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The Role of Prosody in Conditioning Tagalog *o/u* Variation

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Abstract

The present study explored the role of prosodic structure in conditioning a segmental pattern in Tagalog, namely the raising of non-final back vowels. In particular, we investigated durational patterns in compound reduplications, which show variable application of this raising, e.g., *hal[u]halo* ~ *hal[o]halo* 'ice dessert'. Previously, it has been proposed that this variation may be due to lexically-sensitive prosodic structure assignment; during lexical access, some compounds are more likely to be accessed as single prosodic units (placing the vowel in the first-copy reduplicant in non-final position), while some tend to be accessed as individual prosodic units (placing the same vowel domain-finally, where it should undergo raising) [1]. We present instrumental phonetic data that seem to support this proposal: compound reduplications with the [o] variant in the first copy show some durational correlates of a prosodic boundary (final-lengthening in the first copy, but not initial strengthening in the second).

Index Terms: variation, Tagalog, reduplication, prosodic phonology, lexical access

1. Introduction

1.1. /u/~/o/ Variation in Tagalog

In Tagalog, Spanish and English loanwords have created a contrast between the two high, back vowels, /u/ and /o/ [2]. In the native Tagalog lexicon, however, they are (with few exceptions) in complementary distribution. For example, the native root morpheme *halo* /halo/ 'mix,' occurring in two different environments, illustrates the contrast between citation pronunciation of an unsuffixed single word (1a) versus pronunciation in a suffixed form (1b) [3].

(1) a. /halo/ '*mix*'
[hal**o**] *[hal**u**]

b. /halo-hin/ '*to mix (together)*
[hal**u**in] *[hal**o**in]

Here, the alternation is straightforward: [o] surfaces in the final syllable of a monomorphemic word, as in (1a); in this environment, raising is blocked. In the suffixed form shown in (1b), [u] is predicted to occur in the final syllable of the stem; in this environment, raising appears to be obligatory.

While [o] is predictable in environments found in (1), cases also exist where /o/-raising does not apply straightforwardly, resulting in apparent optionality. In a study of data from a written corpus [1], Zuraw reported that the back vowels were variable in reduplicated forms, as illustrated in (2a); however, there was a strong preference for suffixed reduplications to show raising (2b). Thus, raising can be characterized as applying most reliably to the last vowel in a prosodic unit—the prosodic word, or perhaps some higher-level phrase [2, 4].

(2) a. /halo-halo/ *'an ice desert'*
[hal**u**halo] ~ [hal**o**halu]

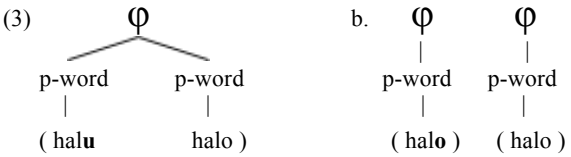
b. /halu-halu-an/ '*very well mixed*'
[hal**u**hal**u**an] * [hal**o**hal**u**an]

Finally, however, Zuraw's analysis of the corpus provided evidence that some of the variability in the occurrence of first-copy vowel raising in words like (2a) was predicable based on lexical frequency, such that more frequent reduplications were more likely to show raising. The question we are interested in is whether the observation about the prosodic context in which we find raising and the observation about lexical frequency are related.

1.2. Prosodic Conditioning

Zuraw proposes that they are. To account for the variation seen in cases like (2a), it is hypothesized that the correlation between frequency and vowel raising is indirect, and reflects frequency's influence on the lexical access route. In particular, reduplicants like *haluhalo* ~ *halohalo* can be stored in, and accessed from, the lexicon in one of two ways: as a single unit, or more compositionally, i.e., each copy separately. The linking hypothesis, then, is that these units can be characterized as prosodic, as in (3).

(3)



Zuraw proposes a prosodic level above the prosodic word, which she refers to tentatively as the MajorPhrase (and which we refer to here even more agnostically using the placeholder 'φ'). As can be seen in (3a), where the reduplicant is accessed as a single prosodic unit, there is a sense in which the first copy's final vowel is prosodically medial, and thus meets the structural description for raising. This is not true in (3b), where each copy is accessed as a separate higher-level phrase unit.

Finally, to account for the suffixed reduplications' apparent immunity from frequency effects, the first copy's

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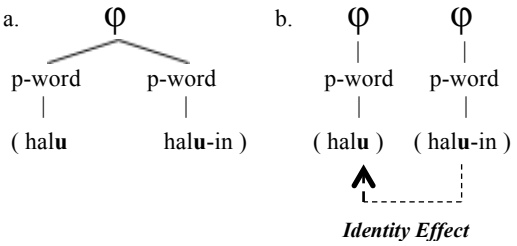
vowel in words like *halu-halu-in* (see 2b, above) is assumed to be subject to an identity effect [5]—i.e., when the second copy's vowel is obligatorily [u], the grammar requires the first copy's vowel to match, regardless of prosodic structure:

(4) a. b.



