Prosodic conditioning:
An instrumental production study
of Tagalog o/u variation

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Overview
❖ o and u alternate in the native Tagalog lexicon
❖ However, there is free variation in reduplicants’, e.g., /puno-puno/ ‘overflowing’
   [puno-puno] ~ [punu-puno]
❖ This study instrumentally investigates this free variation and probes for an effect of prosody.

Outline
1. Introduction
   ❖ The data: Tagalog back vowels
   ❖ Zuraw’s (2009) study
   ❖ Present study: Questions and predictions
2. The Experiment
   ❖ Methods
   ❖ Analysis 1 and results 1
   ❖ Analysis 2 and results 2
3. General Discussion
   ❖ Research questions and predictions
   ❖ Limitations and future research

Tagalog Vowel Inventory

<table>
<thead>
<tr>
<th></th>
<th>Front</th>
<th>Central</th>
<th>Back</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>i</td>
<td></td>
<td>u</td>
</tr>
<tr>
<td>Mid</td>
<td>e</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td>a</td>
<td></td>
</tr>
</tbody>
</table>

Minimal pairs in loans:

/u/  /o/
uso  ‘fad’  eso  Sp. ‘bear’
butas  ‘hole’  botas  Sp. ‘boots’
kuro  ‘think’  koru  Sp. ‘choir’
bukal  Sp. ‘fountain’  bokal  Sp. ‘vowel’
Tagalog Back Vowels

❖ In the native lexicon, however, o and u are in complementary distribution:

• [o] surfaces in the final syllable; raising is blocked
  /halo/ 'mix'
  [halo] cf. *[halu]

• [u] surfaces in suffixed words; raising is obligatory*
  /halo+in/ 'to mix together'
  [haluin] cf. *[haloin]

Tagalog Optionality

❖ The alternation is not straightforward in reduplicated words.

• /halo-halo/ 'ice dessert'
  [halo-halo] cf. * [halu-halu]

• /halo-halo+an/ 'halo-halo+an' cf. *[halo-halu] 'very well mixed'

Zuraw’s (2009) Study

❖ Case study: o/u alternation

• Web corpus (Zuraw, 2006) of ~20 million
• Investigated the effects of frequency
• Looked at the rate of u spellings

❖ Findings

• Lexical frequency effects in unsuffixed reduplicants:
  more "u" spellings in higher frequency words.

• Reduplicative identity effect:
  /halo-halo+tan/ "halo-halo" cf. *"halo-halo" 'very well mixed'


❖ Prosody-based explanation

• Lexical frequency influences which prosodic structure is accessed, e.g., /halo-halo/ 'ice dessert'

  Single prosodic unit
  Higher frequency item
  "u" surfaces

  Separate prosodic units
  Lower frequency items
  "o" surfaces
Summary of o/u

❖ Straightforward alternation
  • [o] surfaces when it's final in the word
  • [u] surfaces in suffixed forms

❖ Optionality (Zuraw, 2009)
  • Compound-reduplicated words
  • Found that it correlates with frequency, but not when
    the reduplicants are suffixed
  • Conditioned by a prosodic structure assignment that
    is sensitive to lexical frequency

The Current Study

❖ No existing data that:
  • Describe the phonetic details of the Tagalog o/u
    optionality
  • Support Zuraw’s (2009) findings
  • Provide support for the presence of a prosodic boundary

❖ Research questions and predictions
  • Q1: Is there variation? Does [o] or [u] surface?
  • Q2: Is there gradience?
  • Q3: Are there frequency influences?
  • Q4: Is there evidence for a relation with prosody?

Q1: Variation?

❖ Unsuffixed reduplicants
  • High frequency items: more [u] productions
  • Mid frequency items: variable
  • Low frequency items: more [o] productions

❖ Suffixed reduplicants
  • All [u] productions (recall the reduplicative identity effect)

Q2: Gradience?

❖ A large number of words have o spellings most of the time, the
  2nd largest group have u most of the time, but there’s also a lot
  of within-item variation.

Fig. 8 (Zuraw, 2009) reproduced
Q2: Gradien?e, cont.
- A comparison of the rate of u-use in first copy vowels (L) versus the rate of tapping (R)
- Fig 1: Binary choice between the tap or the stop; very little within-item variation

Q3: Frequency Effects?
- As frequency gets lower, the preference for o increases. In the higher frequency ranges, the rate of u-use is more evenly distributed.

