The Emergence of Consonant-Vowel Metathesis in Karuk

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- Karuk master speakers Sonny Davis and the late Lucille Albers, Charlie Thom, and especially Vina Smith;
- research collaborators LuLu Alexander, Tamara Alexander, Crystal Richardson, and Florrine Super (in Yreka) and Erik H. Maier, Line Mikkelsen, and Clare Sandy (at Berkeley); and
- Susan Lin and the audience at UC Berkeley's Phonetics and Phonology Forum for insightful comments and suggestions.

Data in this talk is drawn from *Ararahi'urípih*, a Karuk dictionary and text corpus (`http://linguistics.berkeley.edu/~karuk`).

Overview

- Karuk V_1CV_2 sequences show much coarticulation of V_1 into V_2
  /uCi/ $\rightarrow$ [uC^{w}i], /iCa/ $\rightarrow$ [iC^{j}a], /iCu/ $\rightarrow$ [iC^{j}u] (all high V_1)
- We argue that this coarticulation is a source of CV metathesis along lines that are phonologized in other languages.
- Goals
  - To figure out the environments in which this process occurs
  - To test the hypothesis that coarticulation along with *perceptual enhancement* is the driving force behind CV metathesis (rather than pure perceptual reanalysis, as per some previous research)

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VC > CV Metathesis

- V_1CV_2 > CV_1V_2 metathesis in a prefix **ú-* in Grassfields Bantu class 3 nouns (Hyman, 1979, 1981; Blevins and Garrett, 1998)

Aghem	**ó**-k**w**ɨ́ŋ	(cf. plural é-kɨ́ŋ)	'mortar'
Noni	k**w**en	(cf. plural ken)	'firewood'

- Aghem: **ú-* prefix causes labialization of following consonant
- Noni: **ú-* is lost and class is marked only by labialization
- Proposed pathway of VC > CV metathesis

Stage 1		**Stage 2**		**Stage 3**
Little coarticulation		Heavy coarticulation		Vowel Loss
uCV	→	uC^wV	→	C^wV

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Coarticulation into Metathesis: Misperception Approaches

- Selected literature: Blevins and Garrett (1998, 2004); Hume (1998, 2004); Steriade (2001); Buckley (2011)
- *Misperception* (listener-driven): automatic coarticulation is misperceived as being underlying rather than phonetic
  - /uCV/ [uC^{w}V] is misperceived as /uC^{w}V/
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- *Perceptual enhancement* (speaker-driven): metathesis occurs to optimize the perception of a weakened cue
  - Along with initial coarticulation, a weakened [u] is accompanied by strengthening of the coarticulated gesture [^{w}]
  - The strengthening of the coarticulation compensates for the weakened gesture, leading to eventual metathesis
- Parallel example in process of vowel nasalization (VNC > $\tilde{V}$C) (Beddor, 2009)

Predictions: gradient offgliding; offglide gesture magnitude or duration greater than that of V_1

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Karuk language background

Karuk (*káruk* 'upriver')

- 'Hokan' isolate
- Spoken along the mid-Klamath River in northern California (and diasporically)

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Karuk language background

- Karuk language vitality
  - In 1950: ∼100 speakers (Bright, 1957)
  - In 2018: <∼6 first-language elder speakers
  - Very active language revitalization
- Extensive language preservation work by Karuk speakers
  - beginning in the 19th century
  - especially in collaboration with A.L. Kroeber, J.P. Harrington, William Bright, Monica Macaulay, current Berkeley researchers
- Data in this talk
  - drawn from *Ararahi'urípih*, a Karuk dictionary and text corpus (`http://linguistics.berkeley.edu/~karuk`)
  - opportunistic (not elicited for this purpose), partly from legacy recordings

Karuk phonology

- Karuk Vowels

i i:		u u:
e:		o:
	a a:	

- Karuk Consonants

p	t		tʃ	k	ʔ
m	n				
f	θ ([θ] ∼ [s])	s ([s̪])	ʃ	x	h
β	ɾ		j		

Karuk Coarticulation

- Earlier sources note labialization of /x/ after back V and palatalization of /k m x/ after front V, even across word boundary [ʔíf kʲâːrim] 'truly badly' (Harrington, 1930, 1932b,a; Bright, 1957)
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Karuk: coarticulation, metathesis, and variation

- Examples of "completed" metathesis (*u-* '3sg', *piip* 'say')
  - *xás upíip "pa'íshaha itárivramnihaak . . . "* [upiːp]
    'And she said, "When you pour the water in . . . "'
  - *xás upíip* [upʷiːp]
    'and he said'
  - *"xas vúra maath káru" upiip* [pʷiːp]
    ' "and it was heavy", he said'
- There is interspeaker variation on the rate of this process
- All examples in this presentation are from one female speaker (more data will be incorporated in future work)

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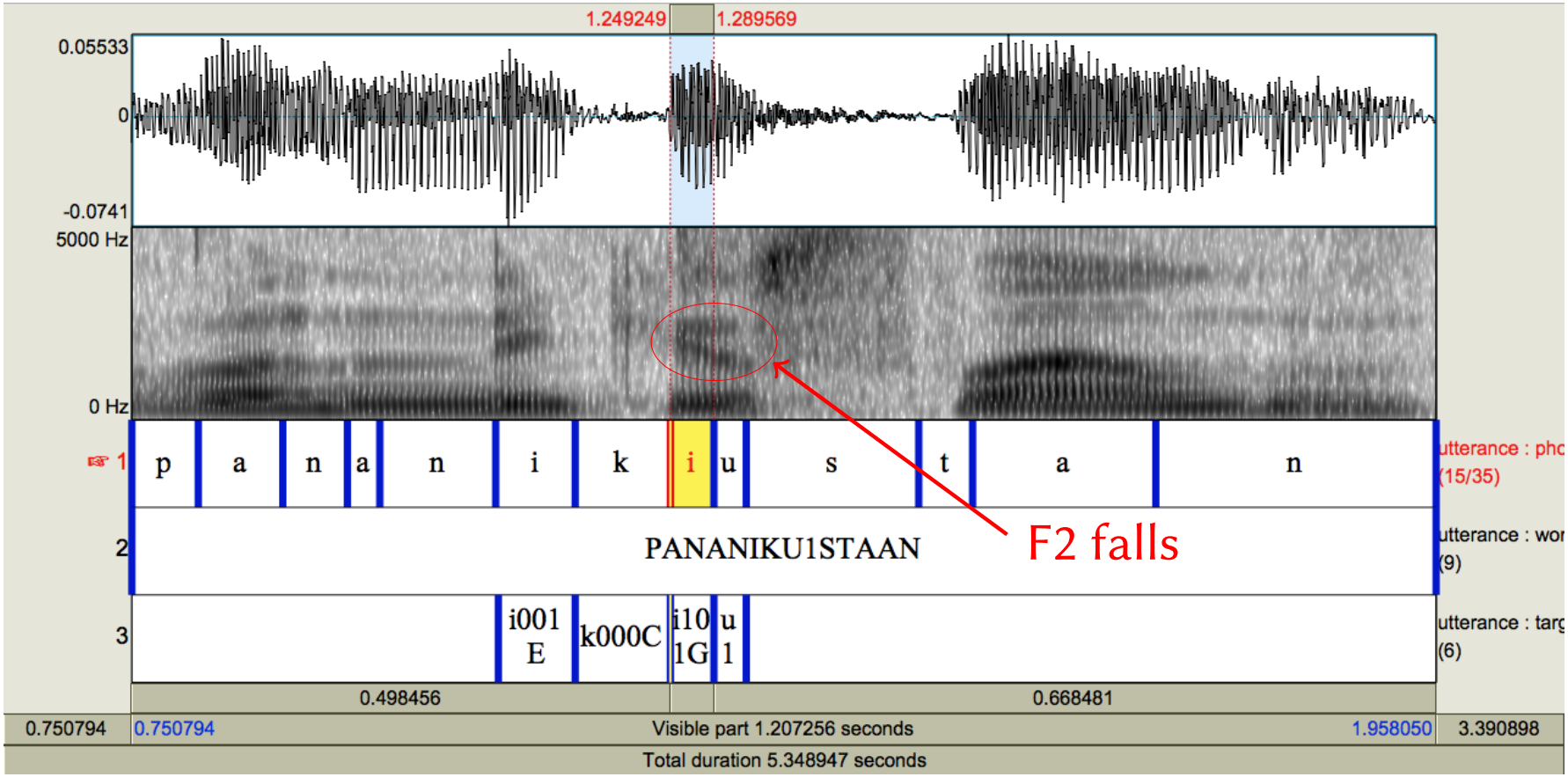
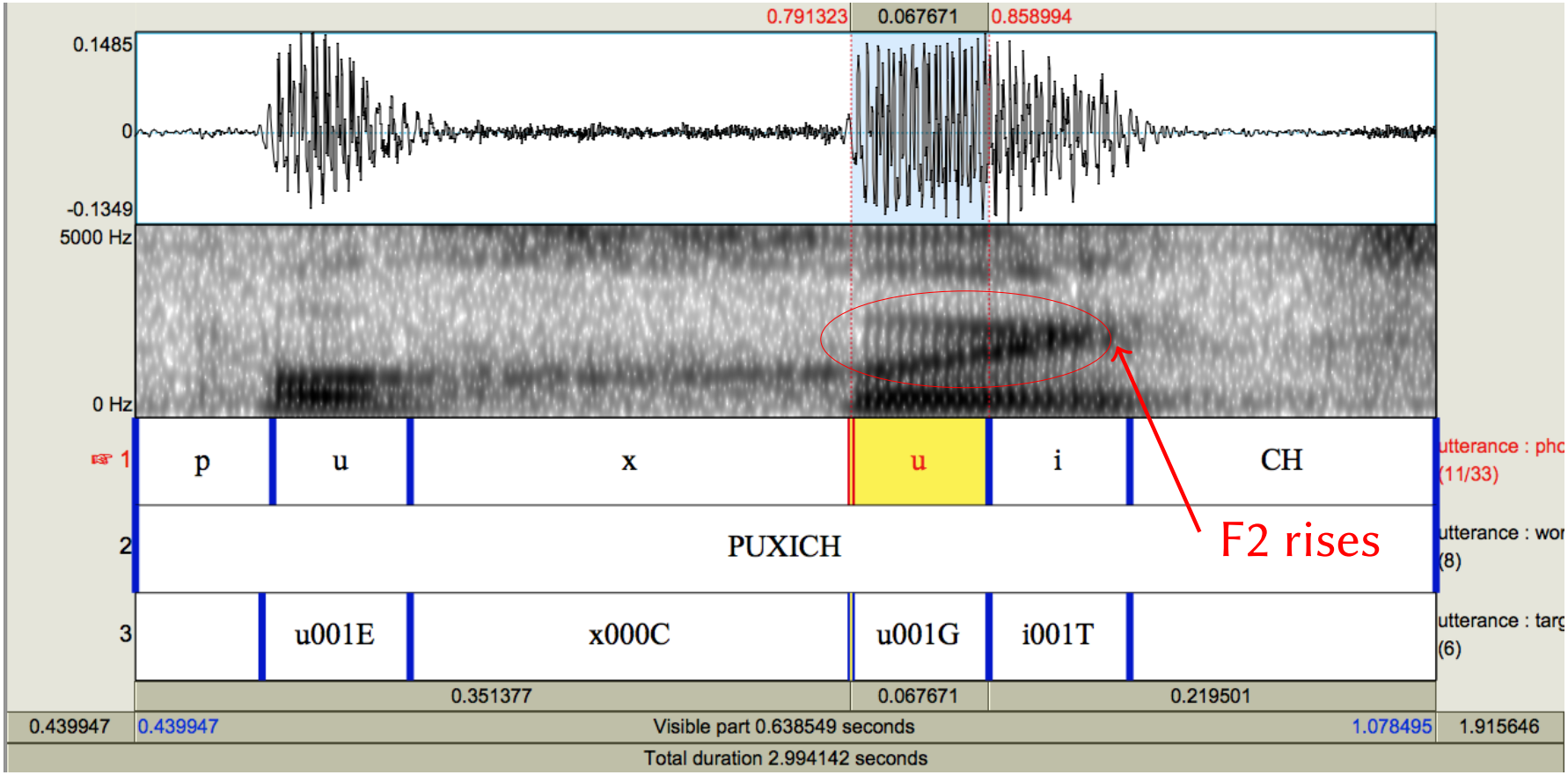