1.3. Present study

Zuraw's proposal suggests that in addition to the phonological grammar, rule application is sensitive to lexical frequency. She provides an explicit mechanism through which frequency has its effects, namely prosodic structure assignment. However, at present there is no instrumental phonetic data that provide independent support for the prosodic contrast represented in (3). The present study sought to investigate this matter further by examining whether there is phonetic evidence for prosodic constituency that correlates with the occurrence of [o]/[u] in the relevant reduplicated forms in Tagalog.

To do this, segmental durations were examined, since it is well known that segmental durations reflect, in part, position in a larger prosodic structure [7-11]. It was predicted that if [o] surfaces in first-copy reduplicants when at the edge of a prosodic grouping, [o]s should be significantly longer, due to final lengthening, than [u] vowels in the same position. Similarly, first-copy [o] vowels should be followed by longer segmental durations, due to initial strengthening, in the second-copy's initial segment. In both cases, [u]s, which are hypothesized to be phrase-medial, should be significantly shorter—above and beyond small differences that are expected given the lower jaw height for [o] relative to [u]. Thus, the goal of the present paper is not to test the putative correlation between first-copy vowel realization and lexical frequency, but the correlation between first-copy vowel realization and the prosodic structure that is said to be the link.

2. Experiment

2.1. Method

2.1.1. Stimuli

The productions analyzed here were a subset of productions taken from a larger study of Tagalog reduplications. The list of test items for that larger study consisted of 60 forms (30 reduplicated forms ranging in frequency, with bare and suffixed versions of each) and 48 fillers items (24 reduplicated words without the possibility for the relevant vowel alternation, suffixed and unsuffixed forms for each). Productions analyzed for the present study were a small subset of the aforementioned original 60 words, selected on the basis of ease of segmentation, namely those with obstruent consonants at the onset in each syllable. (All words analyzed in this study were un-suffixed). The set is shown in (5):

(5) a. bago-bago *'new; more recent'*
b. bako-bako *'rough'*
c. buko-buko *'node'*
d. buto-buto *'bones'*
e. dugo-dugo *'bloody'*
f. puno-puno *'overflowing'*

The words analyzed were produced in two carrier frames, and were designed to minimize the effects of orthography, since the target vowel (the second vowel of the first copy) was always spelled with an "o". The first carrier sentence (6) explicitly showed the stem of interest, and participants were to fill in a blank with its reduplicated form at the end. The second carrier frame (7) elicited an additional production of the reduplication in a more neutral sentence. This was added due to a concern that the first frame used might elicit a contrastive focus, possibly altering the prosodic realization in the word in crucial ways. It was also added in case the speaker's first production was disfluent.

(6) Ang unang salita ay [bago], at ang pangalawang salita ay [___].
(The first word is [new], and the second word is [___].)

(7) Ang paborito kong salita ay [___].
(My favorite word is [___].)

2.1.2. Participants

Thirteen female native speakers of Tagalog were recruited, mainly from The CUNY Graduate Center, to participate in the study. Their mean age was 36 years. Length of residence in the U.S. ranged from 0-25 years; age of arrival ranged from 14-22 years; 11 reported using an additional language at home; 1 reported the use of 2 additional languages at home; and 2 reported English as their main home language. All participants received monetary compensation.

2.1.3. Procedure

Each testing session consisted of a background questionnaire and the production task (which included a practice session, followed by a short debriefing). English was used to communicate with the participants during the informational and instructional stages. Recordings were carried out in a sound-attenuating booth. The stimuli (i.e., the carrier sentences) were presented to the participants in PowerPoint slides and read from a computer monitor.

Three different pseudo-randomized versions of the trials were distributed across the participants. They contained either a test or control item, and were ordered such that test items did not appear in subsequent order, and were always separated by at least one filler item. Additionally, each unsuffixed form and its corresponding suffixed form were separated by at least 4 different items. Participants read a second repetition of the list, which was done presenting the same PowerPoint list in reverse order.

Participants proceeded through the slides at their own pace while being recorded; recordings were made digitally using a Shure SM10A head-mounted microphone and a computer running Audacity at a 16-bit resolution with a sampling rate of 22,050Hz. Participants were offered a short break if they desired, in-between repetitions of the list. The entire experimental session lasted approximately 75 minutes.