Q4: Relation with Prosody?
- The prosodic structure affects the vowel variant.
- The prosodic boundary in the item with first-copy [o] should be bigger than the boundary for first-copy [u].
- Segmental durations: final lengthening and initial strengthening
  - Single prosodic unit
  - Higher frequency item
  - “u” surfaces

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   - Limitations and future research
Methods: Stimuli, cont.

❖ A production task: reduplicated words and their corresponding suffixed forms.

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/bako-bako/ 'rough'
Sentence B
1st repetition

/buhok-buhok+an/ 'a lot of hair'
Sentence A
1st repetition

Methods: Stimuli, cont.

❖ Selected from Zuraw’s (2006) web corpus
  • Subset tagged for frequency and rate of u-use
  • Provided to J. Bishop by K. Zuraw and used for this study.

❖ Selection based on the frequencies ranges:
  • Low (2-9); Mid (10-18); High (19-32)

❖ Additional criteria:
  • Tagalog roots selected only in attested forms, vetted by 2 non-participants
  • Fairly easy to segment, i.e., vowels flanked by obstruents and nasals

Methods: Stimuli, cont.

❖ Example stimuli from each frequency range

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Baseline condition</th>
<th>Test condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>buhuk-buhukan 'play or fake hair'</td>
<td>buhuk-buhok ~ buhok-buhok 'lots of hair'</td>
</tr>
<tr>
<td></td>
<td>lutu-lutuin 'to overcook'</td>
<td>lutu-luto ~ luto-luto 'cooked'</td>
</tr>
<tr>
<td>Mid</td>
<td>bungkus-bungkusin 'to make into a wad'</td>
<td>bungkus-bungkus ~ bungkos-bungkos 'bunch/lewad'</td>
</tr>
<tr>
<td></td>
<td>yapus-yapusin 'to hug tightly'</td>
<td>yapus-yapus ~ yapos-yapos 'act of hugging tightly'</td>
</tr>
<tr>
<td>High</td>
<td>dugu-duguhin 'to make bloody'</td>
<td>dugu-dugo ~ dugo-dugo 'very bloody'</td>
</tr>
<tr>
<td></td>
<td>butu-butuhan 'a lot of bones'</td>
<td>butu-buto ~ buto-buto 'bones'</td>
</tr>
</tbody>
</table>

Methods: Stimuli, cont.

❖ 60 test items
  • 10 compound reduplicated words and their suffixed forms for each of the 3 frequency ranges

❖ 48 filler items
  • 24 compound reduplicated words and their suffixed forms for each of the 3 frequency ranges
Methods: Carrier Sentences*

❖ Design of production task
  • Reduce effects of orthography
  • Encourage naturalistic speech production
  • Increase token count

Sentence A:
  Ang unang salita ay [tatlo], at ang pangalawang salita ay [_____].
  (The first word is [three], and the second word is [_____].)

Sentence B:
  Ang paborito kong salita ay [_____].
  (My favorite word is [_____].)

Methods: Participants

❖ 13 female native Tagalog speakers
❖ Mean age: 36 years
❖ LOR: 0 to 25 years
❖ AoA: 14-22 years
❖ Different hometowns (8 represented)
❖ 11 use a 2nd home language; one has 2 additional home languages; 2 reported English as their home language
❖ All received monetary compensation

Methods: Test Phase

❖ 240 items per speaker: two repetitions of the 60 (test and control) items x2/slide
❖ Stimuli were pseudo-randomized
❖ Break period in between trial repetitions
❖ Self-paced

Methods: Analysis 1

❖ Goal: Provide data for Q1, Q2, Q3
❖ Phonetic transcriptions were used as the measure of analysis
❖ Vowel labeling in reduplicants
  • 4 categories — [u], [o], “?”, “other” — for all first-copy vowels in both unsuffixed and suffixed compounds
  • Productions from sentences A and B were combined and analyzed for this study
Methods: Analysis 1, cont.

❖ Acoustic analysis

• Properties that correlate with their assignment to [u], [o], and “?” — mainly F1; also duration
• The intervals were defined by a strong F2, marking the vowel’s onset and offset; this interval also defined the vowel’s duration.
• F1 values were extracted from a stable region from the interval’s midpoint using a Praat script

Results: Analysis 1

❖ Assignment of vowel variants: Overall pattern

• Some variation in this vowel for both unsuffixed and suffixed forms
• [u] is more common in the suffixed versus the unsuffixed forms ($p < .001$).
• There was no main effect of frequency on vowel raising ($p > .10$).
• Frequency was not a reliable predictor in unsuffixed reduplicants: HIGH had more [u] tokens (relative to the suffixed items), but this was significant only when compared to MID and not to LOW.