Labialization



Corpus and Alignment

- Extracted sentences and tokens from *Ararahi'urípih* corpus
- Force-aligned using faseAlign (Wilbanks, 2017), designed for Latin American Spanish data—some differences:
  - /h/ treated as /x/
  - /β/ (<v>) treated as /b/ (Spanish has [β] allophone of /b/)
  - /θ ʃ/ treated as /s/ (/θ/ often [s] in Karuk, [ʃ] similar to [s])
- Target words had two possible representations
  - Ex. *puxích* = [puxítʃ] ∼ [puxʷítʃ]
  - Best representation chosen probabilistically by aligner
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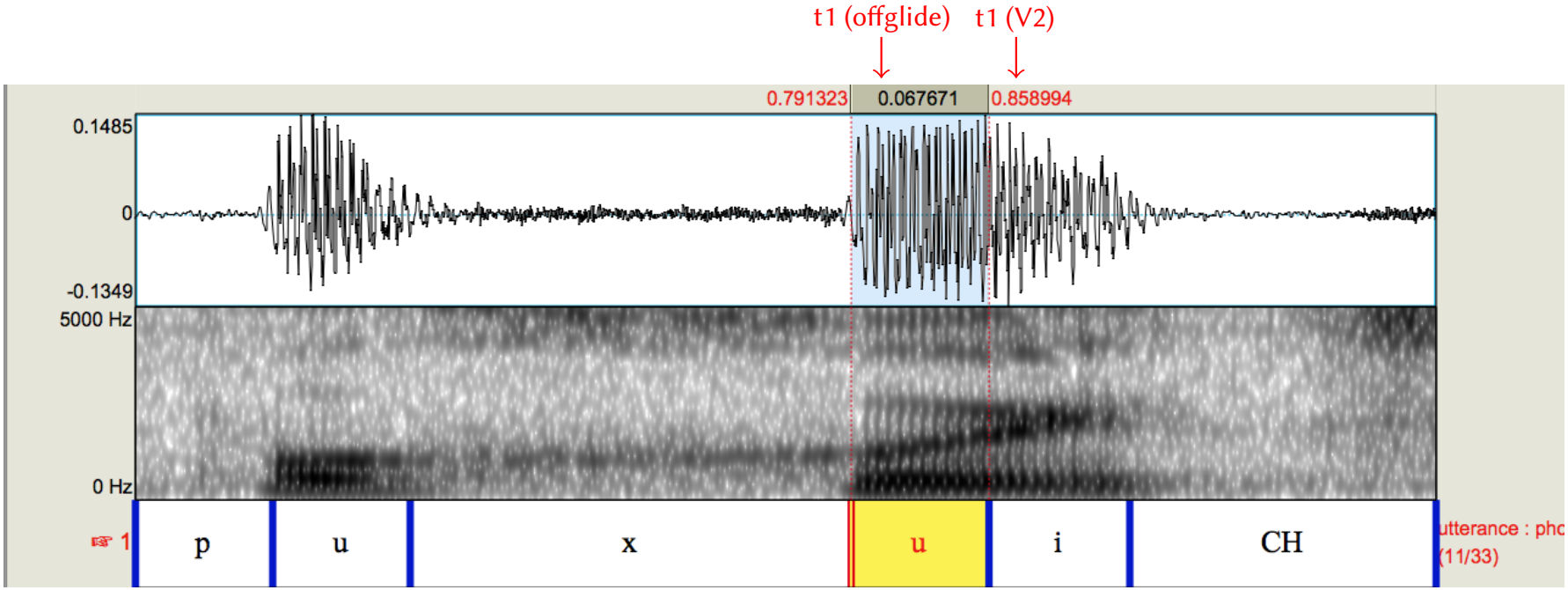

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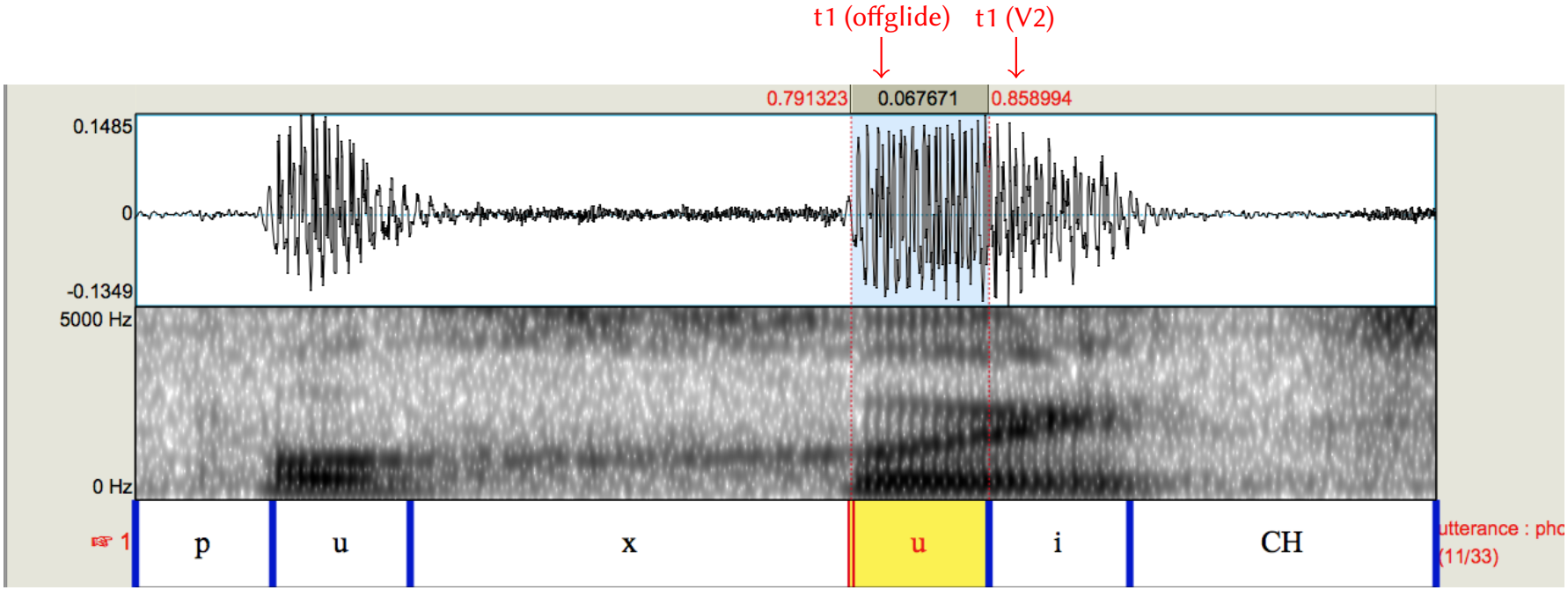

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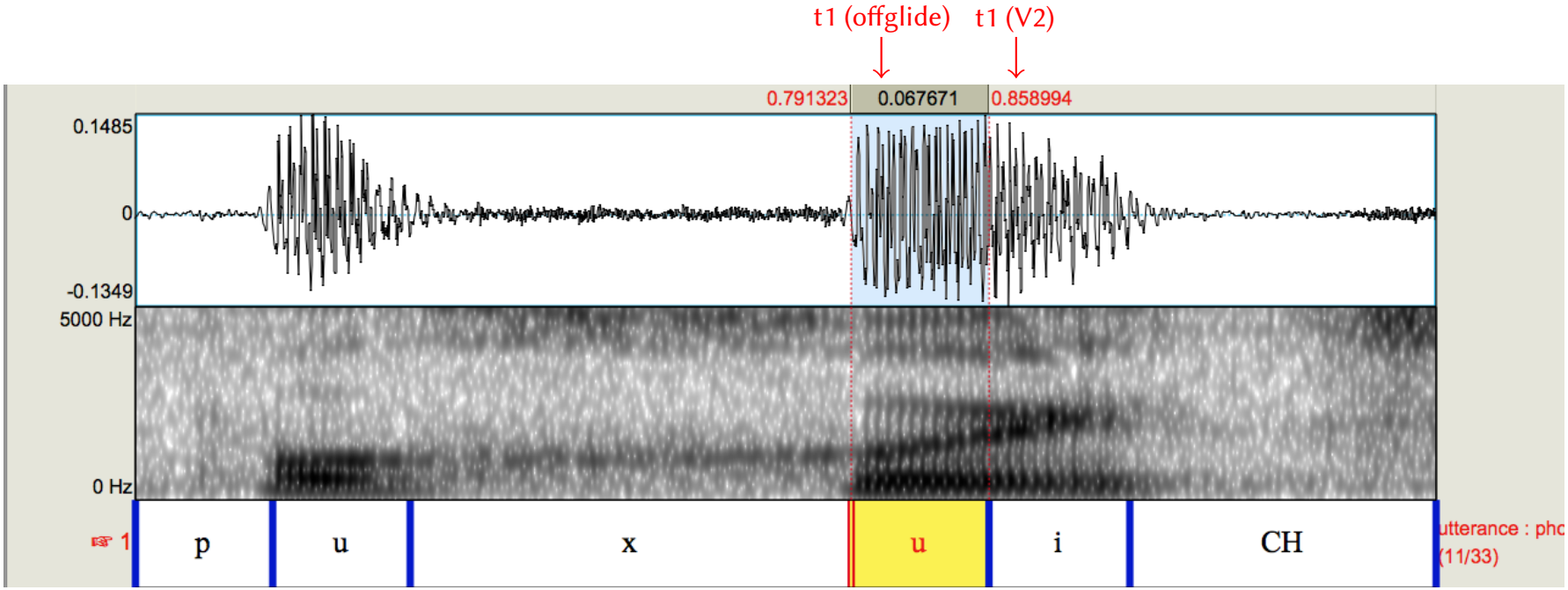

