

Coarticulation Dampening Properties of the Glottal Stop

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INTRODUCTION

Coarticulation

- Different phonemes require different movements of speech articulators.
- The transition of the articulators from one phoneme to the next is imperfect which changes the acoustics of adjacent phonemes.

The Glottal Stop /ʔ/

- It is found in the middle of the word “uh-oh.”
- It requires a complete closure of the vocal folds followed by a sudden opening (Laver and John, 1994).
- The articulators above the larynx are not used (Esling et al., 2005; Stemberger, 1993).

Coarticulation Dampening

- There is minimal resistance above the larynx, which can facilitate transitional movements.
- Glottals don't block adjacent phonemes from affecting each other and are therefore “transparent” (Stemberger, 1993).

The Malayo-Polynesian language Cebuano will be used to examine the coarticulation properties of the glottal stop to see if the glottal stop can prevent a preceding /g/ from influencing the subsequent vowel.

METHOD

Participant

- 1 female native Cebuano speaker

Data

- 30 words were elicited for each of the utterance context #ʔV, gV, and gʔV for each vowel /a, i, u/.
- The formants F1 and F2 were extracted from each vowel in onset and mid positions.
- The onset measure was taken 20% of the way through the vowels' relative durations.
- The midpoint measure was taken 50% of the way through the vowels' relative durations.

HYPOTHESIS

- The glottal stop will be able to reduce coarticulation between phonemes with similar constrictions.
- F1 of /i/ and /u/ in the gʔV utterance context will be more similar to #ʔV than gV.
- F2 of /a/ and /u/ in the gʔV utterance context will be more similar to #ʔV than gV.

ACOUSTIC DATA

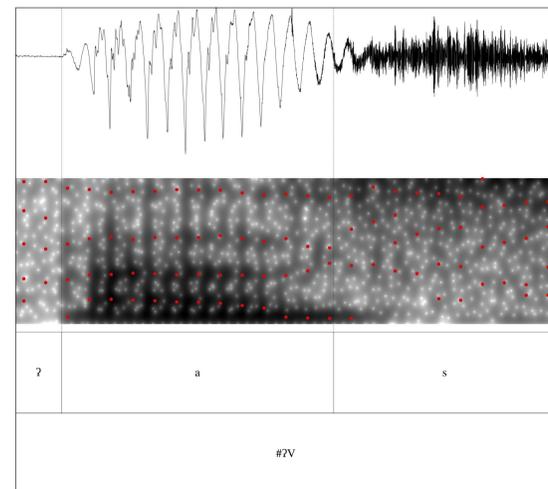


Figure 1: Sound wave with spectrogram of /a/ in a #ʔV context

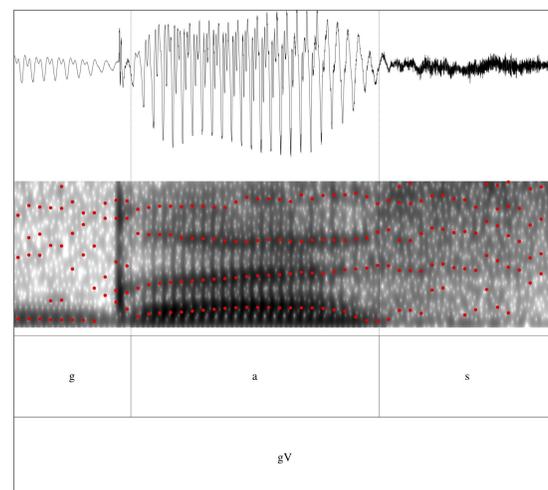


Figure 2: Sound wave with spectrogram of /a/ in a gV context

ANALYSIS

Model

- A multiple linear regression was run for each of the two formants in onset and mid positions using the lme4 package in R.
- Vowel type and utterance context and their interaction were used as predictors for each of the two formants.
- Pair-wise comparisons were done for the estimated marginal means in each utterance context grouped by vowel using the emmeans package in R.
- The distance between the estimated marginal means were used to calculate whether gʔV is more similar to #ʔV or gV.

RESULTS

F1

- /a/
 - Onset: gʔV is not significantly different from gV
 - Mid: gʔV is closer to #ʔV
- /i/
 - Onset: gʔV is closer to #ʔV but gʔV is not significantly different with either #ʔV or gV
 - Mid: gʔV is closer to #ʔV but #ʔV and gV are not significantly different
- /u/
 - Onset: gʔV is closer to #ʔV but #ʔV and gV are not significantly different
 - Mid: gʔV is closer to #ʔV but #ʔV and gV are not significantly different

F2

- /a/
 - Onset: gʔV is not significantly different from #ʔV
 - Mid: gʔV is not significantly different from #ʔV
- /i/
 - Onset: gʔV is closer to #ʔV
 - Mid: gʔV is closer to #ʔV
- /u/
 - Onset: gʔV is closer to #ʔV
 - Mid: gʔV is closer to #ʔV

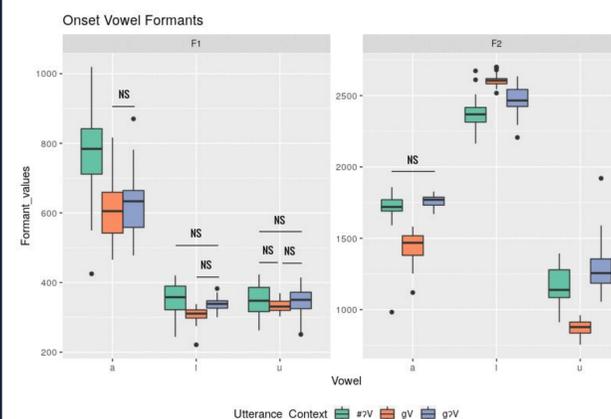


Figure 3: Distributions of the vowel formants at the onset position

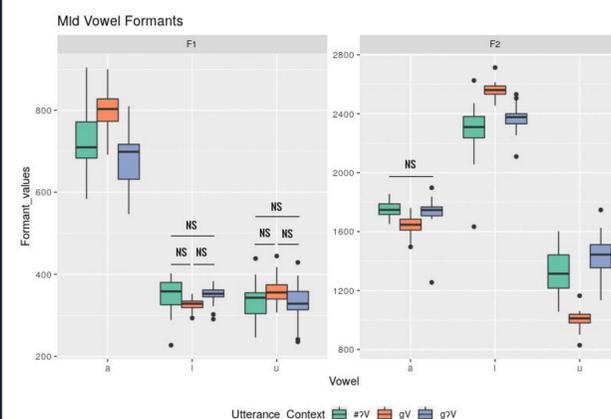


Figure 4: Distributions of the vowel formants at the mid position

SHORTCOMINGS

- The current procedure assumes that #ʔV and gV are drastically different; it is not informative if the two distributions are not significantly different.
- The glottal stop is sometimes realized as a creaky voice that is hard to differentiate from the following vowel
- The glottal stop sometimes has a premature release of the closure making it harder to find the actual beginning of the following vowel

CONCLUSIONS

- The findings support the idea that the glottal stop plays a role in coarticulation.
- The glottal stop absorbs and dampens coarticulation effects from the preceding phoneme.
- The F1 of /i/ and /u/ had non-significant differences between the contexts which shows difference in tongue height was minimal in the first place.
- The F1 of /a/ was not prevented from having coarticulation effects from /g/ in the onset position but was prevented in the mid position likely due to the difference in tongue position between /g/ and /a/.
- The coarticulation effects for F2 in the onset and mid positions for all vowels were dampened by the glottal stop.

ACKNOWLEDGEMENTS

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