Results: Analysis 1, cont.

❖ Acoustic properties of ambiguous vowels: F1

• Vowels assigned “?” had significantly larger F1 values than [u], and significantly smaller F1 values than [o].

Results: Analysis 1, cont.

❖ Acoustic properties of ambiguous vowels: Duration

• Vowels assigned “?” had a significantly shorter duration compared to both [u] and [o].
Methods: Analysis 2

❖ Goal: Provide data on Q4

❖ Measure of analysis: Segmental durations
  • Final lengthening and initial strengthening
  • Subset of unsuffixed reduplicants; Cs were obstruents
  • Tokens produced with a large pause between the two copies were excluded

<table>
<thead>
<tr>
<th>Reduplicant</th>
<th>Gloss</th>
<th>Reduplicant</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>/bago-bago/</td>
<td>'new; more recent'</td>
<td>/buto-buto/</td>
<td>'bones'</td>
</tr>
<tr>
<td>/bako-bako/</td>
<td>'rough'</td>
<td>/dugo-dugo/</td>
<td>'bloody'</td>
</tr>
<tr>
<td>/buko-buko/</td>
<td>'node'</td>
<td>/puno-puno/</td>
<td>'overflowing'</td>
</tr>
</tbody>
</table>

Results: Analysis 2

❖ Final lengthening
  • First-copy [o]s (A) are longer than first-copy [u]s (B), based on transcriptions in Analysis 1
  • Relative effect: first-copy [u]s are significantly shorter compared to their second-copy vowel counterparts than [o] is compared to its counterpart.

Results: Analysis 2, cont.

❖ Initial strengthening
  • Consonants following [o] productions were slightly longer; however, this was not found to be significant (p > .10).

❖ Discarded tokens
  • 26 tokens discarded for first-copy [o]s and only 2 for first-copy [u]s.
  • Marginal significance for pauses following [u] versus [o] (p = .07).

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Q1: Variation

- Is there evidence for variation? Does /u/ or /o/ surface? **YES.**
  - Results from Analysis 1 are in line with Zuraw’s (2009) findings: unsuffixed reduplicants like /halo-halo/ showed far fewer [u] tokens than for suffixed forms like /halo-halo+an/.
  - Though variation was found in suffixed forms, it was trending in the expected direction.

Q2: Gradience

- Is there gradience? **YES**
  - Analysis 1 showed that this perceptually in-between vowel was also acoustically in between [u] and [o].

Q3: Frequency Effects

- Are there frequency influences on this gradience? **NOT REALLY.**
  - No strong relationship between variation and frequency for both suffixed forms (in line with Zuraw) and unsuffixed forms (not in line with Zuraw).
  - Suggestive trends, however: there were more [u] tokens in the high frequency range compared to the mid range, but not compared to the low range.

Q4: Relation with Prosody

- Is there evidence for a relation with prosody? **MOSTLY YES**
  - Final lengthening of first-copy [o] vowels compared to [u] vowels suggests that [o]s tend to occur before a larger boundary than [u] productions.
  - A significant relative effect suggested a difference in the overall prosodic structure of the compound.
Q4: Relation with Prosody, cont.

+ Is there evidence for a relation with prosody?
  MOSTLY YES
  - Greater pauses following [o] productions in the dropped tokens, suggesting a larger prosodic boundary.
  - Initial strengthening. NO
    - No statistically significant evidence for any initial strengthening effects that correlated with vowel production in the compounds.

Discussion, cont.

+ Conclusion
  - Attested o/u optionality in native Tagalog reduplicants.
  - The current paper investigated Zuraw's proposal of lexically-sensitive prosodic structures using data from a web corpus
  - Findings provided partial support
  - If prosody story is right, then frequency doesn’t fit in so neatly.

Contributions:

- Variation is described in the literature but not as much for compound reduplicants.
- New instrumental production data
- Influence of prosody on segmental alternations

Limitations and future research:

1. Intended to be a first look. More that can be done with the data that was collected.
2. No existing model of Tagalog sentence prosody to mark boundary tones
3. Using a second and third transcriber
4. Using a different pool of participants to rule out dialectal differences and language attrition
Thank you!

References


Keating, P., Cho, T., Fougeron, C., Hsu, C. (2003, Fall). Domain-initial articulatory strengthening in four languages: invited departmental colloquium presented at University of California, Santa Barbara, Santa Barbara, CA.


References, cont.