2.2. Data Analysis

To examine whether there was evidence for a relation to prosody—in particular, whether [o] vowels tend to precede a prosodic boundary and [u] vowels do not—segmental durations were measured. The boundaries of the consonants (and thus the intervening vowels) were identified according to the recommendations in Turk, et al. [12]; generally, the onsets of obstruents were marked by the onsets of constriction following a previous vowel, visible by a sharp and abrupt decrease in the amplitude of the waveform. Offsets (and therefore vowel onsets) were marked by the release of the constriction. An example of a segmentation of *puno-puno* 'overflowing' is shown in Figure 1.

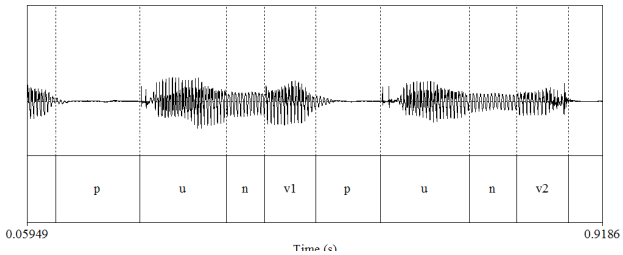


Figure 1. *Example segmentation of the test word /puno-puno/ 'overflowing', produced by a participant in the production study.*

One thing that this did not allow for was accurate measurement of stop consonants in initial position of either of the two copies, if that copy followed a pause. The only acoustic evidence of the stop's onsets following a silent pause would, in the case of voiced stops, be the onset of voicing during closure. For voiceless stops (like the initial stop in *puno-puno*) even this evidence would be absent. We addressed this issue as follows: first, if a noticeable pause occurred directly before the first or second copy, the item was excluded from the statistical analysis. A pause was defined as silence if it was more than 2.5 times the stop's average duration in the data collected. However, it should be noted that the presence of a long pause *between* the two copies is in fact a kind of evidence in and of itself; such pauses suggest the possibility of a prosodic boundary's presence, and so the number of inter-copy exclusions for pauses is potentially informative. It is therefore predicted that the number of inter-pause exclusions should be very few in the case of compounds with first-copy [u], and more likely for those produced with first-copy [o].

Finally, to determine whether the durational measurements taken correlated with the identity of the second-copy vowel, impressionistic transcription was carried out (by the first author). This was done as follows: for each production of a target word, the author listened to the reduplicant in isolation (i.e., isolated from the rest of the carrier sentence) a maximum of five times, sometimes listening to the whole reduplicant, sometimes listening to only the copy containing the vowel being transcribed. A forced-choice decision about the identity of final vowels in both copies was made, based on the four categories:

a. a rounded high vowel (perceived as either IPA [u] or [ʊ][1]), henceforth simply referred to as "[u]"

b. a rounded low vowel, henceforth "[o]"

c. a vowel in-between (i.e., a rounded back vowel that could not be clearly identified as either high or low), henceforth simply "?"

d. any other vowel other vowel category (a non-back or non-rounded vowel)

Test words with vowels meeting the description in (c) or (d), i.e., those that could not be categorized as either [u] or [o], were excluded from the analysis.

2.3. Results

Figure 2 displays average segmental durations, separately for compounds containing first-copy [o]s (A) and first-copy [u]s (B). Although the absolute differences were small, first-copy [o]s were numerically longer than first-copy [u]s, the basic pattern expected if there were final lengthening of [o]s but not [u]s. Notably, this difference is more striking when considered relatively; first-copy [u]s in Figure 2B are strikingly short compared to their second-copy (i.e., word-final) vowel counterparts. While the small absolute differences between [o] and [u] are expected based on their intrinsic durations, the relative differences are not, and thus are more likely to reflect position in prosodic structure.

Looking next at second-copy initial consonants, these were also longer in compounds with first-copy [o]s than compounds with first-copy [u]s. The direction of this numerical difference is consistent with initial strengthening, which would also serve as evidence for an inter-copy prosodic boundary in compounds with first-copy [o]s, but not those with first-copy [u]s.

To determine whether these numerical differences were statistically confirmed, a mixed-effects linear regression model was constructed to test the durational differences between first-copy [o]s versus first-copy [u]s. In addition to random-effects for speaker and test word, the model contained the crucial fixed-effects "Copy" (first-copy final vowel vs. second-copy final vowel) and "Vowel" (assigned an [u] or an [o] transcription), and, crucially, their interaction.

