, Labov *et al.* 1991, Di Paolo 1992, Bowie 2001, etc.)

MARY-MERRY/MARRY: distinct in production, merged in perception

PULL-POLE: merged in production, distinct in perception

# CONCLUSION

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Cowlitz County natives merge PULL and POLE while maintaining a distinction between MARY and MERRY/MARRY.

Hypothesis 1: ✗ complete MARY-MERRY-MARRY merger

Hypothesis 2: ✗ separation of POOL, PULL, POLE, and PULP

Hypothesis 3: ✓ production/intuition mismatch  
awareness of possible distinction affecting intuition?

Ongoing changes in Cowlitz County

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Special thanks to Cathy Jones for invaluable help in finding research participants, to the University of Georgia Graduate School Dean's Award for funding the fieldwork, and to both the UGA Linguistics Program and the UGA Graduate School for travel funding.

This slideshow available at  
[joeystanley.com/ADS2017](http://joeystanley.com/ADS2017)

# APPENDICES

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# WORD LIST ITEMS

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These were embedded psuedorandomly in a 160-item word list, with words targeting other research questions acting as fillers.

Participants often commented on how random the words seemed, so they likely did not catch on to the research questions these words targeted.

/er/

dairy, hairy, vary

/ɛr/

heritage, numeric, sheriff

/æɪr/

arrow, carry, narrate, parrot, sparrow

/ul/

cool, school

/ʊl/

fulcrum, pulpit, wool

/ol/

control, holster, stroll, whole

/ʌl/

adult, culprit, vulture

The following words were excluded because they did not satisfy the required syllable type for their particular merger (open syllables for *Mary-merry-marry* and closed syllables for the pre-laterals), which was only learned after data-collection:

*bullet, (Coca-)Cola, gullible, hooligan, polar (bear), pulley, sullen, tulips, yuletide,*

# MINIMAL PAIRS & TRIPLETS

/er/	/ɛr/	/æɪr/		/ul/	/ʊl/	/ol/	/ʌl/
fairy	ferry			rule		role	
	perish	parish		stool		stole	
	very	vary			bull	bowl	
	terrible					goal	gull
hairy		Harry				colt	cult
Mary	merry	marry				whole/hole	
						bolder/boulder	
				school			skull
				who'll		hole	hull
				pool	pull	pole	
				fool	full	pole	

The pairs *bear~bare*, *hair~hare*, and *stares~stairs* were excluded because the targeted vowel was not before an *intervocalic /r/*.

The word *terrible* was paired with the invented word "tear-able" (as in 'able to be torn'), but participants didn't respond well to that, and it was excluded.

Pairs from the same class are assumed to be homophonous for all speakers and were included to test speakers' attention.



# POOL STATISTICS

## *pool* ≠ *pull* (word list)

(independent two-sided *t*-tests)

$$F1: t_{(155.89)} = -13.99, p < 0.001$$

$$F2: t_{(144.62)} = -5.01, p < 0.001$$

Pillai score: 0.14

Bhattacharyya's affinity: 0.60

This is admittedly interesting. /ɔl/ is a bit fronter in the minimal pairs than in the word list.

## *pool* ≠ *pull* (minimal pairs)

(independent two-sided *t*-tests)

$$F1: t_{(234.23)} = -14.92, p < 0.001$$

$$F2: t_{(331.42)} = -0.52, p = 0.601$$

Pillai score: 0.12

Bhattacharyya's affinity: 0.72

## *pool* ≠ *pole* (word list)

(independent two-sided *t*-tests)

$$F1: t_{(160.853)} = -13.47, p < 0.001$$

$$F2: t_{(158.27)} = -1.27, p = 0.205$$

Pillai score: 0.13

Bhattacharyya's affinity: 0.60

To be expected: /ul/ is the same backness as /ol/

## *pool* ≠ *pole* (minimal pairs)

(independent two-sided *t*-tests)

$$F1: t_{(517.85)} = -20.35, p < 0.001$$

$$F2: t_{(444.58)} = 1.89, p = 0.059$$

Pillai score: 0.15

Bhattacharyya's affinity: 0.70

## *pool* ≠ *pulp* (word list)

(independent two-sided *t*-tests)

$$F1: t_{(153.79)} = -17.37, p < 0.001$$

$$F2: t_{(154.47)} = -10.52, p < 0.001$$

Pillai score: 0.24

Bhattacharyya's affinity: 0.47

## *pool* ≠ *pulp* (minimal pairs)

(independent two-sided *t*-tests)

$$F1: t_{(268.94)} = -23.73, p < 0.001$$

$$F2: t_{(382.35)} = -9.27, p < 0.001$$

Pillai score: 0.25

Bhattacharyya's affinity: 0.53

# PULP STATISTICS

*pulp* ≠ *pool* (word list)

(see previous slide)

*pulp* ≠ *pull* (word list)

(independent two-sided t-tests)

F1:  $t_{(182.43)} = 4.04, p < 0.001$

F2:  $t_{(167.19)} = 6.52, p < 0.001$

Pillai score: 0.06

Bhattacharyya's affinity: 0.84

*pulp* ≠ *pole* (word list)

(independent two-sided t-tests)

F1:  $t_{(175.92)} = 6.31, p < 0.001$

F2:  $t_{(177.14)} = 9.71, p < 0.001$

Pillai score: 0.09

Bhattacharyya's affinity: 0.74

*pulp* ≠ *pool* (minimal pairs)

(see previous slide)

