Ka puana paʻa ʻole: glottal stop variation in Hawaiian

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outline

• background: phonetic reduction and predictability

• the “glottal stop” in Hawaiian

• phonetic reduction in Hawaiian word *kēia*

• implications and questions for future work
Probabilistic phonetic reduction

• High predictability leads to more phonetic reduction in words (Aylett & Turk 2004; Baker & Bradlow 2009; Bell et al. 2009) and morphemes (Davis 2003; Blevins 2005; Rose et al. 2015)

• Repeated words undergo reduction (Fowler & Housum 1987; Fowler 1988)

• Greater reduction in function word tokens that have high conditional probabilities based on previous and following words (Bell et al. 2009)

• Effect of repetition found for content not function words (Bell et al. 2009)
Research questions

Do probabilistic or social factors influence phonetic reduction of function words in Hawaiian?

And while there was no effect of repetition for function words in Bell et al. (2009), they are already highly frequent.

Perhaps with function words there could be an effect of the repetition of word pairs rather than single words?
focus on *kēia* ‘this’

- allows for greater control than if looking at multiple words
- calculate speaker- and corpus-based measures for the likelihood of the following word
- examine repetitions of word sequences
- Pukui & Elbert (1986) list two variants:

<table>
<thead>
<tr>
<th>kē.ia</th>
<th>ke‘ia</th>
</tr>
</thead>
<tbody>
<tr>
<td>demon. This, this person, this thing; the latter.</td>
<td>Var. of kēia.</td>
</tr>
</tbody>
</table>

- fluent and semi-fluent speakers often lack variation found in speech of people who learned from intergenerational transmission (NeSmith 2005)
- factors influencing variation unknown → informs revitalization movement
Phonetic variation in Hawaiian

- interviews with 8 native-speaking kūpuna, recorded in 1970
- born between 1884-1894

<table>
<thead>
<tr>
<th></th>
<th>Hawaiʻi</th>
<th>Oʻahu</th>
</tr>
</thead>
<tbody>
<tr>
<td>males</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>females</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

- transcription is time-aligned using ELAN
- 422 tokens analyzed of the 488 tokens extracted from SOLIS using LaBB-CAT
Phonetic variation in *kēia*

4 categories of reduction

- **A**: [keʔia], [ke:ia], [keʔea], [kaʔia], [te:ia]
- **B**: [keʔi], [keʔe], [kaʔi], [keia], [ke:a], [ke:i], [keʔa]
- **C**: [ke:], [kea], [kei], [kia], [keo], [kai], [keu]
- **D**: [ke], [ge], [ki], [te]

- **non-reduced**: o [keʔia] poʻe (Minnie Parker Paloney from Oʻahu)
- **reduced**: [ke] wahi nei (John Campbell from Hawaiʻi)
Variation in glottal stop realization

kēia mea (Hilda Kawelo)
model of glottal stop in *kēia*

|                          | Estimate | Std.Error | z value | Pr(>|z|) |
|--------------------------|----------|-----------|---------|----------|
| (Intercept)              | 0.539    | 0.2954    | 1.825   | 0.0681   |
| gender = male            | -1.4112  | 0.4186    | -3.371  | 0.0007   |
| following word = ‘okina but not first | -0.302 | 0.2808 | -1.076 | 0.2821 |
| following word = starts with ‘okina | -1.6447 | 0.4173 | -3.942 | <.0001 |
glottal stop in the following word

**Females**

- **Females' glottal stop production**

**Males**

- **Males' glottal stop production**

Contains.any.kind.gs

<table>
<thead>
<tr>
<th></th>
<th>No 'okina</th>
<th>'okina but not first</th>
<th>Starts with 'okina</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Females</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Males</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number of tokens
Phonetic variation in *kēia*

4 categories of reduction

A: [keʔia], [ke:ia], [keʔea], [kaʔia], [te:ia]

B: [keʔi], [keʔe], [kaʔi], [keia], [ke:a], [ke:i], [keʔa]

C: [ke:], [kea], [kei], [kia], [keo], [kai], [keu]

D: [ke], [ge], [ki], [te]

treated as reduced
overview

• reduction exhibited by:
  – 5/19 (26%) tokens followed by a pause
  – 205/403 (51%) of tokens not followed by pause
  – 4/8 (50%) at start of IP
  – 2/12 (17%) at end of IP
  – 204/402 (51%) IP-medial

• remaining analysis focuses only on IP-medial tokens not followed by a pause
### model

|                  | Estimate | Std.Error | z value | Pr(>|z|) |
|------------------|----------|-----------|---------|----------|
| (Intercept)      | -1.01153 | 0.32564   | -3.106  | 0.0019   |
| gender=male      | 1.57869  | 0.43967   | 3.591   | 0.0003   |
| bigram repetition| 0.05822  | 0.02647   | 2.2     | 0.0278   |
reduction and speaker gender

Reduction in kēia by gender

Number of tokens

Degree of reduction (D = most reduced)

Gender F M

p < .001
males
females

Females: reduction level A

Females: reduction level B

Females: reduction level C

Females: reduction level D
What does this tell us?

- Phonetic reduction in function word linked with repetition of word sequences – analogous to content word repetition

- Bigram probability not a predicting factor once bigram repetition is taken into account

- Effect in Polynesian language: evidence that effects of probability on phonetic reduction is widespread
Phonetic reduction and gender

• Previous work on English has found:
  – greater phonetic reduction among male speakers (Byrd 1994; Bauer 2005)
  – that females are more intelligible (Bradlow, Torretta & Pisoni 1996)
  – that male speakers perceived as masculine exhibit more reduction (Heffernan 2010)

• But not about reduction being associated with males or even masculinity
  – less effort → indexes less investment → toughness and stoicism (Kirtley 2015:204)
Moving forward: spreading the word

• Three findings in particular will be of interest to L2ers hoping to attain native-like fluency:
  1. the realization of the word *kēia* with the glottal stop is highly frequent
  2. males and females have different patterns of realization
  3. the Hawaiian “glottal stop” is often not realized as a glottal stop

• How to spread the word?
  – reaching Hawaiian language scholars who teach
  – reaching speakers beyond the university
Reaching speakers beyond the university

- Making our time-aligned transcripts freely available
- Website with sounds and/or video
- Podcasts like those by Kealopiko
In Sum

• The “glottal stop”
  – often not a stop
  – frequently realized in kēia by the female speakers
  – less frequently realized if the following word starts with a glottal stop

• Phonetic reduction
  – common for the male speakers
  – bigram repetition increases reduction in the function word kēia
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• all of the kūpuna
mahalo

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Bell, Alan, Jason M. Brenier, Michelle Gregory, Cynthia Girand, and Dan Jurafsky (2009) Predictability effects on duration of content and function words in conversational English, *Journal of Memory and Language* 60: 92-111.


Fowler, Carol and Jonathan Housum (1987) Talkers’ signaling of “new” and “old” words in speech and listeners’ perception and use of the distinction.

