Cebuano Stress: Phonetic Cues and Phonological Pattern[1]

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1 Introduction

Cebuano, also known as Bisaya', is a member of the Bisayan languages, under the Malayo-Polynesian subdivision of the Austronesian family. It is spoken by about 16 million people around the world (Ethnologue 2019), most of who live in central Philippines, mainly on the islands of Cebu and Bohol, eastern Negros, western Leyte, and northern parts of Mindanao (Wolff 1972).

Shryock (1993) presents a metrical analysis of the distribution of primary and secondary stress in Cebuano. No phonetic measurements are mentioned as a support for the data, i.e., it is not clear what criteria were used to decide which syllable of a word is stressed. This paper first presents data which shows that the most significant phonetic correlates of stress in Cebuano are duration and vowel quality, specifically the first and second formant (F1 and F2). In addition, this paper argues that the stress pattern in Cebuano is weight-sensitive, iambic, right-aligned, and extrametrical, with certain loanwords being the exceptions, and presents an analysis of the stress pattern using Optimality Theory (henceforth OT, Prince & Smolensky 1993/2004). All the data used in this paper are extracted from two sources: a dictionary of Cebuano compiled by Wolff (1972) and Shryock (1993), and presented using IPA symbols. All the recordings are collected from a native speaker of Cebuano.

The rest of the paper is structured as follows: §2 gives the basic backgrounds of Cebuano as related to the data; §3 presents the data that show the phonetic correlates of Cebuano stress; §4 presents the data showing the phonological pattern and an analysis of the stress pattern in OT; §5 discusses the analysis employed in comparison with other possible explanations; §6 concludes.

2 Cebuano phoneme inventory

According to Endriga (2010), Cebuano has three vowel phonemes, "the high, back, rounded, lax /ʊ/, the high, front, unrounded, lax /ɪ/ and the open-mid, back, unrounded, lax /ʌ/." /ɪ/ is in free variation with [i] and the mid, front vowel [ɛ], and /ʊ/ varies freely with [u] and the mid, back vowel [ɔ] (Endriga 2010:6). However, there are sources that assume or claim a five-vowel system instead of a three-vowel system. For instance, in the data presented in Shryock (1993), all five vowels of /a, e, i, o, u/ are found. In addition, in "Cebuano Phonetics and Orthography", it is claimed that the Cebuano language originally used the three-vowel system, and expanded to include /e, o/ under the influence of Spanish, English, and other languages. The three-vowel system is adopted here, the reason for which is explained later in §3.4. For convenience reasons, the IPA symbols /u, i, a/ will be used to represent them respectively.

Table 1 shows the consonant inventory of Cebuano, as described in Wolff (1972). The exact place of articulation in the alveolar column is arguable; some sources describe some of the

[1] I would like to thank my advisor, Prof. Kie Zuraw, for her endless patience and guidance. Many thanks to my consultant, Minerva Vier, for her recordings and generous help. Any mistake in this work is my own.

stops to be dental, other sources claim that they are all apical-alveolar (Endriga 2010; Wolff 1972).[2]

	Bilabial	Alveolar	Palatal	Velar	Glottal
Plosive	p b	t d		k g	ʔ
Nasal	m	n		ŋ	
Trill		r			
Fricative		s			h
Approximant	(w)	l	j	w	

Table 1. Consonant inventory

Lexical entries in Wolff are marked with stress, following a claimed stress pattern. Wolff asserts that, for most words in Cebuano, stress falls 1) on the syllable with a long vowel if there is one; 2) or else on the penult if it is closed; 3) otherwise on the final syllable. Entries that do not follow these rules are otherwise marked with diacritics to indicate stress.

3 Phonetic correlations

3.1 Phonetic cues of stress in other Philippine languages

Tagalog, another member of the central Philippine language family, is closely related to Cebuano. Klimenko et al. (2010) inquires into the relative importance of three variables, pitch, duration, and intensity, in differentiating the two members of minimal stress pairs in Tagalog. Minimal pairs were first recorded from a native speaker and measurements for all three variables were taken. Then the recordings were synthesized to produce multiple versions where in each version one of the variables was modified. The synthesized utterances were then played to native speakers in a perceptual experiment. By comparing the results of the measurements and the results of the experiment, they conclude that the variable that contributes most to the perception of stress in Tagalog is duration, followed by pitch. Measurements of elicited words show that duration interacts with the position of the vowel within a word. For each pair of words that only differ in stress assignment, the durations of the vowel in the ultima are approximately the same, whether it is stressed or stressless. However, for the penult vowel, its duration is significantly greater if it is stressed. It is also mentioned in Klimenko et al. that duration is discovered to be the only factor that is phonemic among the three stress correlates of Tagalog (Moriguchi 1977).

Talavera et al. (2013) investigates the sound systems of Ilokano, another language of the Philippines, and measures the pitch, intensity, and duration of /a, i, ə, ɔ/, both stressed and unstressed. The results show that duration is the phonetic correlate that is directly related to stress assignment in Ilokano.

[2] I am inclined to claim them all to be dental, at least for the dialect of Cebuano spoken on the island of Cebu, based on observation of a native speaker.

3.2 Methods

3.2.1 Participant

The recordings are collected from the native speaker consultant Minerva Vier. The consultant grew up on the island of Cebu, where Cebuano is the dominant language. Vier also speaks Tagalog and English since the age of 7 and is near-native in both languages.

3.2.2 Items and context

All the items used for the phonetic measurements are disyllabic words extracted from Wolff (1972), see (1) for examples (for the full list of items, see appendix). In addition to the number of syllables, the items are further controlled for vowel, manner of articulation of consonants, and syllable structure. The only vowels involved are /a, u/, and the consonants only include obstruents, namely the stops /p, b, t, d, k, g/ and the fricative /s/. The words are represented in the same way as in Wolff, where underlying long vowels are indicated with an acute accent.

(1) Items

a. ˈCa.CaC

pápap	‘sound of a low-pitched car horn’
tápak	‘patch’
kábat	‘reach up to an amount or length of time’

b. Ca.ˈCaC

bakak	‘be a lie, false’
tapat	‘be true and loyal to s.o.’
kasap	‘not being able to taste’

c. ˈCu.CuC

púsud	‘navel’
súgud	‘start, begin s.t.’
kúgus	‘carry s.t. in the arms’

d. Cu.ˈCuC

putut	‘full-grown person that is short’
tuduk	‘sprout, grow from the surface’
kusug	‘fast, rapid’

Only lexical entries with the syllable structure CV.CVC are used for the phonetic measurements, while others are excluded for the following reasons. Words with the structure CV.VC are left out because the two vowels are the same for most of the words and it is hard to determine the point where the first vowel ends and the second begins. In addition, lexical items with a closed penult, i.e., CVC.CV and CVC.CVC, are left out because they do not show alternating stress patterns. Lastly, words ending with an open syllable, i.e., CV.CV and CVC.CV, are not included for the concern that it is not easy to be consistent in marking the end point of the final vowel for phonetic measurements.