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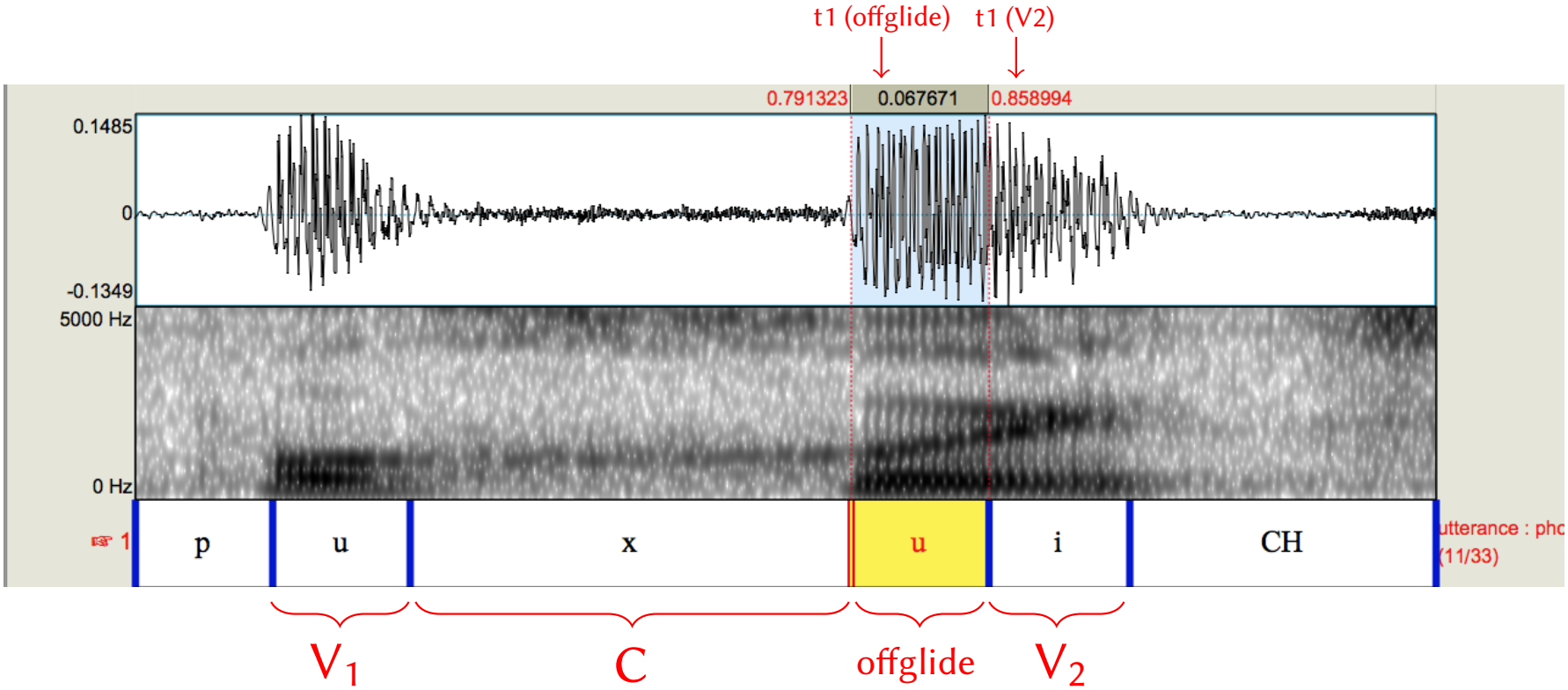

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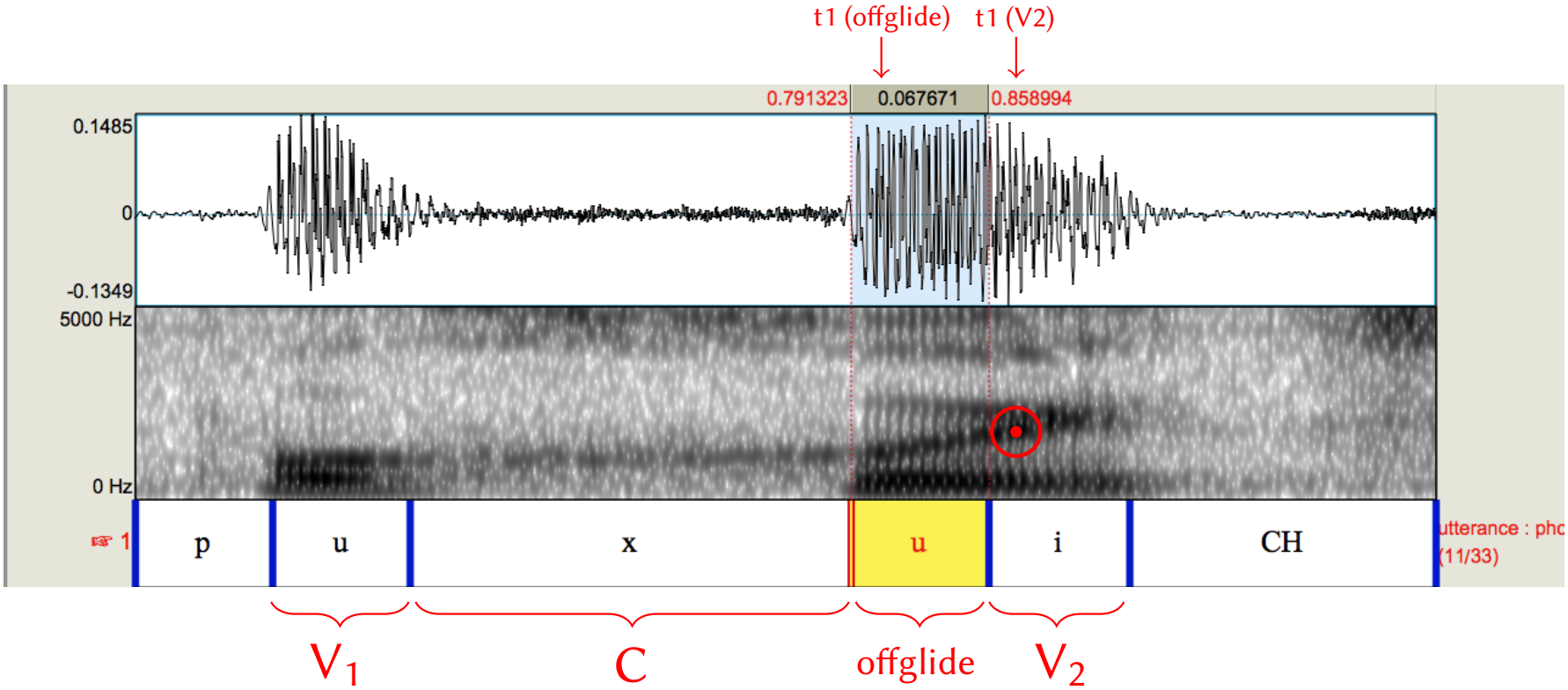

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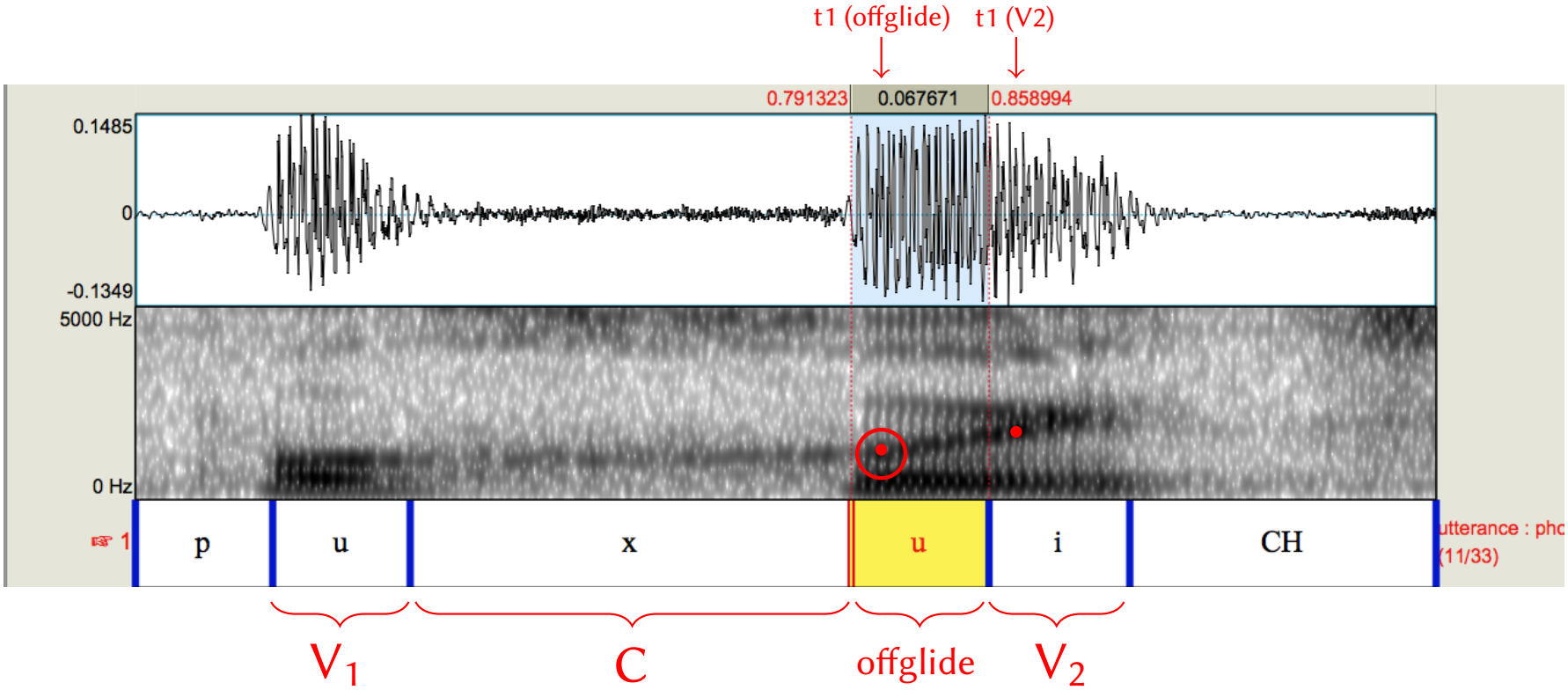

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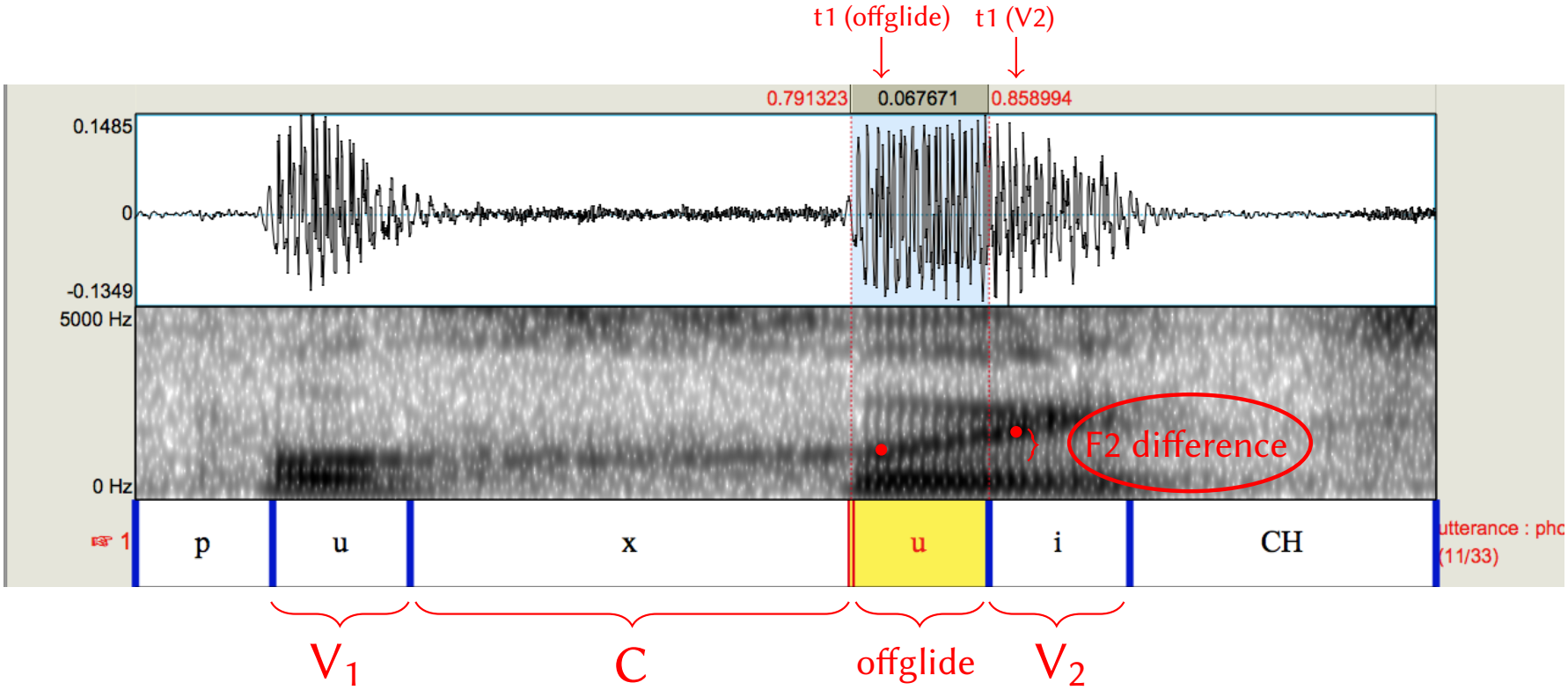

