The Emergence of Consonant-Vowel Metathesis in Karuk

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Many thanks to the following:

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

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  \text{Stage 2} & \quad \text{Heavy coarticulation} \\
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  \text{C}^wV & 
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  Noni   kwen   (cf. plural ken)   ‘firewood’

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- **Misperception** (listener-driven): automatic coarticulation is misperceived as being underlying rather than phonetic
  - /uCV/ [uCwV] is misperceived as /uCwV/
  - Can be misperceived as /CwV/ if initial /u/ weakened

Prediction: categorical presence vs. absence of offglide
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Coarticulation into Metathesis: Perceptual Enhancement

- *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 $\rightarrow \tilde{V}C$) (Beddor, 2009)

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

Stage 1: $uC$ $\rightarrow$ Stage 2: $uC^w \sim uC^w$ $\rightarrow$ Stage 3: $C^w$
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Karuk language background

Karuk (káruk ‘upriver’)

• ‘Hokan’ isolate

• Spoken along the mid-Klamath River in northern California (and diasporically)

Map by Hannah Haynie and Maziar Toosarvandani (http://linguistics.berkeley.edu/Survey/), colored by a Wikipedia user
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- Karuk language vitality
  - In 1950: \( \sim 100 \) speakers (Bright, 1957)
  - In 2018: \(<\sim 6\) 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](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  ?
m  n
f  θ ([θ] ~ [s])  s ([ʂ]) ʃ  x  h
β  r  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 kʰáːrim] ‘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 . . . ”  
    ‘And she said, “When you pour the water in . . .”’

  • xás upíip  
    ‘and he said’

  • “xas vára maath káru” upiip  
    ‘“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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Palatalization

F2 falls
Labialization

F2 rises
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/)
  - /θʃ/ 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
  - All tokens hand-checked
- Formants taken at 7 equally spaced intervals via ifcformant
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Measurements

- **Total duration** = $V_1 + C + \text{offglide} + V_2$
- **$V_1$ percentage** = Duration of $V_1$/Total duration
- **F2 difference** = $F2_{t_1}(V2) - F2_{t_1}(\text{offglide})$
Measurements

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Measurements

- Total duration = V₁ + C + offglide + V₂
- V₁ percentage = Duration of V₁/Total duration
- F2 difference = F2_{t1 (V2)} - F2_{t1 (offglide)}
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Variables

• **Independent variable**
  • $V_1$ percentage (= normalized duration)

• **Dependent variables**
  • Offglide percentage (= normalized duration)
  • F2 difference

• Comparison of target offglides vs. control /u/ formant means
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Our analysis evaluates predictions of three proposed explanations for sound change with respect to metathesis:

- Misperception
- Gestural Shift
- Perceptual Enhancement
Misperception

Prediction: Misperception and $V_1$ duration

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

u  x  i

labial  velar  tongue blade
**Prediction: Perceptual Enhancement and $V_1$ duration**

- 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/.
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Prediction: F2/F3 and Perceptual Enhancement

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

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**Prediction: Formants and Perceptual Enhancement**

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

- **Misperception**
  - F2/F3 difference: no correlation with V₁ duration
  - Offglide duration: no correlation with V₁ duration
  - Offglide formants = normal vowel formants

- **Gestural Shift (without perceptual enhancement)**
  - F2/F3 difference: no correlation with V₁ duration
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- **Perceptual Enhancement**
  - F2/F3 difference: inverse correlation with V₁ 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
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• 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
F2/F3 Difference

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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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Formant Comparisons: Offglide vs. Normal /u/

- Target vowel F1 & F3 values significantly lower than in control vowels
- F2 being higher is unsurprising because of transition to /i/
- Lower formants suggest a coarticulation with greater magnitude of labialization
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\[ t = -3.26, \ p < 0.01 \quad t = 3.5, \ p < 0.001 \quad t = -3.76, \ p < 0.001 \]
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Conclusions

• 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 V₁ 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!
References I