A sentence frame was used to elicit the words phrase-medially. The sentence frame was chosen to satisfy the following criteria: 1) the sentence frame must be compatible with words of different parts of speech; 2) there should not be an intermediate phrasal boundary between the target word and the next word in the sentence, at least not one that leads to a boundary tone, in order to avoid confounds for the fundamental frequency (f0). The sentence frame used is:

(2) Na'ay ____ pirmi.
EXIST [target word] always
"There is always [target word]."

3.2.3 Procedures

The words were recorded both in citation form and within the sentence frame to control for possible confounds resulting from their position in the sentence. In citation form they may carry phrase-final intonation, while within the sentence frame they may manifest phrase-medial intonation. The consultant produced every word for at least four times, first in isolation, next within the sentence frame, and then both repeated. The consultant was asked to speak in a neutral declarative tone. Whenever the tone changed, she was asked to repeat.

Garellek & White (2015) uses seven different acoustic measures to determine the phonetic correlates of Tongan stress. These include fundamental frequency (f0), a.k.a. pitch, duration, root mean squared (RMS) energy, i.e., intensity, first formant (F1), second formant (F2), H1*-H2* (a correlate of voice quality), and cepstral peak prominence (CPP). The first five measures are employed in this study to investigate Cebuano stress. Apart from pitch, duration, and intensity, the common "stress" variables, one would also expect vowel quality, specifically F1 and F2 values, to vary with stress. When a vowel is stressed, it is usually pronounced more clearly and more distinct from other vowels than when it is not. In other words, the tongue would reach closer to the target place and as a result it is more peripheral. Take /u/, a high back vowel, for instance. When it is stressed, it is usually higher, resulting in a smaller F1 value, and more back, resulting in a smaller F2 value. In terms of /a/, a low central vowel, it is likely to be lower when stressed. In addition, since it is neither front nor back, its backness is not likely to differ by a great degree whether it is stressed or not. Hence one would expect a stressed /a/ to have greater F1 value but not a different F2 value from that of an unstressed /a/.

The recordings were segmented and annotated using Praat (Boersma & Weenink). Both vowels in each repetition of the target word were segmented out such that: the starting point is marked to be the 0 crossing at the beginning of the first regular periodic cycle of the waveform, and the end point to be the point where the voice bar and the first formant bar ends in the spectrogram, as exemplified in Figure 1. Then Praat scripts were used to obtain the measurements at the midpoint.

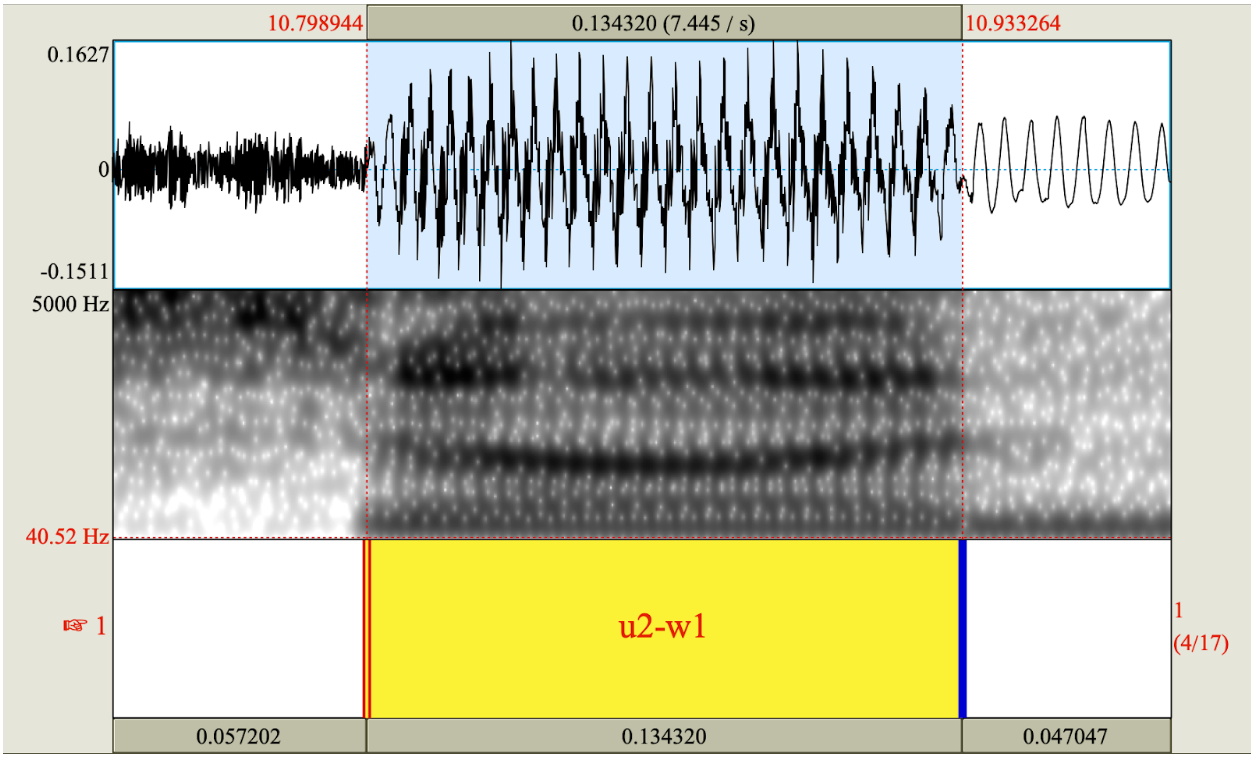

Figure 1. An example of segmentation: the starting point at the 0 crossing at the beginning of the first regular periodic cycle of the waveform, and the end point at the point where the voice bar and the first formant bar ends in the spectrogram.

3.3 Results

The measurements were then analyzed in R. For each of the five measures, a box-and-whisker plot was graphed using the *bwplot()* function from the *lattice* library. In addition, linear models were built for each of the measures using the *glm*() function, with the two interacting binary variables, stress (stressed vs. stressless) and position in the word (penult vs. ultima), as the independent variables. The only exception is the one for intensity, where there is an additional independent variable, F1. Intensity is known to correlate with vowel height, i.e., F1 (Geumann 2001), and it will be shown later that the degree of variation of F1 values differ for different vowels (see §3.3.3). Hence F1 is also included as an independent variable in the Intensity model. For duration, f0, and intensity, one model was built to include /a/ words and /u/ words. For measurements of vowel quality, i.e., F1 and F2, two models were used, one for /a/ words and the other for /u/ words, for reasons mentioned in §3.2.3.