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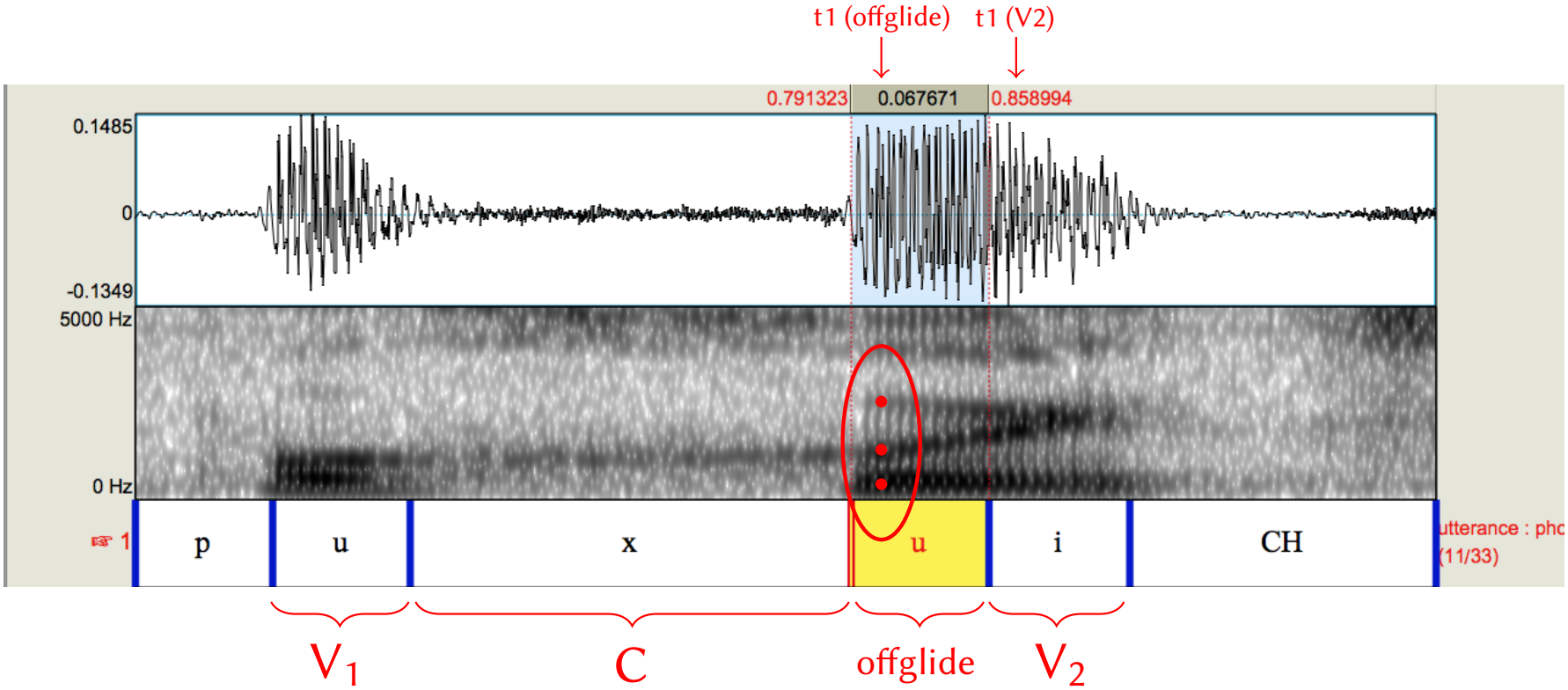

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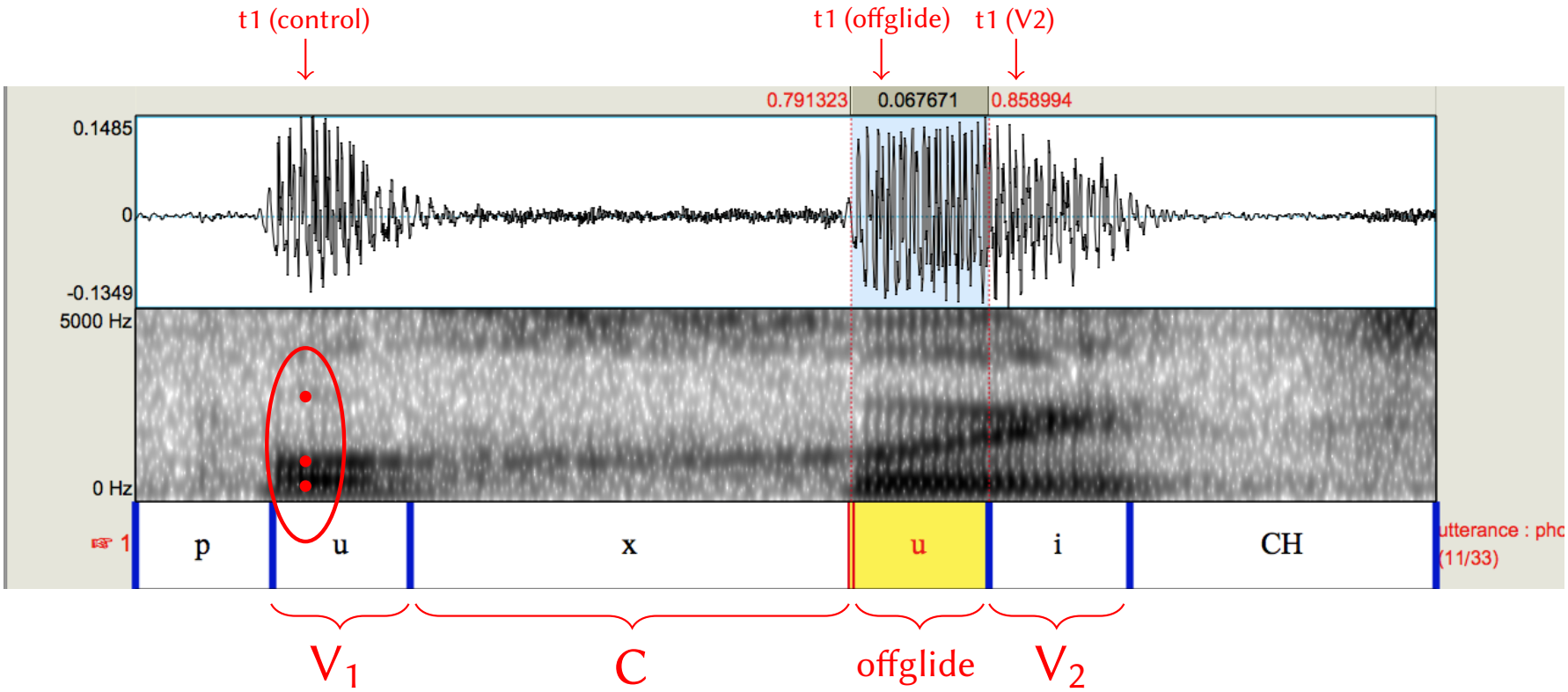

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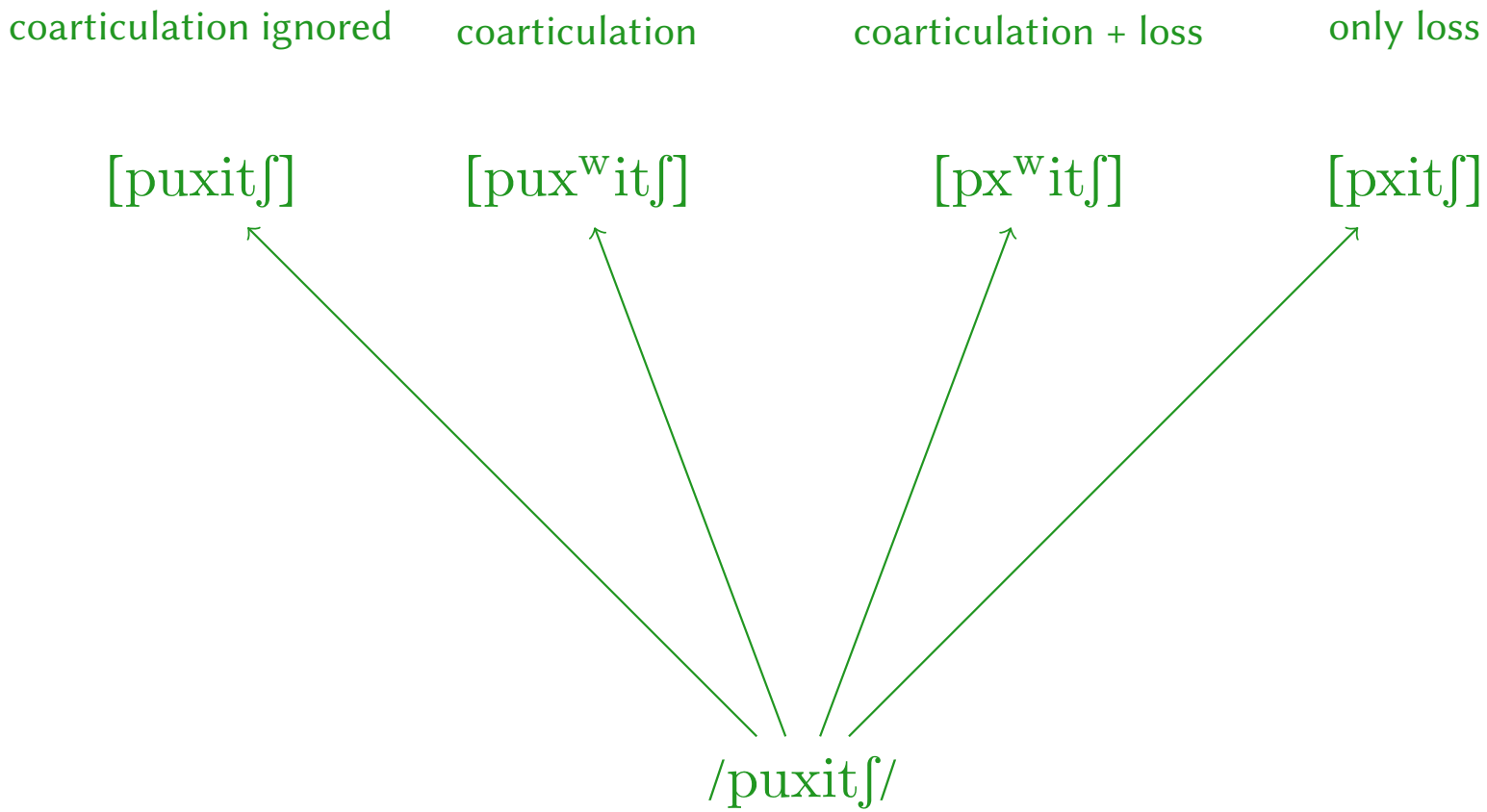
Predictions