*pulp* ≠ *pull* (minimal pairs)

(independent two-sided t-tests)

F1:  $t_{(285.81)} = 8.33, p < 0.001$

F2:  $t_{(282.14)} = 8.74, p < 0.001$

Pillai score: 0.07

Bhattacharyya's affinity: 0.82

*pulp* ≠ *pole* (minimal pairs)

(independent two-sided t-tests)

F1:  $t_{(249.73)} = 10.13, p < 0.001$

F2:  $t_{(312.02)} = 12.69, p < 0.001$

Pillai score: 0.10

Bhattacharyya's affinity: 0.79

# "PHONEME CONTINUUM" STATISTICS

## *Mary = merry*

(independent one-sided t-tests)

$$F1: t_{(361.44)} = -2.11, p = 0.012$$

$$F2: t_{(313.141)} = 2.20, p = 0.014$$

Pillai score: 0.03

Bhattacharyya's affinity: 0.98

Marginal significance.

## *merry ≠ marry*

(independent one-sided t-tests)

$$F1: t_{(210.088)} = -2.54, p = 0.994$$

$$F2: t_{(231.412)} = 0.87, p = 0.807$$

Pillai score: 0.03

Bhattacharyya's affinity: 0.98

No significance.

## *Mary ≠ marry*

(independent one-sided t-tests)

$$F1: t_{(212.07)} = -4.11, p < 0.001$$

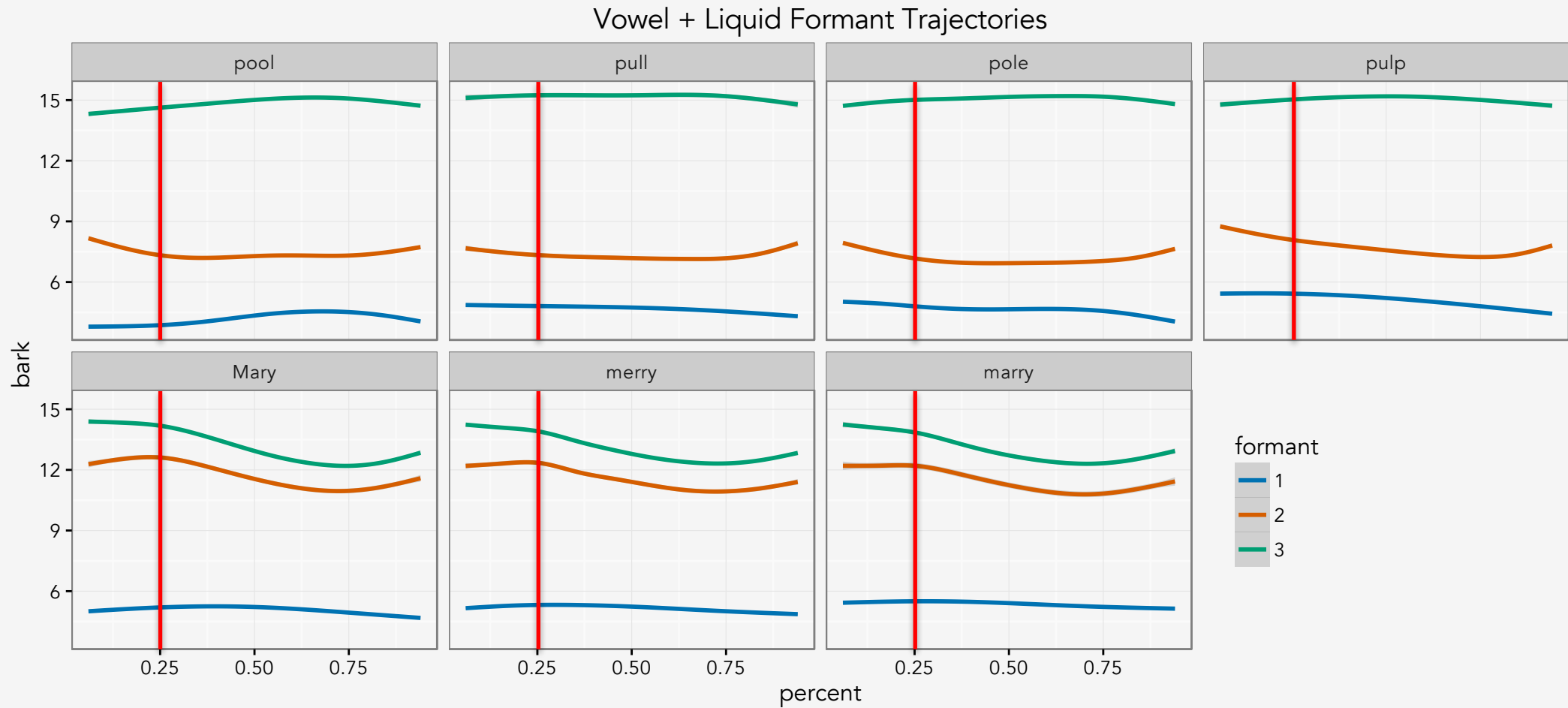
$$F2: t_{(257.82)} = 2.67, p = 0.004$$

Pillai score: 0.13

Bhattacharyya's affinity: 0.94

Yet, more significance and less overlap.

# WHY THE 25% POINT?



# WHY THE 25% POINT?

past transitional  
formants

[ɫ] is in full effect  
(and merged for  
everyone) by 60%

PULP is at its lowest  
POOL is at its backest  
MARY-MERRY-MARRY at  
their frontest