Six of the seven linear models show stress to be significant with a p-value of 0.001. The only exception is the one modeling on F2 values for /a/ words. Although stress is significant in the variation of most of the phonetic correlates investigated here, it can be seen that duration and vowel quality (F1, F2 values) are the most significant acoustic cues to stress in Cebuano. The extent to which F1 and F2 values vary with stress depends on the vowels that are involved, but combining the two, they change most significantly with stress (see §3.3.3 and §3.3.4 below). Among the three other variables, by comparing the coefficients of stress, it can be seen that duration (-54.235) shows much greater variation than f0 (-9.231) and intensity (-2.5656). It may be noteworthy from the boxplots that, for all the variables, the contrasts are only observed in the penults but not the final syllables.

The findings here, assuming general accuracy, show that Cebuano manifests stress in a similar way as Tagalog, one of its close relatives. Recall from §3.1 that Klimenko et al. (2010) investigates the phonetic cues of stress in Tagalog by looking at duration, f0, and intensity, and concludes that, among these three correlates, duration contributes most to the perception of stress, and f0 comes after. This same conclusion can be drawn from the results presented here.

3.3.1 Duration

Among the five phonetic correlates measured here, duration seems to be the most reliable cue for stress in Cebuano. The boxplots in Figure 2 clearly illustrate that stressed penults are longer than unstressed penults, though stressed and unstressed ultimas are of similar duration. This is particularly notable in the boxplots for /a/ words, for which the whiskers of the stressed and stressless penults barely overlap with each other. The model summary in Table 2 shows that, on average, stressed syllables are 54.235 milliseconds longer than their unstressed counterparts.

Recall Wolff's claim that vowels in the open stressed penults are underlyingly long. Shryock (1993) also posits phonemic vowel length contrast in the analysis of the stress pattern. Indeed, duration may not simply be a manifestation of stress, but also the cause of stress.

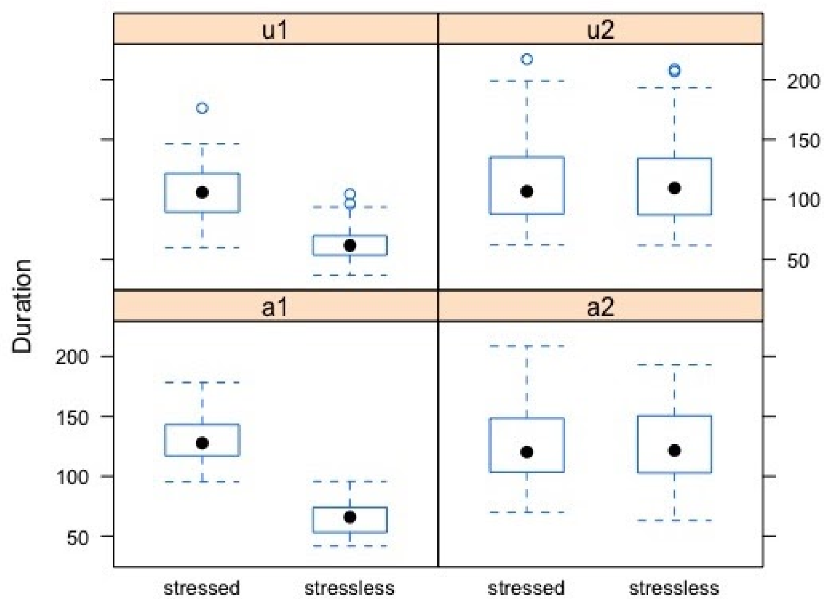

Figure 2. Box-and-whisker plot of duration by the factor variables stress, vowel, and position within word

*glm(formula = Duration ~ Stress * Syllable, data = df.cvcvc.au)*

Deviance Residuals:

Min	1Q	Median	3Q	Max
-59.215	-17.897	-2.755	15.552	98.469

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	117.842	2.227	52.911	<2e-16	***
Stress=stressless	-54.235	3.150	-17.219	<2e-16	***
Syllable=ultima	0.769	3.150	0.244	0.807	
Stress=stressless:Syllable =ultima	56.522	4.454	12.689	<2e-16	***

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*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

(Dispersion parameter for gaussian family taken to be 753.9581)
Null deviance: 807434 on 607 degrees of freedom
Residual deviance: 455391 on 604 degrees of freedom
AIC: 5759.6
Number of Fisher Scoring iterations: 2

Table 2. Model summary statistics report - Duration

3.3.2 f0

The box-and-whisker plots in Figure 3 seem to indicate that f0, or pitch, does not vary significantly with stress, since the whiskers of the stressed syllables and their unstressed counterparts overlap with each other by a great degree. However, the more precise linear model, as summarized in Table 3, shows that stress is significant in determining f0 values, although the degree to which f0 varies with stress is small (on average, stressed syllables are 9.231 Hz higher than their unstressed counterparts).

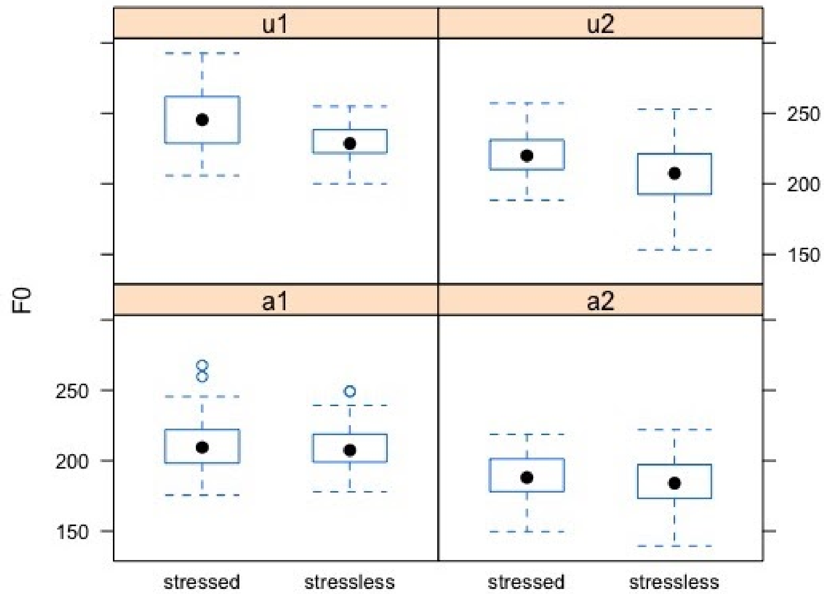

Figure 3. Box-and-whisker plot of F0 by the factor variables stress, vowel, and position within word

*glm(formula = F0 ~ Stress * Syllable, data = df.cvcvc.au)*

Deviance Residuals:

Min	*1Q*	*Median*	*3Q*	*Max*
-56.24	*-16.52*	*-0.15*	*15.23*	*63.23*

Coefficients:

	Estimate	*Std. Error*	*t value*	*Pr(>|t|)*	
(Intercept)	*229.432*	*1.810*	*126.784*	*< 2e-16*	***
Stress=stressless	*-9.231*	*2.559*	*-3.607*	*0.000335*	***
Syllable=ultima	*-23.549*	*2.559*	*-9.202*	*< 2e-16*	***
Stress=stressless:Syllable =ultima	*-1.006*	*3.619*	*-0.278*	*0.781215*	

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*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

(Dispersion parameter for gaussian family taken to be 497.7659)
Null deviance: 403018 on 607 degrees of freedom
Residual deviance: 300651 on 604 degrees of freedom
AIC: 5507.2
Number of Fisher Scoring iterations: 2

Table 3. Model summary statistics report - f0

3.3.3 F1

The measurement of F1 and F2 values together show that vowels in Cebuano are significantly more centralized when they are unstressed. This result seems to favor the theory of a three-vowel system as opposed to that of a five-vowel system. A vowel system with few vowels allow more space for each vowel to vary without being confused as some other vowels. Indeed, the /e, o/ in the five-vowel system may be just the unstressed version of /i, u/ respectively.

The box-and-whisker plots in Figure 4 seem to indicate that the degree of variation of the first formant (F1) values depends on the vowel. The F1 value of the low central vowel /a/ in the penult changes notably depending on whether the syllable is stressed or not, while that of the high back vowel /u/ does not. In other words, the low vowel /a/ in the penult is notably less low, i.e., more centralized, when they are unstressed.

The linear model summarized in Table 4 confirms part of the observation. Table 4 shows that, for /a/ words, the stressed syllables have a F1 value 276.71 Hz greater than their unstressed counterparts. This verifies the observation from the boxplots that the low vowel /a/ in the penult is significantly less low when unstressed.

What is not obvious in the boxplots is that the high back vowel /u/ is also less low when unstressed, as shown in Table 5. For /u/ words, the stressed penults have a F1 value 73.93 Hz greater than their unstressed counterparts, which is also significant with a p-value of 0.001. This raising is to a much smaller degree compared with that of /a/, but even a small degree of raising is not expected for /u/, since /u/ is already a high vowel. The average F1 value for all instances of /u/ is 497.44 Hz. This indicates that the vowels are in fact produced as mid vowels instead of high vowels. Recall from §2 that Endriga (2010) claims the phoneme to be the high, back, lax vowel /ʊ/ that varies freely with the mid, back vowel [ɔ]. One possible explanation for the raising of /u/, thus, is that all non-high vowels are raised when unstressed due to a lack of jaw-lowering, and /u/ is produced so much lower than a typical high vowel that it centralizes in the same way as a mid vowel.

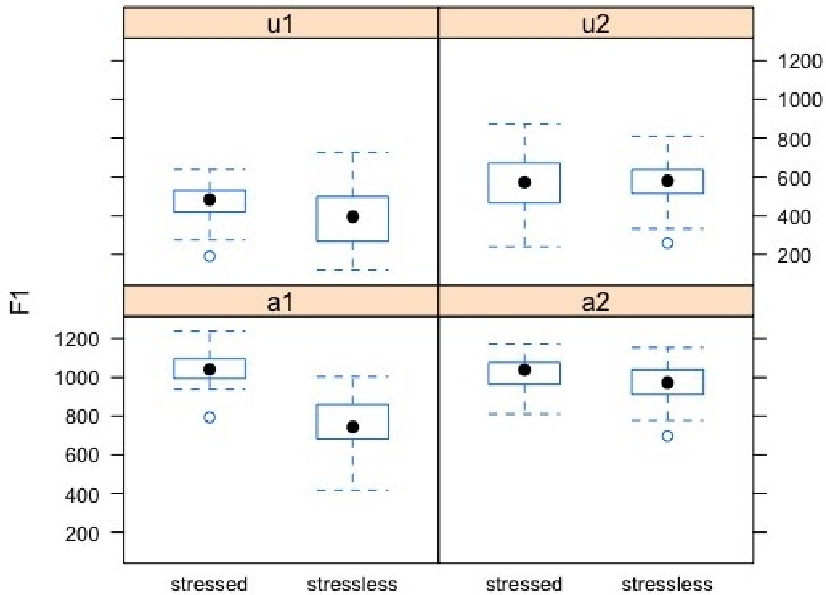

Figure 4. Box-and-whisker plot of F1 by the factor variables stress, vowel, and position within word

*glm(formula = F1 ~ Stress * Vowel, data = df.cvcvc.a)*

Deviance Residuals:

Min	*1Q*	*Median*	*3Q*	*Max*
-348.12	*-62.48*	*-0.55*	*67.41*	*237.82*

Coefficients:

	Estimate	*Std. Error*	*t value*	*Pr(>|t|)*	
(Intercept)	*1042.05*	*11.43*	*91.150*	*<2e-16*	***
Stress=stressless	*-276.71*	*16.17*	*-17.115*	*<2e-16*	***
Vowel=ultima	*-20.04*	*16.17*	*-1.240*	*0.216*	
Stress=stressless:Vowel =ultima	*227.53*	*22.86*	*9.951*	*<2e-16*	***

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*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

(Dispersion parameter for gaussian family taken to be 9410.138)

Null deviance: 6148469 on 287 degrees of freedom

Residual deviance: 2672479 on 284 degrees of freedom

AIC: 3458.3

Number of Fisher Scoring iterations: 2

Table 4. Model summary statistics report - F1, /a/ words

*glm(formula = F1 ~ Stress * Vowel, data = df.cvcvc.u.rev)*

Deviance Residuals:

Min	*1Q*	*Median*	*3Q*	*Max*
-314.13	*-76.00*	*11.04*	*74.59*	*328.31*

Coefficients:

	Estimate	*Std. Error*	*t value*	*Pr(>|t|)*	
(Intercept)	*470.61*	*13.33*	*35.307*	*< 2e-16*	*****
Stress=stressless	*-73.97*	*18.85*	*-3.924*	*0.000107*	*****
Vowel=ultima	*81.73*	*18.85*	*4.336*	*1.96e-05*	*****
Stress=stressless:Vowel =ultima	*91.80*	*26.66*	*3.444*	*0.000651*	*****

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*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

(Dispersion parameter for gaussian family taken to be 25506.73)
Null deviance: 6026164 on 319 degrees of freedom
Residual deviance: 4491392 on 316 degrees of freedom
AIC: 3973.9
Number of Fisher Scoring iterations: 2

Table 5.   Model summary statistics report - F1, /u/ words

3.3.4   F2

The box-and-whisker plots in Figure 5 indicate that the degree of variation of F2 values also depends on the vowel. The F2 value of the high back vowel /u/ in the penult changes notably depending on whether the syllable is stressed or not, while that of the low central vowel /a/ does not. That is to say, the back vowel /u/ in the penult is less back, i.e., more centralized, when it is unstressed.