Our analysis evaluates predictions of three proposed explanations for sound change with respect to metathesis:

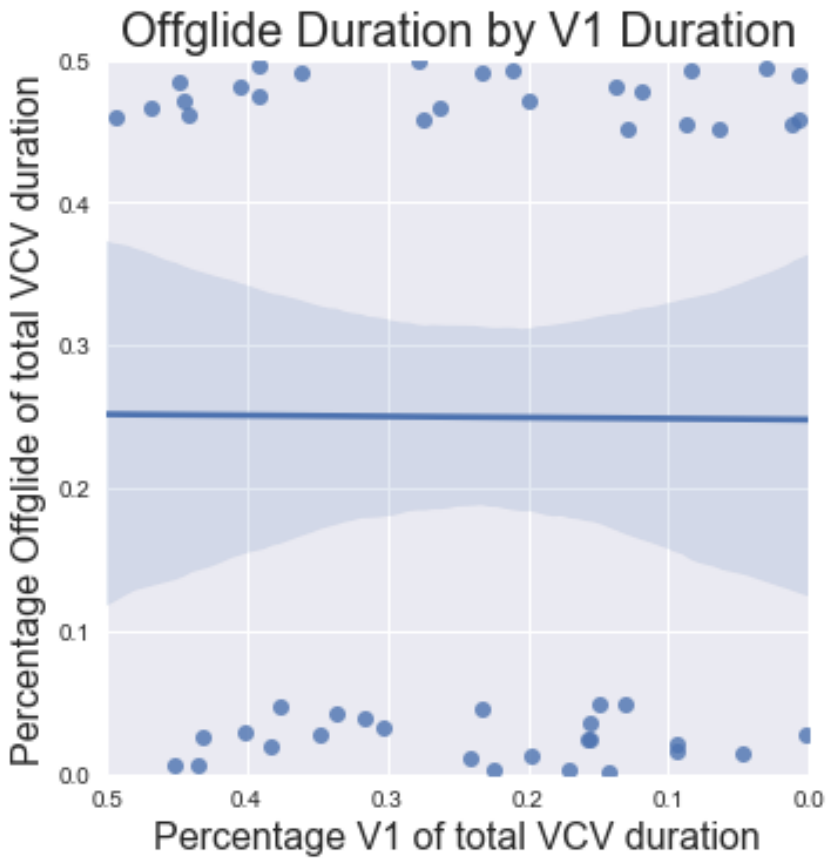
- Misperception
- Gestural Shift
- Perceptual Enhancement

Misperception



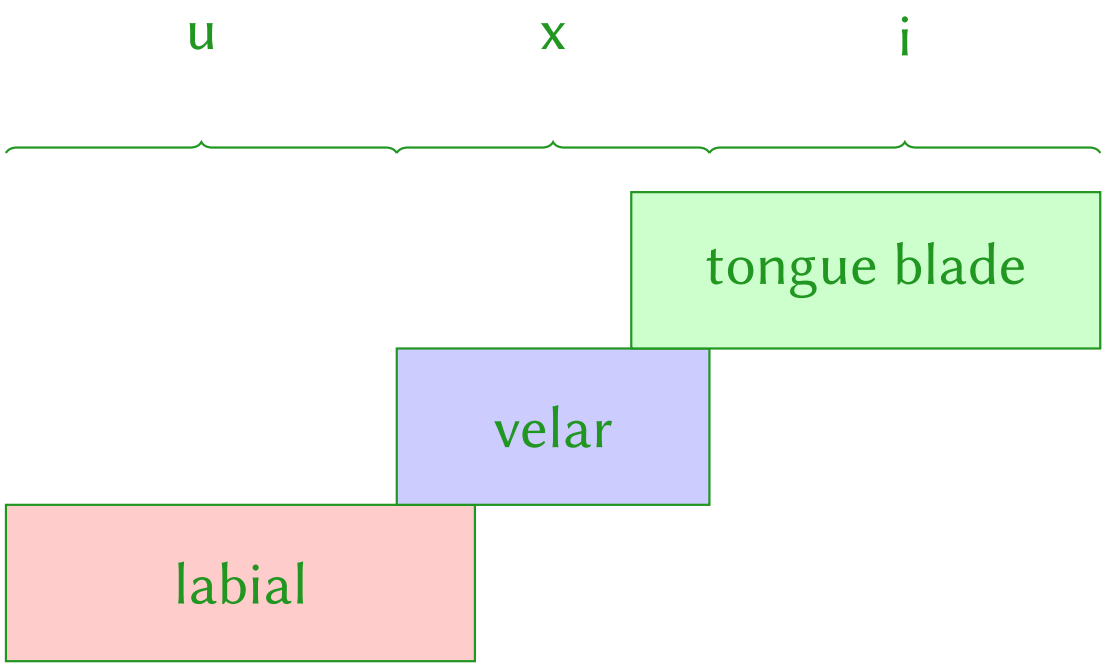
- Pure misperception *à la* Blevins and Garrett (1998, 2004) should yield categorically distinct alternants.

Prediction: Misperception and V_1 duration

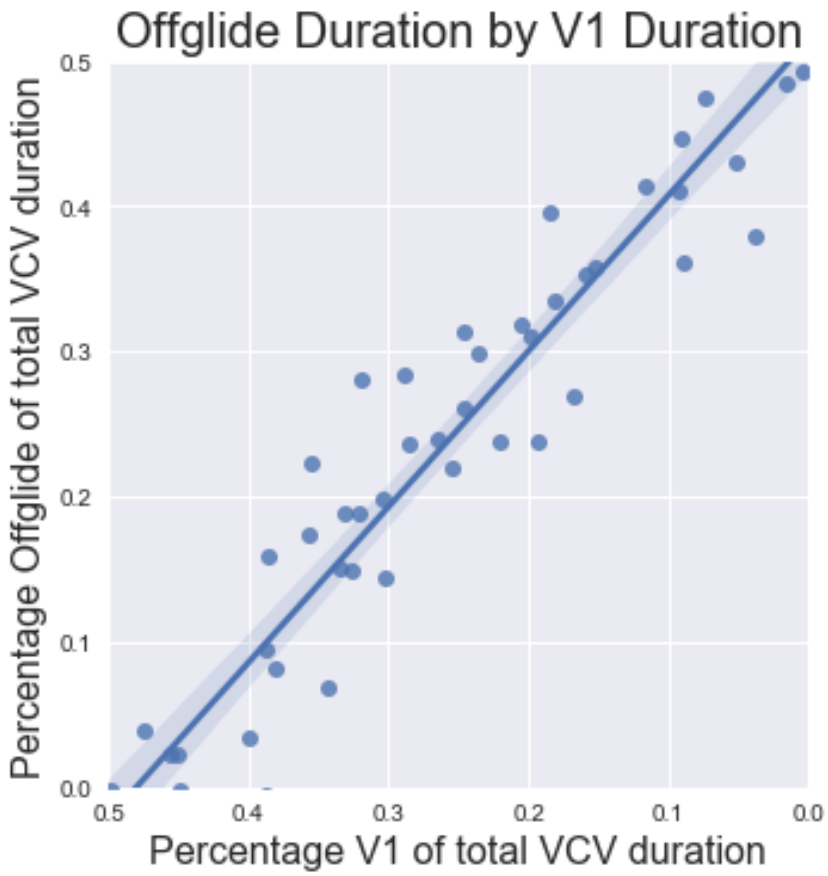


- Offglide duration should not continuously increase as V_1 duration decreases
- We should expect little to no correlation

Gestural Shift

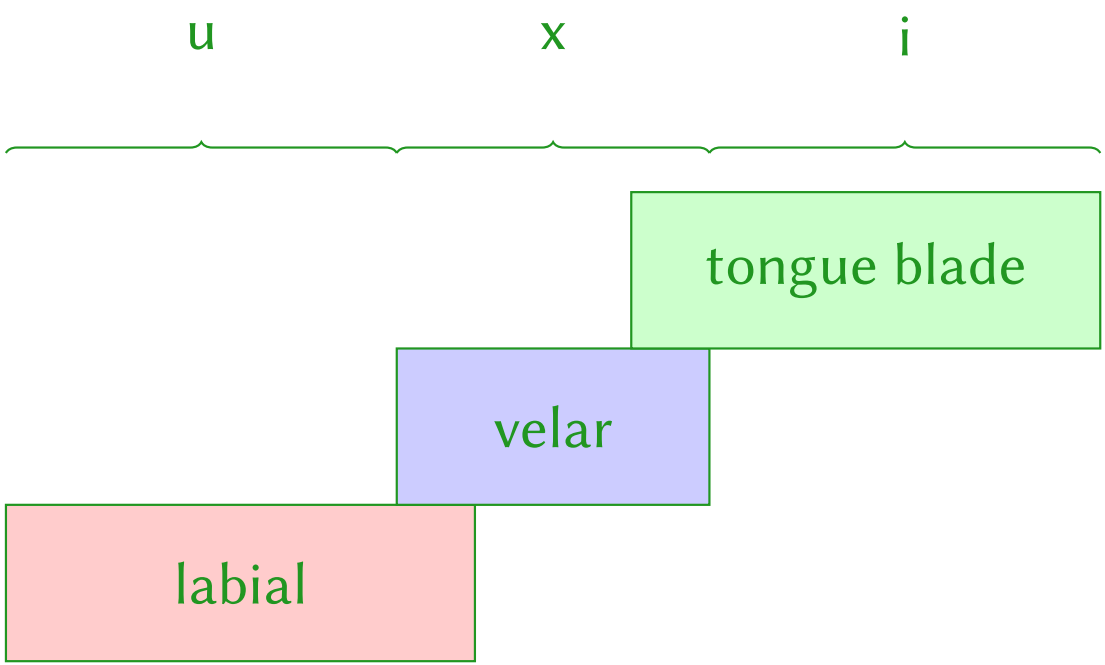


Prediction: Gestural Shift and V_1 duration



- As V_1 duration decreases, offglide duration increases
- Labial/palatal gesture shifts from V_1 into following vowel