In fact, as shown in Table 1, below, the interaction between Copy and Vowel was significant, such that the duration of first-copy final [u]s was (relative to their second-copy counterparts) significantly shorter than first-copy [o]s (relative to *their* second-copy counterparts). It is necessary to emphasize the importance of this relative effect, which was presumably due to the fact that first-copy [u]s were not only shorter in absolute terms than first-copy [o]s, but also because word-final second-copy [o]s were longer in test words with a first-copy [u]. This is the type of relative lengthening effect we would expect to see if there were a difference in the overall prosodic structure of the reduplication.

Unlike lengthening due to prosodic phrase boundaries, the effect of initial strengthening of the second-copy initial segments is less likely to be a relative effect, and in most studies testing articulatory strengthening of consonants at the onsets of prosodic phrases, a comparison of absolute measures is the standard type [7]. This was tested using a very simple model (with the same random-effects structure), comparing second-copy initial consonants following [u] versus [o]. Although post-[o] initial consonants were slightly longer, this difference was not found to be significant ($\beta = -1.069$, $t = -0.589$, $p > .1$). Thus, there was not statistically significant

[1] See Schachter and Otanes [2] for some description of variation involving the realization of back vowels in Tagalog.

evidence for any initial strengthening effects that correlated with vowel production in the compounds.

Finally, as mentioned above, it was of interest to know if there were any differences in the number of tokens discarded due to large pauses between copies. The number of tokens discarded for compounds with second-copy [o] vowels was 26, and only 2 for compounds with second-copy [u] vowels. A mixed-effects logistic regression model found this difference to be only marginally significant (pauses following [u] vs. [o]: $\beta = -1.555$, $t = -1.769$, $p = .07$), which was likely due to the small number of discarded tokens overall.

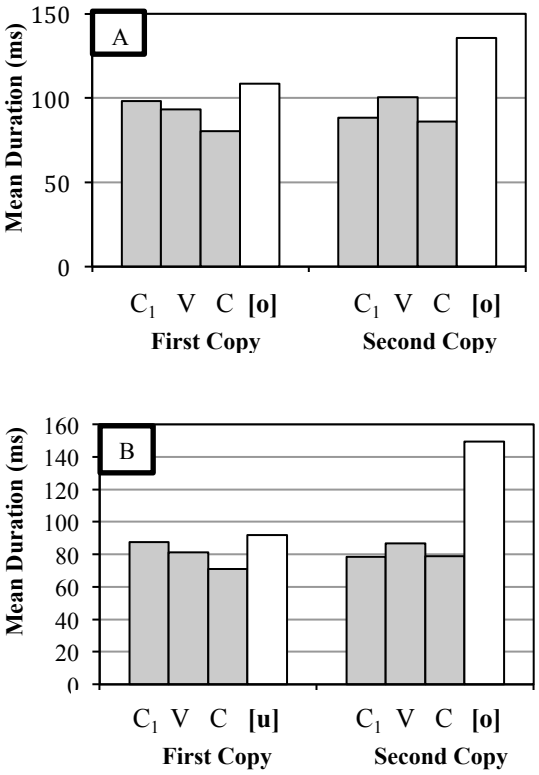


Figure 2: *Mean segmental durations of reduplicated forms in first-copy [o]s (A), and first-copy [u]s (B).*

Fixed effects:	*β*	*SE*	*t*	*p*
(Intercept)	144.4	7.169	20.14	< .001
Copy-1 V vs. Copy-2 V	-26.671	3.876	-6.88	< .001
Vowel Label (u vs. o)	10.417	4.137	2.51	< .05
Copy-1 V * V-label (u)	**-30.792**	**5.192**	**-5.93**	**< .001**

Table 1. *Output of the linear mixed-effects model used to test differences between vowel variants in the first copy of compound reduplicants.*

3. Discussion and Conclusion

The present production study was carried out to test a prediction based on Zuraw's corpus study of reduplicated Tagalog words in [1], in particular, that phonetic evidence for a prosodic boundary might correlate with the presence of a surface [o] vowel in certain types of compound reduplicated forms. Some of the durational results seem to line up with the prosodic proposal. This evidence did not come from initial strengthening of first-copy initial consonants, although the durational difference was in the right direction. Instead, there was evidence for final lengthening; realizations of [o] in the first copy were significantly longer than [u] in the first copy. Note that this pattern is also predictable based on basic articulatory factors required for the segments themselves, i.e., the longer time required to execute a low vowel like [o] rather than a higher vowel like [u]. However, the fact that speakers not only produced shorter first-copy [u]s but also longer word-final [o]s in the same words, suggests a more general prosodic adjustment. Thus, while further research is needed to explore other phonetic correlates of prosodic grouping, e.g., intonational properties, there is reason to believe that some of the segmental variation in the reduplicated forms explored here may be prosodically conditioned.

4. Acknowledgements

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