Table 6 and 7 corroborates the observation. Table 6 shows that, for /a/ words, the stressed syllables have a F2 value 78.73 Hz smaller than their unstressed counterparts, which is relatively large compared to the difference for F1 values in /u/ words. However, the difference is insignificant with a p-value of 0.001. As shown in Table 7, for /u/ words, the stressed syllables have a F2 value 275.0 Hz smaller than their unstressed counterparts, which is significant with a p-value of 0.001.

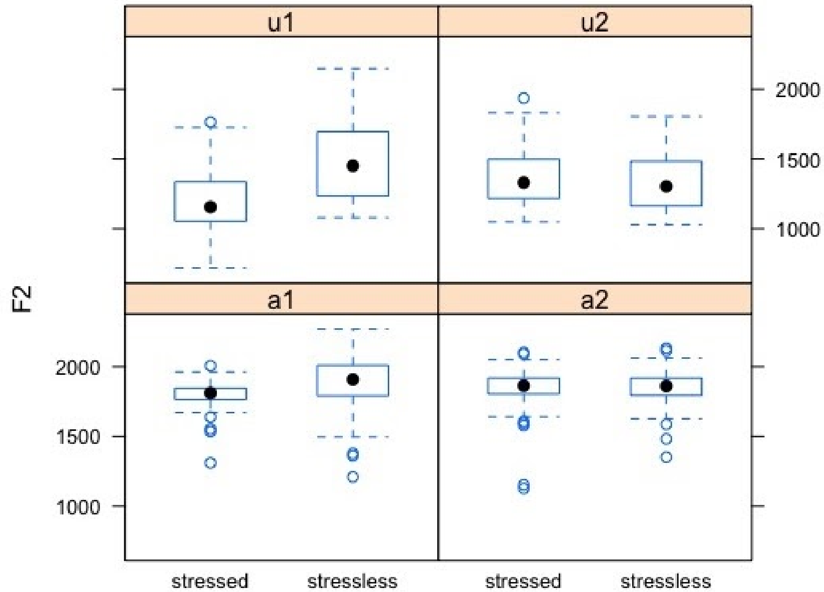

Figure 5. Box-and-whisker plot of F2 by the factor variables stress, vowel, and position within word

*glm(formula = F2 ~ Stress * Vowel, data = df.cvcvc.a)*

Deviance Residuals:

Min	*1Q*	*Median*	*3Q*	*Max*
-713.51	*-45.78*	*18.28*	*74.00*	*395.04*

Coefficients:

	Estimate	*Std. Error*	*t value*	*Pr(>|t|)*	
(Intercept)	*1795.31*	*17.66*	*101.661*	*< 2e-16*	***
Stress=stressless	*78.73*	*24.97*	*3.152*	*0.00179*	**
Vowel=ultima	*44.08*	*24.97*	*1.765*	*0.07862*	.
Stress=stressless:Vowel =ultima	*-67.35*	*35.32*	*-1.907*	*0.05754*	.

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*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

(Dispersion parameter for gaussian family taken to be 22454.58)
Null deviance: 6612690 on 287 degrees of freedom
Residual deviance: 6377100 on 284 degrees of freedom
AIC: 3708.8
Number of Fisher Scoring iterations: 2

Table 6. Model summary statistics report - F2, /a/ words

*glm(formula = F2 ~ Stress * Vowel, data = df.cvcvc.u.rev)*					
Deviance Residuals:					
Min	*1Q*	*Median*	*3Q*	*Max*	
-490.51	*-166.17*	*-35.39*	*151.96*	*664.62*	
Coefficients:					
	Estimate	*Std. Error*	*t value*	*Pr(>|t|)*	
(Intercept)	*1208.80*	*24.69*	*48.959*	*< 2e-16*	***
Stress=stressless	*275.00*	*34.92*	*7.876*	*5.49e-14*	***
Vowel=ultima	*139.58*	*34.92*	*3.998*	*7.97e-05*	***
Stress=stressless:Vowel =ultima	*-290.12*	*49.38*	*-5.875*	*1.07e-08*	***
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*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*					
(Dispersion parameter for gaussian family taken to be 91316.67)					
Null deviance:	*18446944 on 319 degrees of freedom*				
Residual deviance:	*15410453 on 316 degrees of freedom*				
AIC:4368.4					
Number of Fisher Scoring iterations: 2					

Table 7. Model summary statistics report - F2, /u/ words

3.3.5 Intensity

As mentioned above, the linear model for intensity includes one extra independent variable, F1, for the reasons that intensity interacts with F1 and the extent to which F1 varies with stress depends on which vowel it is. In the box-and-whisker plots in Figure 6, the whiskers of the stressed syllables and their unstressed counterparts mostly overlap with each other, suggesting that intensity does not vary notably with stress. However, the linear model as summarized in Table 8 shows that, on average, stressed syllables are 2.136 dB greater than their unstressed counterparts, and such difference is significant, despite being small.

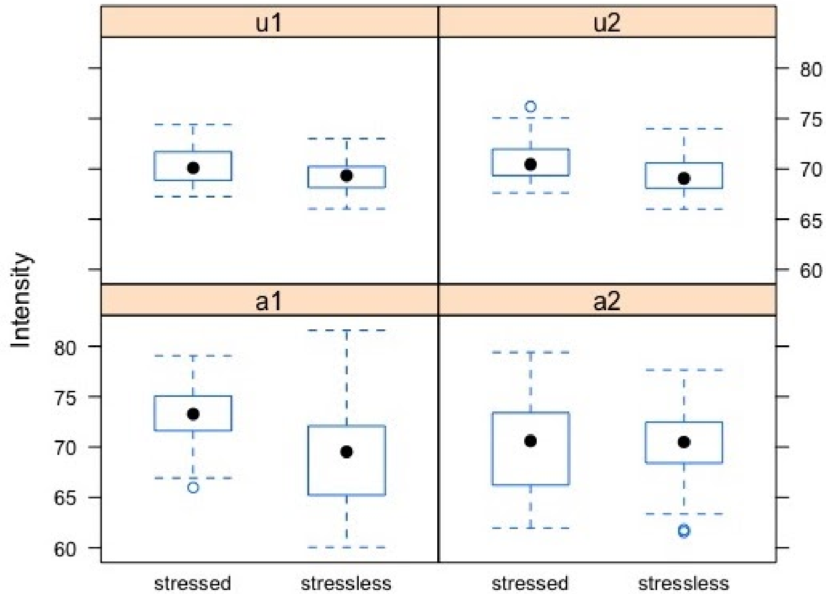

Figure 6. Box-and-whisker plot of intensity by the factor variables stress, vowel, and position within word

*glm(formula = Intensity ~ Stress * Syllable + F1, data = df.cvcvc.au.rev)*

Deviance Residuals:

Min	*1Q*	*Median*	*3Q*	*Max*
-9.263	*-1.512*	*0.154*	*1.913*	*11.929*

Coefficients:

	Estimate	*Std. Error*	*t value*	*Pr(>|t|)*	
(Intercept)	*69.8134997*	*0.4311142*	*161.937*	*< 2e-16*	***
Stress=stressless	*-2.1359659*	*0.3540761*	*-6.033*	*2.82e-09*	***
Syllable=ultima	*-1.3814289*	*0.3449278*	*-4.005*	*6.98e-05*	***
F1	*0.0025271*	*0.0004798*	*5.267*	*1.93e-07*	***
Stress=stressless:Syllable=ultima	*1.6139506*	*0.4929930*	*3.274*	*0.00112*	**

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*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

(Dispersion parameter for gaussian family taken to be 9.421924)

Null deviance: 6227.7 on 607 degrees of freedom

Residual deviance: 5440.5 on 604 degrees of freedom

AIC: 3069.8

Number of Fisher Scoring iterations: 2

Table 8. Model summary statistics report - Intensity

4 Phonological stress pattern

The main focus of this analysis is the phonological pattern of primary stress in Cebuano. The pattern is investigated here by referring to the word list used in Shryock (1993). Words are mainly selected from (1a)-(6f) in Shryock, which deals with primary stress. Those words that are left out either are unfamiliar to the consultant, do not fit the sentence frame used (see §3.2 above), or contain suffixes. Since suffixation causes stress shift in Cebuano, it should be dealt with separately. For categories where no words from Shryock are suitable, substitutes with the same syllable structure and stress assignment are extracted either from other parts of the paper or from Wolff (1972) and used. The words chosen are elicited from the speaker by the author, who makes judgments of the stress according to the findings in §3. The elicitation is also recorded using Audacity for later reference.

The words elicited are then categorized to illustrate the stress pattern. The categorization utilized here differs from that in Shryock. Shryock categorizes the words according to the weight of the syllables and the stress assignment. For instance, the first category in Shryock is ˈHL, standing for words with heavy penult, light final syllable, and penultimate stress. However, since claims about the weight of the syllables would be part of the analysis, they are avoided in the categorization adopted here in order to keep it purely descriptive. The words are instead categorized based on the structure of each syllable, with CV standing for an open syllable, and CVC for a closed one. This categorization using both syllable structure and stress assignment in fact is equivalent with Shryock's categorization.

Among the words being elicited, a certain number of them have a different stress assignment from Shryock. A few others differ in the presence of glottal stop or syllabification. The data mostly support Shryock's description of the stress pattern. To analyze the pattern, Shryock first posits contrastive vowel length in order to make sense of the different stress assignments in words that seem to have the same syllable structure. Shryock then claims that stress in Cebuano is weight-sensitive, iambic, extrametrical, and assigned from right to left, with certain loanwords being the exceptions. The analysis of the stress pattern adopted here is at variance with the one in Shryock in two~~several~~ aspects. The first difference is that analysis in Shryock is rule-based, while that performed here is in OT and utilizes constraints. Using constraints simplifies the analysis as the rule-based analysis requires feet and stress to be deleted and reassigned. Secondly, binarity of feet is required here, i.e., no degenerate feet are allowed in the surface form.

In §4.1, the recategorization of the words in Shryock is illustrated and the phonological pattern is described. In §4.2, an analysis of the stress pattern is performed using classic OT.

4.1 Pattern

(3)-(9) list the words selected from Shryock, with slight modification, and elicited for stress. The syllabification is determined by asking the speaker to pronounce the word syllable by syllable. See appendix for definitions of the abbreviations in the glossing. To be appropriate to the frame sentence, the prefix /pag-/ is always substituted with /mag-/, another prefix with the same syllable structure, i.e. CVC. In the surface form, every instance of substitution is marked by italicization, and words and roots that are loans are underlined. When elicitation differs from Shryock, the differing part, whether it is IPA or stress assignment, is in bold. The categorization does not take the number of onset consonants into consideration, as the onset does not seem to be related to the issue in concern. That is to say, words of the structures V.CV, CV.CV and CCV.CV will fall into the same category. Hence in the notation for the category (3a), "CVC.CV", for instance, CVC in fact stands for C_0VC and CV stands for C_0V.

(3) Words with closed penult and open final syllable: penultimate stress

a. CVC.CV			
	[ˈsul.ti]	'say'	penultimate
	[ˈʔad.tu]	'go'	penultimate
	[ˈlib.ru]	'book'	penultimate
b. CV.CVC.CV			
	[hi.ˈgug.ma]	'love'	penultimate
	[ma.ˈʔis.tru]	'teacher'	penultimate
c. CVC.CVC.CV			
	[*mag*.-ˈsim.ba]	'ADF-attend church'	penultimate
	[mag.-ˈsul.ti]	'ADF-say'	penultimate
d. CV.CV.CVC.CV			
	[ma.ka.-ˈʔad.tu]	'APoF-go'	penultimate
	[du.ku.ˈmin.tu]	'document'	penultimate
e. CVC.CV.CVC.CV			
	[tar.ta.ˈnil.ja]	'carriage'	penultimate
	[tis.ta.ˈmin.tu]	'testament'	penultimate
f. CV.CVC.CVC.CV			
	[gi.-paŋ.-ˈkan.ta]	'DPP-instr-sing'	penultimate
	[gi.-ʔis.ˈtur.ja]	'DPP-tell a story'	penultimate
g. CVC.CVC.CVC.CV			
	[mag.-ʔis.ˈtur.ja]	'ADF-tell a story'	penultimate
	[*mag*.-sin.ˈsil.ju]	'ADF-make small change'	penultimate
	[ris.pun.ˈsab.li]	'responsible'	penultimate

(3) lists words elicited that have a closed penult and an open final syllable. As shown, all words with a closed penult and an open final syllable show penultimate stress, regardless of the number of syllables, the structure of the other syllables, whether there are prefixes attached, and whether the word is native or loan.

Notice that all the loanwords in (3), which are all from Spanish, also retain the stress from their Spanish counterparts.