Perceptual Enhancement



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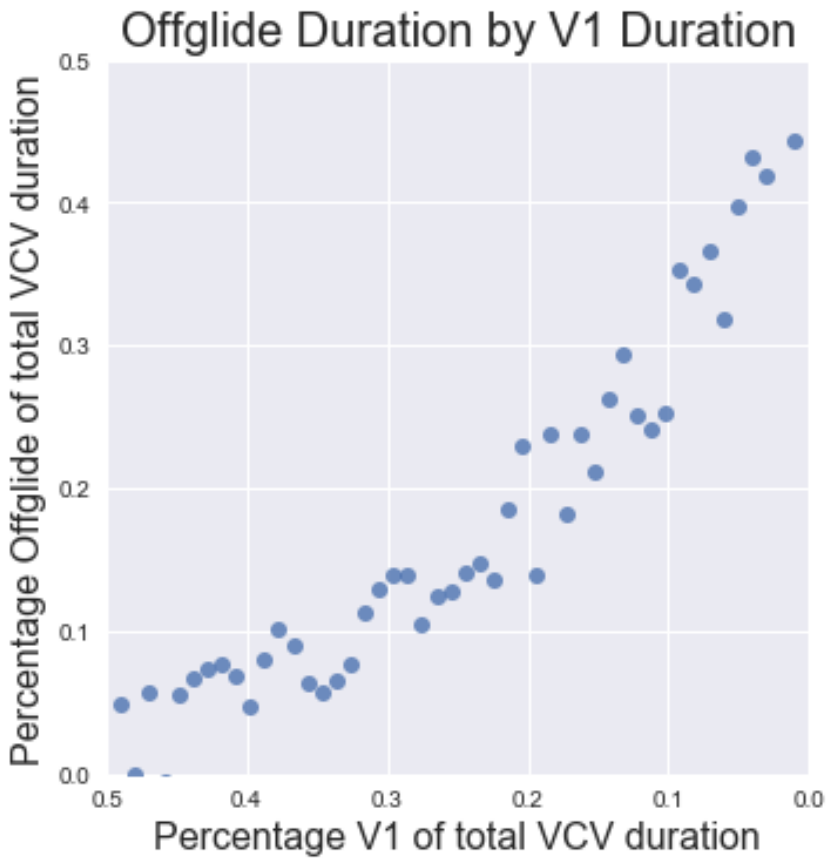
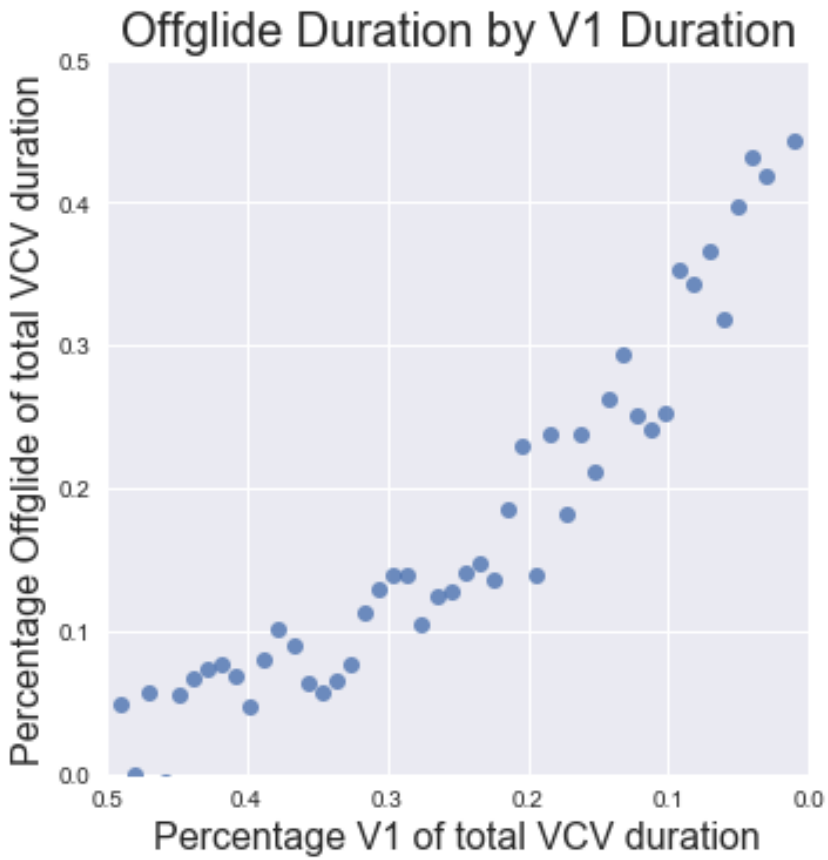


- As V_1 duration decreases, offglide duration increases exponentially
- Labial gesture not only shifts from V_1 into following vowel but is also *enhanced*
- Duration of latter part of labial/palatalized gesture may increase
- Alternatively, greater labialization may cause lower formant values than expected for /u/

Prediction: Perceptual Enhancement and V_1 duration



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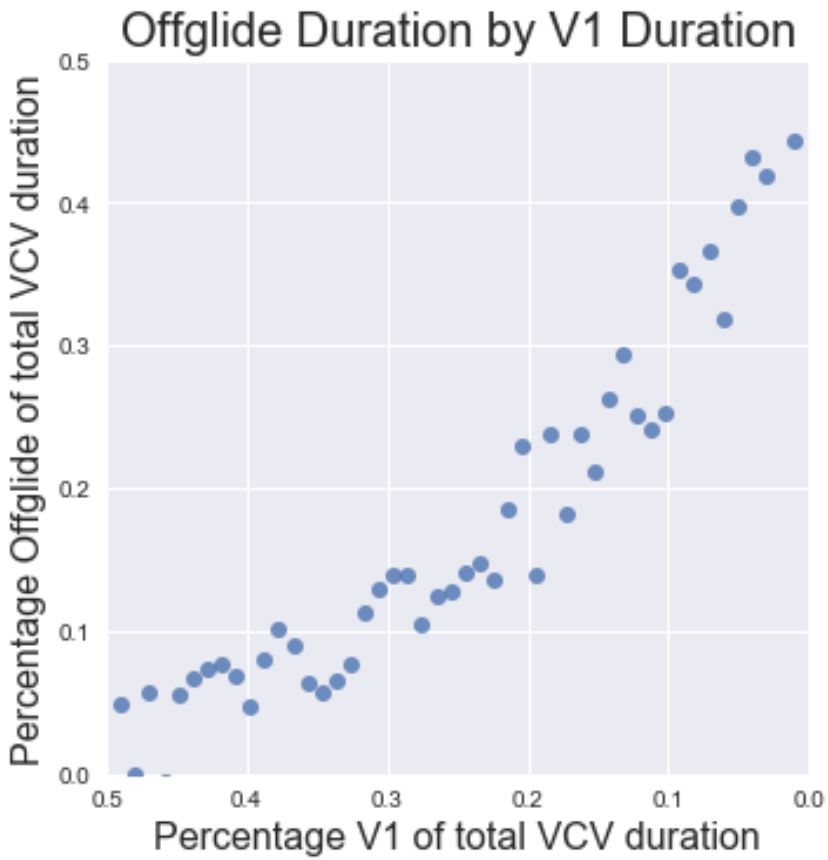

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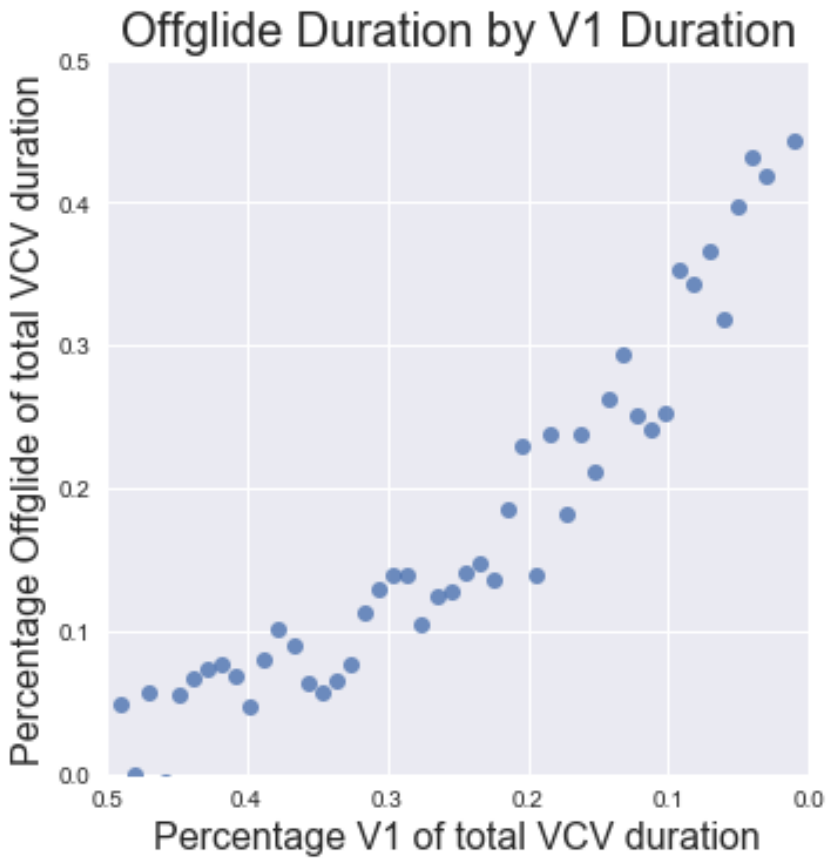

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Prediction: F2/F3 and Perceptual Enhancement

Offglide following longer V1

Offglide following shorter V1

- As V_1 weakens, offglide should be expected to be strengthened
- One way to strengthen could be a greater F2 (and F3) difference

Prediction: Formants and Perceptual Enhancement

Offglide

Control /u/

- Labialization lowers formants, especially F3 (Beeley, 2015)
- Another way to strengthen would be for offglide formants to be lower than those in /u/

Prediction: Formants and Perceptual Enhancement

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Predictions: Summary

- Misperception
  - F2/F3 difference: no correlation with V_1 duration
  - Offglide duration: no correlation with V_1 duration
  - Offglide formants = normal vowel formants
- Gestural Shift (without perceptual enhancement)
  - F2/F3 difference: no correlation with V_1 duration
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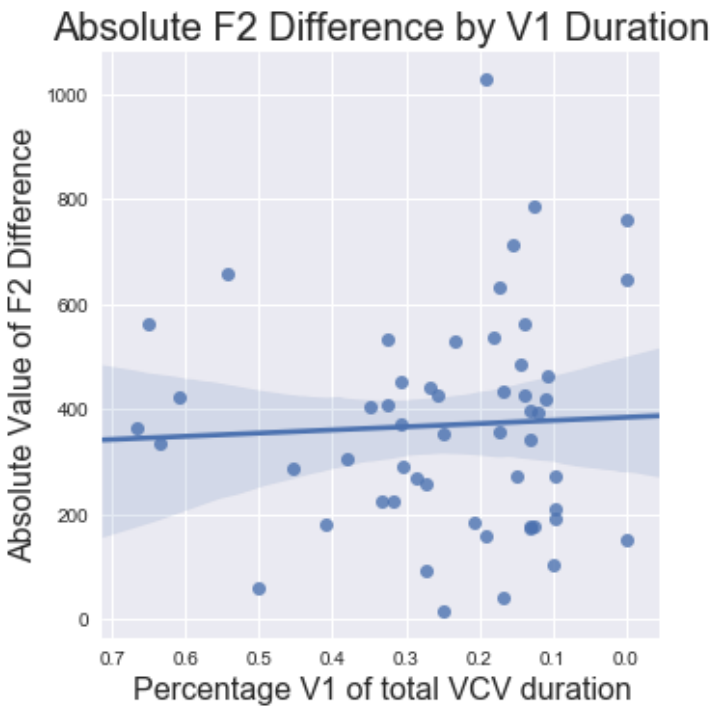
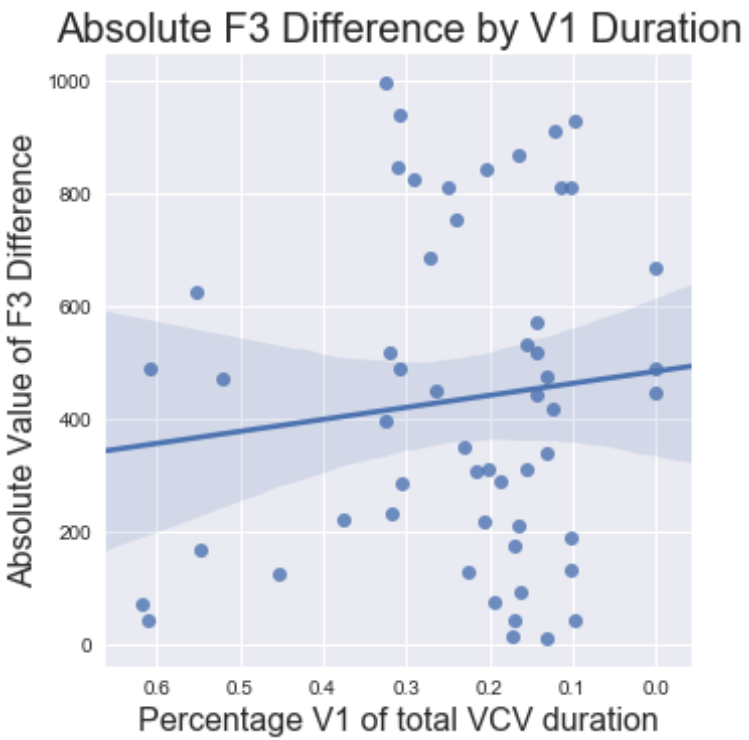
Data Summary