(4) Words with closed penult and closed final syllable: penultimate or final stress

a. CVC.CVC			
	[ˈtam.ʔis]	'sweet'	penultimate
	[ˈput.haw]	'iron'	penultimate
	[ˈlad.lad]	'bleach'	penultimate

(more on the next page)

(4) Words with closed penult and closed final syllable: penultimate or final stress *(continued)*

b. CV.CVC.CVC

[gi.-ˈlad.lad]	‘DPP-bleach’	penultimate
[mu.-man.ˈdaːr]	‘APF-command’	final
[gi.-ˈtud.luʔ]	‘DPP-teach’	penultimate

c. CVC.CVC.CVC

[*mag*.-ˈsum.bag]	‘ADF-hit’	penultimate
[mag.-tus.ˈtaːr]	‘ADF-toast’	final

d. CV.CV.CVC.CVC

[ma.ka.-ˈtan.dug]	‘APoF-touch’	penultimate
[gi.-pa.-ˈtud.luʔ]	‘DPP-cau-teach’	penultimate

e. CVC.CV.CVC.CVC

[mag.ba.ˈlan.taj]	‘watchman’	penultimate
[*mag*.-pa.-duk.ˈtuːr]	‘ADF-cau-doctor’	final

f. CV.CVC.CVC.CVC

[ma.kig.-ˈsum.bag]	‘APoFP-hit’	penultimate
[di.mun.stras.ˈjuːn]	‘demonstration’	final
[mu.-sin.tin.ˈjaːl]	‘APF-be a century’	final

(4) lists words elicited that have a closed penult and a closed final syllable. In most cases, stress falls on the penult, again, regardless of the structure of other syllables. The exceptions receive final stress. Notice that all exceptions are either loanwords or have a root that is borrowed. These loans also all happen to be from Spanish. Furthermore, they all retain the stress from their Spanish counterparts.

The root /tudluʔ/, which means ‘teach’, is found to have a final glottal stop, which is absent in Shryock. Hence it should belong to the category CVC.CVC rather than CVC.CV. The stress assignment, though, is found to be in accordance with Shryock—both [gi.ˈtud.luʔ] in (4b) and [gi.pa.ˈtud.luʔ] in (4d) are elicited to have penultimate stress. [gi.ˈlad.lad] is not from Shryock.

(5) Words with open penult and open final syllable, and penultimate stress (analyzed by Shryock and Wolff as having a long penultimate vowel)

a. CV.CV

[ˈŋiː.si]	‘grin’	penultimate

b. CV.CV.CV

[ʔa.ˈbaː.ga]	‘shoulder’	penultimate
[ʔa.ˈmiː.go]	‘friend’	penultimate
[ʔi.-ˈtaː.pa]	‘IPF-smoke meat’	**penultimate**

c. CVC.CV.CV

[nag.-ˈgiː.ra]	‘ADP-wage war’	penultimate
[mag.-ˈtaː.pa]	‘ADF-smoke meat’	**penultimate**

d. CV.CV.CV.CV

[gi.-tra.ˈbaː.hu]	‘DPP-work’	penultimate

(more on the next page)

(5) Words with open penult and open final syllable, and penultimate stress *(continued)*

e. CVC.CV.CV.CV

[mag.-tra.ˈbaː.hu]	‘ADF-work’	penultimate
[*mag.*-pa.-ˈʔaː.gi]	‘ADF-cau-revenge’	penultimate

f. CV.CVC.CV.CV

[ma.kig.-ˈgiː.ra]	‘APoFP-wage war’	penultimate

g. CVC.CVC.CV.CV

[*mag.-lam.ˈpaː.su*]	‘ADF-polish’	penultimate

(5) lists words elicited that have an open penult and an open final syllable and that exhibit penultimate stress. Words with the root /tapa/, [ʔi.ˈta.pa] in (5b) and [mag.ˈta.pa] in (5c), are elicited to have penultimate stress, contrary to Shryock, which claims them to have final stress.

(6) below lists words elicited that have an open penult and an open final syllable and that exhibit final stress. [da.ˈru] and [ma.ˈla] in (6a), and [ma.ka.da.ˈru] in (6d), are elicited to have final stress, contrary to Shryock, which claims them to have penultimate stress. While Shryock represents the word for ‘school fees’ in (6d) as “mat.rì.ku.lá”, [t] is found to be part of the onset of the second syllable instead of the coda of the first, and hence the word would now belong to the category CV.CV.CV.CV rather than CVC.CV.CV.CV.

(6) Words with open penult and open final syllable, and final stress (analyzed by Shryock and Wolff as having a short penult vowel)

a. CV.CV

[ba.ˈtu]	‘rock’	final
[ma.ˈta]	‘eye’	final
[da.ˈru]	‘plow’	**final**
[ma.ˈla]	‘dry’	**final**

b. CV.CV.CV

[ka.ʔu.ˈsa]	‘once’	final
[gi.-ba.ˈŋa]	‘DPP-bored’	final

c. CVC.CV.CV

[*mag.*-da.ˈla]	‘ADF-bring’	final

d. CV.CV.CV.CV

[ʔi.ka.du.ˈha]	‘second’	final
[ma.ka.-ba.ˈŋa]	‘APoF-bored’	final
[**ma.tri**.ku.ˈla]	‘school fees’	final
[ma.ka.-da.ˈru]	‘APoF-plow’	**final**

e. CVC.CV.CV.CV

[mag.-pa.-wa.ˈla]	‘ADF-cau-go to the left’	final

f. CV.CVC.CV.CV

[ma.har.li.ˈka]	‘native nobles in pre-Hispanic times’	final

(7) Words with open penult and closed final syllable, and penultimate stress

a. CV.CVC

[ˈŋaː.lan]	‘name’	penultimate

b. CV.CV.CVC

[gi.-ˈhaː.tag]	‘DPP-give’	penultimate
[ta.ˈmaː.tis]	‘tomato’	penultimate

c. CVC.CV.CVC

[*mag.*-ˈhaː.tag]	‘ADF-give’	penultimate

d. CV.CV.CV.CVC

[ʔa.li.ˈmaː.tuk]	‘leech’	penultimate

e. CVC.CV.CV.CVC

[*mag.-pa.-ˈhaː.tag*]	‘ADF-cau-give’	penultimate

f. CV.CVC.CV.CVC

[*ma.kig.-ˈhaː.tag*]	‘APoFP-give’	penultimate

g. CVC.CVC.CV.CVC

[*tag.-man.ˈsaː.nas*][3]	‘?-apple’	penultimate

(7) lists words elicited that have an open penult and a closed final syllable and that exhibit penultimate stress.

(8) Words with open penult and closed final syllable, and final stress

a. CV.CVC

[pa.ˈlit]	‘buy’	final
[wa.ˈlaʔ]	‘not, nothing’	final
[ba.ˈlaj]	‘house’	final
[da.ˈkoʔ]	‘large’	final

b. CV.CV.CVC

[pa.ri.ˈsan]	‘partner’	final
[bu.li.ˈŋan]	‘bowling alley’	final

c. CVC.CV.CVC

[nag.-la.ˈka*w*]	‘ADP-walk’	final

d. CV.CV.CV.CVC

[gi.-pa.-su.ˈlud]	‘DPP-cau-follow’	final
[ma.ka.-sa.ˈkaj]	‘APoF-ride’	final

e. CVC.CV.CV.CVC

[mag.-pa.-hu.ˈwam]	‘ADF-cau-borrow’	final
[pub.li.si.ˈdad]	‘publicity’	final
[mag.ka-sa.ˈkaj]	‘ADFS-ride’	**final**

f. CV.CVC.CV.CVC

[*ma.kig.-pa.ˈlit*]	‘APoFP-buy’	final

g. CVC.CVC.CV.CVC

[*mag.-al.pi.ˈlir*]	‘ADF-use a safety pin’	final
[*mag.-ad.mi.ˈrar*]	‘ADF-admire’	final

[3] It is not clear what function the prefix /tag-/ has, but the whole word means ‘someone fond of apples’.