- 95 **target** tokens in total; 54 have an offglide
- Of those 54
  - 20 have palatal offglide
  - 34 have labial offglide; 3 of these have completely lost V_1
- Intervening consonant counts
  - /k/ = 20
  - /f/ = 14
  - /p/ = 11
  - /x/ = 9
- 51 **control** /u/ tokens for F2 comparison to labial offglides
  - /xu/ = 20
  - /fu/ = 17
  - /pu/ = 13

F2/F3 Difference





- As V_1 shortens, F2/F3 difference barely changes
- No significant correlation of F2 ($r = -0.07$, $p = 0.6$) or F3 ($r = -0.11$, $p = 0.42$) difference with V_1 duration

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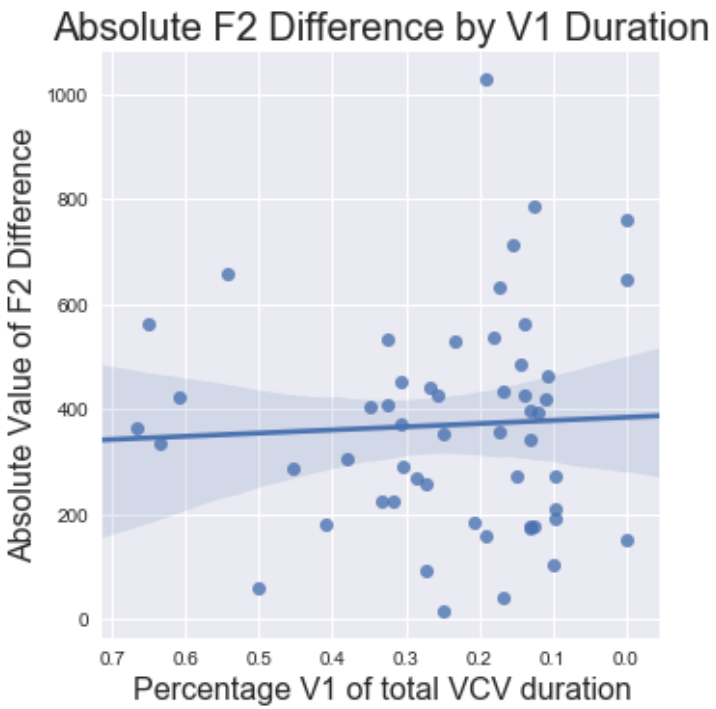

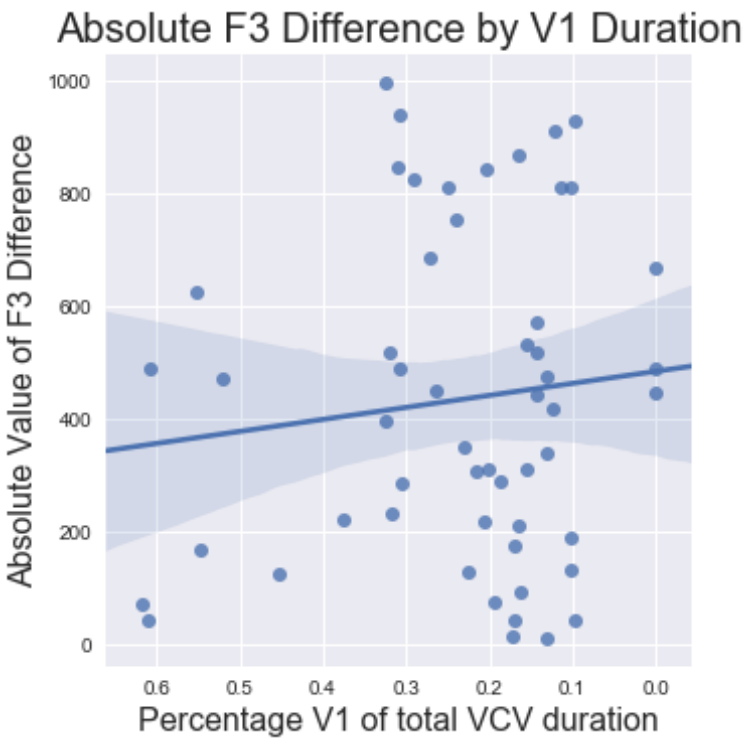

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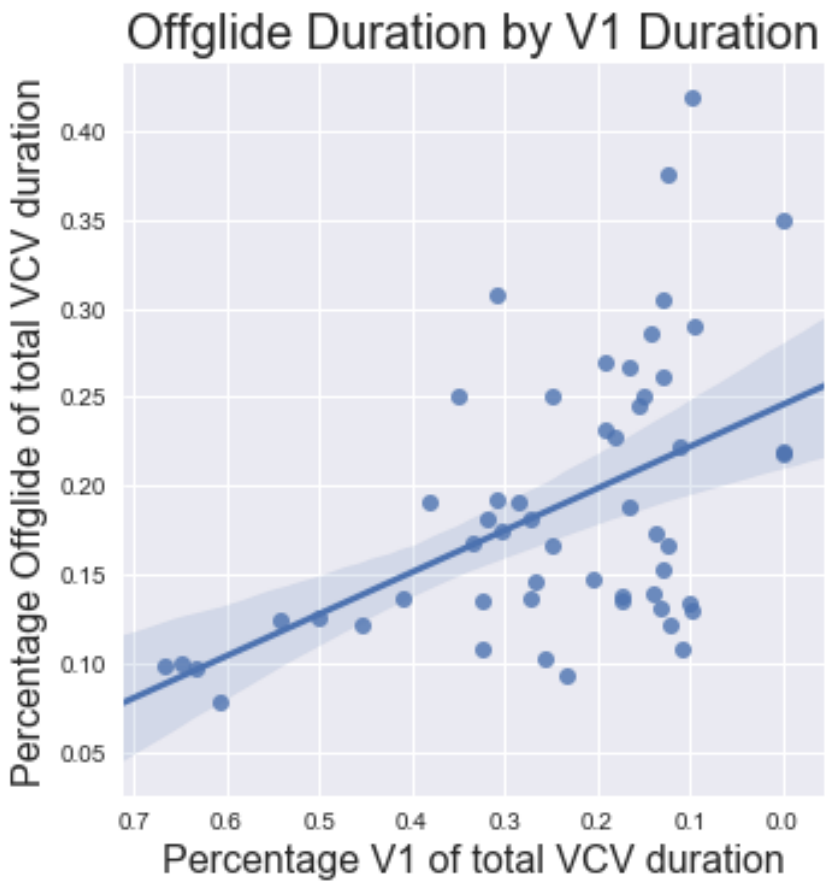
Offglide Duration



- As V_1 shortens, offglide lengthens ($r = -0.54$, $p < .001$)
- But relationship actually looks potentially exponential
- Supports **gestural shift** or **perceptual enhancement**

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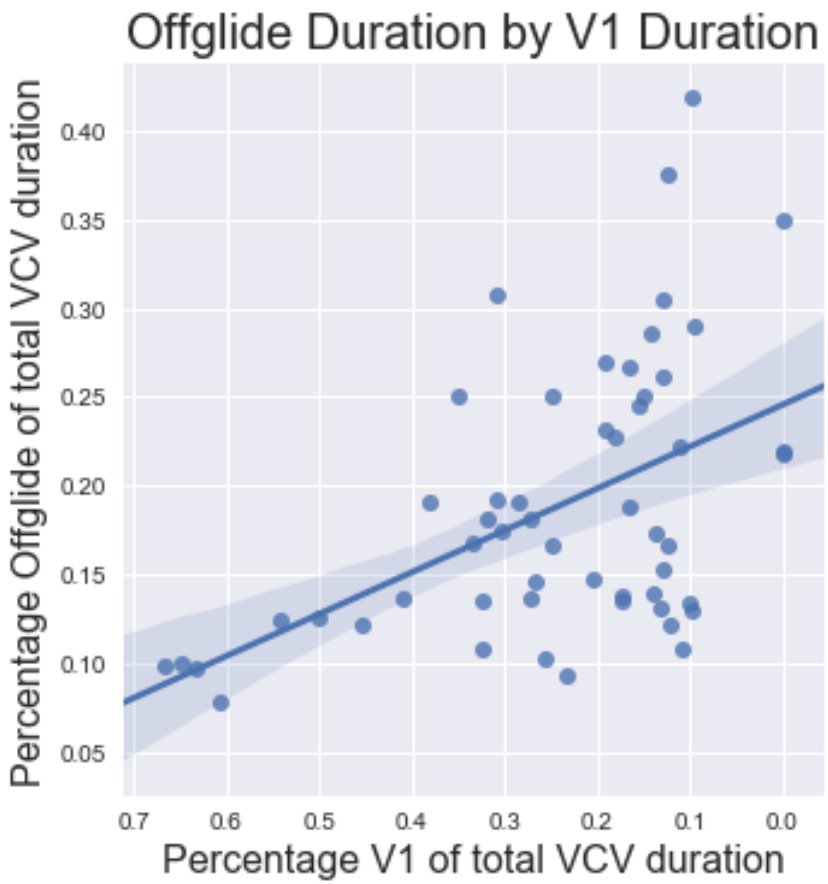

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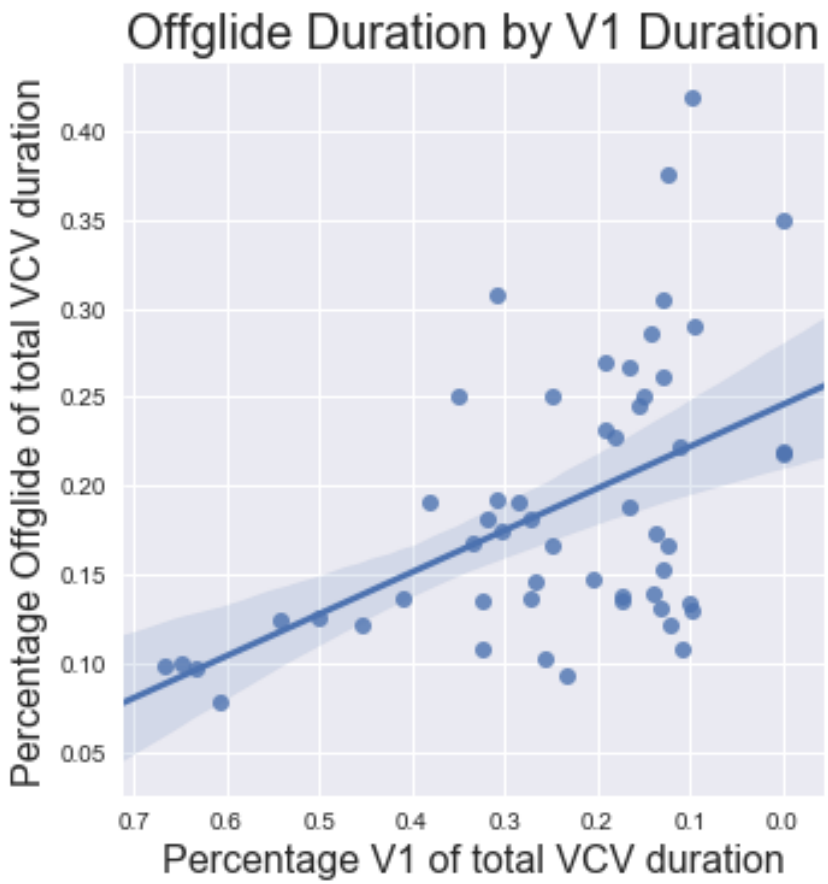

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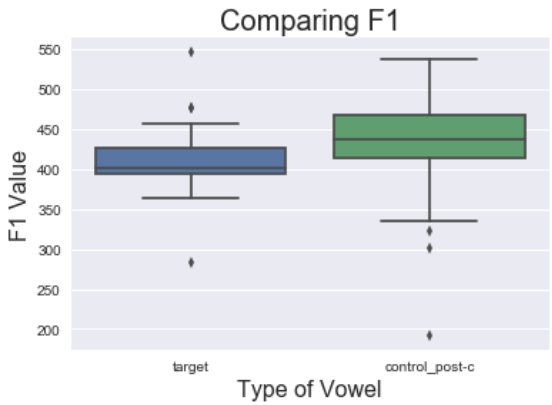
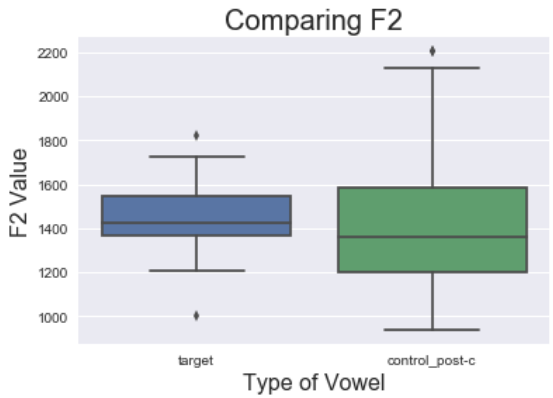
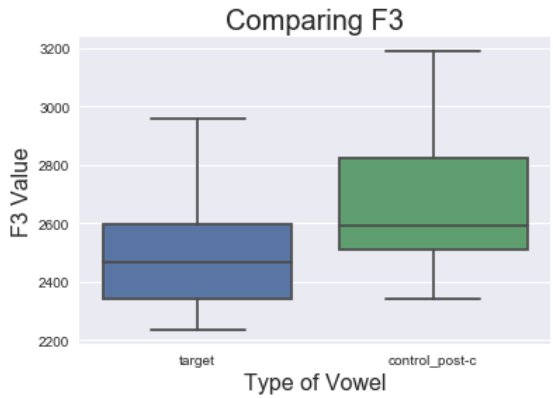
Formant Comparisons: Offglide vs. Normal /u/







$t = -3.26$, $p < 0.01$ $t = 3.5$, $p < 0.001$ $t = -3.76$, $p < 0.001$

- Target vowel F1 & F3 values significantly lower than in control vowels
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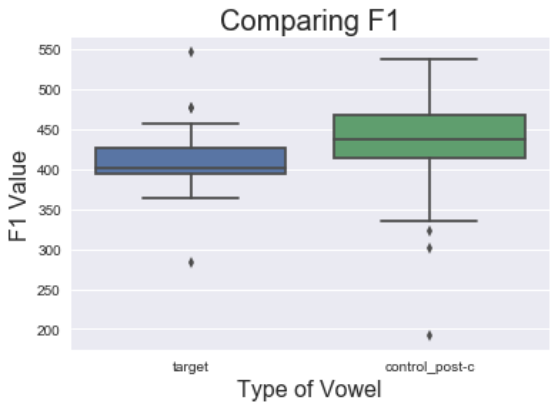

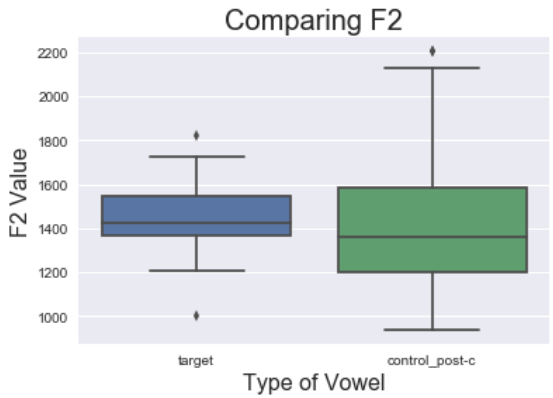

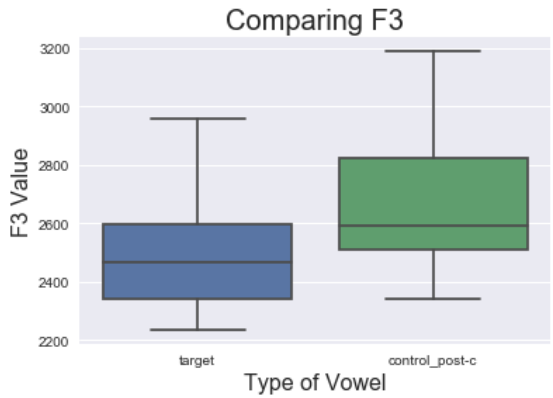

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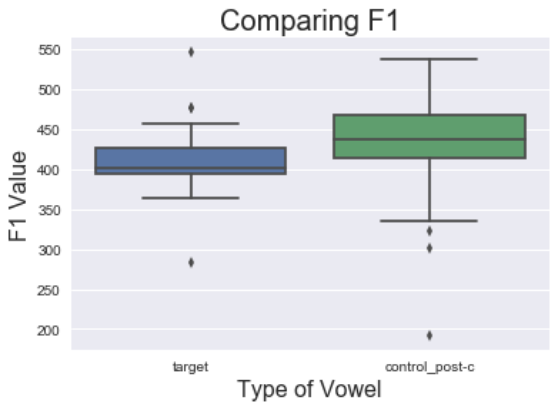

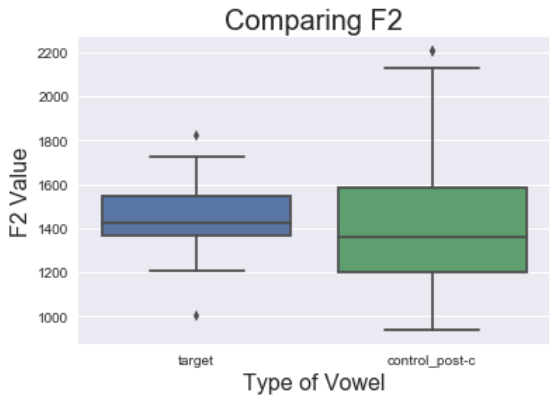

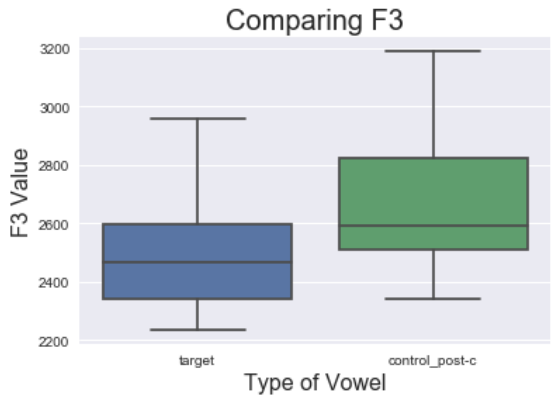

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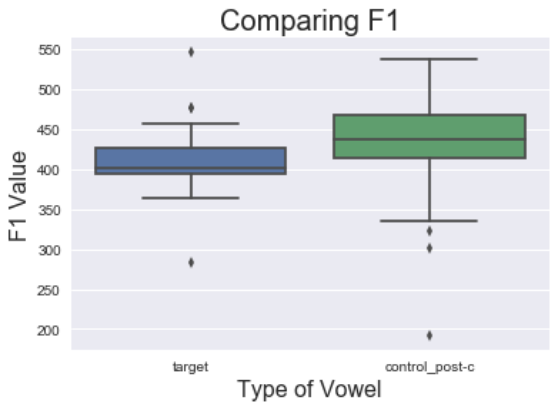

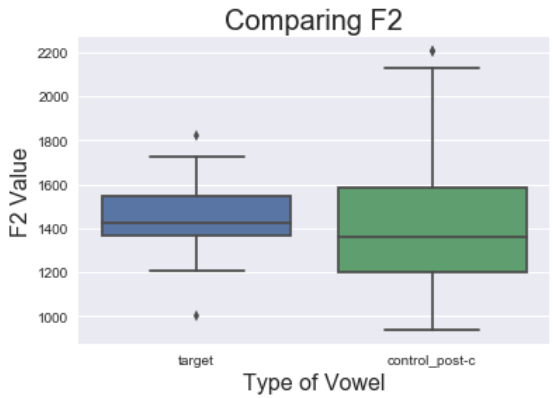

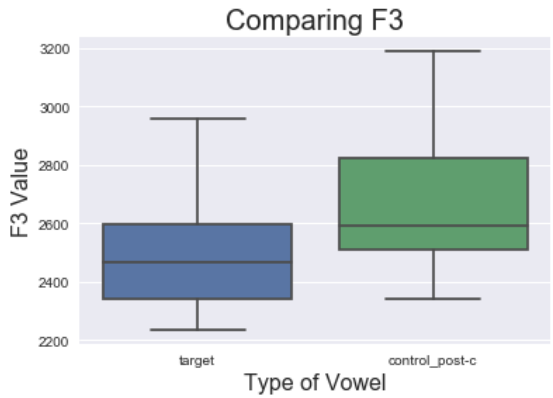

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- F2 does not seem to be informative
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- Speaker-driven perceptual enhancement plays a significant role in the sound change of CV metathesis. In Karuk, this involves:
  - A lengthened offglide
  - A higher (= ↓ F1) offglide
  - A more labialized (= ↓ F3) offglide
- Coarticulation with weakening of V_1 and strengthening of offglide eventually leads to complete metathesis.
- Methodology: opportunistic and legacy recordings can be used to understand the phonetics of sound change.

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Yôotva!
Thank you!

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