(8) lists words elicited that have an open penult and a closed ultima and that exhibit final stress. The word [nag.la.ˈkaw] in (8c) is elicited as an alternative to "nag=la.kát" in Shryock.

Similar to /tudluʔ/ from above, the word [da.ˈkoʔ], which means 'large', is found to have a final glottal stop, which is absent in Shryock. Hence it should belong to the category CV.CVC rather than CV.CV. The stress assignment, again, is found to agree with Shryock.

(9) Words with open penult and open final syllable, and antepenultimate stress

a. CV.CV.CV.CV

[pu.ˈliː.ti.ka]	'politics'	antepenultimate
[pi.ˈliː.ku.la]	'movie'	antepenultimate
[gwa.ˈjaː.ba.nu]	'guava'	antepenultimate

b. CVC.CV.CV.CV

[mag.-ˈdaː-da.ru]	'farmer'	antepenultimate
[maŋ.-ˈhaː-ha.lal]	'lawyer'	antepenultimate

(9) lists words elicited that have an open penult and an open final syllable and that exhibit antepenultimate stress. (The data in Shryock demonstrating that final stress can be optionally retracted to the antepenult are not shown here, as the speaker does not seem to perform this alternating stress assignment.[4]) Notice that antepenultimate stress is only possible when both the penult and the final syllable are open. (9a) shows that some loanwords from Spanish may have antepenultimate stress in order to retain the stress in the Spanish counterpart. The second case of antepenultimate stress is the "nominal agentives formed by reduplication of the initial CV of a stem bearing final stress and affixation of the prefix /mag-/ or /maŋ-/" (Shryock 1993:112), as shown in (9b).

In summary, when the penult is closed, it always receives primary stress, as seen in (3)-(4), with the exceptions being words that either are loanwords or have loanwords as the base. However, when the penult is open, the primary stress may fall on the final syllable, the penult, or even the antepenult. This does not seem to depend on the weight of the final syllable, which most likely receives the stress if it does not fall on the penult, as shown in (5)-(8). For instance, in (5a) and (7a), stress falls on the open penult regardless of whether the final syllable is open or closed. Antepenultimate stress is only observed in two situations: either the word is a Spanish loan and the syllable that is stressed in the Spanish counterpart retains the stress, or the word is formed by partial reduplication, as in (9). Furthermore, loanwords from Spanish retain the stress in their Spanish counterparts. Suffixed loans seem to be exceptions to this pattern of retainment, see later section for further details.

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[4] Shryock (1993) claims that a primary stress on the ultima of a word that is four syllable long "may be optionally retracted onto the antepenultimate syllable if the antepenult bears a secondary stress", with the example:

ma.kà = sa.káy ~ ma.ká = sa.kày 'APoF-ride'

In addition, it is claimed that retraction of final primary stress occurs more frequently in words with five syllables, for instance:

gì = na.pì = pa.lít ~ gì = na.pá = pa.lìt 'DDP-cau-buy'

4.1.1 Suffixation and stress

Shryock provides data to show that suffixation causes a shift of primary stress in Cebuano. Suffixed words that are elicited for stress are listed in (10).

(10) Suffixed words

[ʔis.tur.ˈja:.-ha]	**‘tell a story-IMP?’**	penultimate
[ga.ra.ˈhi:.-ʔa]	**‘park-IMP?’**	penultimate
[sum.ba.ˈg-an]	‘hit-LPF’	**final**
[gi.-tud.ˈlu:.ʔ-an]	‘DPP-teach-dir’	penultimate
[mar.tsa.ˈ-ha:.nan]	‘march-lot’	penultimate
[mag.-hag.ˈk-a:.nan]	‘ADF-kiss-LPF’	**penultimate**

The data elicited is at variance with Shryock to a great extent. For words with the suffix [-a], the meaning elicited differ from the glossing in Shryock. Shryock claims [ʔis.tur.ˈja.-ha] to mean ‘this story’, while the meaning elicited is “Tell a story!” Similarly, [ga.ra.ˈhi.-ʔa] is elicited to mean “Park!” instead of ‘this garage’, as glossed in Shryock. (As noted in Wolff 1972, when a suffix is attached onto a root ending in a vowel, /h/ or /ʔ/ is added before the suffix.) The consultant rejects the possibility of an alternative meaning when prompted. Hence it cannot be sure if the suffix [-a] in the elicited word is the same as the one that is presented in Shryock. In addition, [sum.ba.ˈg-an] is elicited to have final stress instead of penultimate stress, which deviates from Shryock. Shryock claims that when an inflectional suffix is attached, the stress of words with penultimate stress would shift one syllable to its right. Since [ˈsum.bag] has penultimate stress, the word [sum.ba.ˈg-an] would be an counterexample of this claim. Furthermore, the word [mag.-hag.ˈk-a.nan] s elicited to have penultimate stress instead of final stress, which also differs from Shryock.

With the data at hand, the nature of the suffixes cannot be determined, without which a description of the stress pattern in suffixed words would not be accurate. However, one observation can be made. Notice that the word [ʔis.tur.ˈja.ha], unlike [gi.ʔis.ˈtur.ja] in (3f), does not retain the stress from its Spanish counterpart. The same can be observed in [ga.ra.ˈhi.ʔa] in (10), whose Spanish counterpart has stress on the syllable [ra]. These two words differ from those words containing loans and retaining the stress in the original language in that they have the suffix /-a/ attached to them.

4.2 An analysis of Cebuano stress in OT

As observed in §4.1, stress cannot be easily determined if a word has an open penult. Words with the exact same pattern, CV.CV for instance, may have different ways of stress assignment. The reasonable explanation is that the open penults that receive the primary stress are heavy and those that do not are light. Hence it deems necessary to posit contrastive vowel length, and assume that the vowels in the stressed open penults are underlyingly long.

The constraints employed in the analysis are listed below.

(11) ALIGN(σ́, R, FT, R) (Henceforth:IAMB)
For every foot that is not right-headed, assign a violation.

(12) ALIGN(FT, R, PRWD, R)

For every syllable that comes between the right edge of a foot and the right edge of a word, assign a violation.

(13) FTBIN-μ

For every foot that does not contain exactly two morae, assign a violation.

The constraint FTBIN-μ penalizes feet that are not binary under the moraic analysis. In Cebuano, CVC and CVː are considered as heavy and CV as light.

(14) PARSE-σ

For every syllable that is not part of a foot, assign a violation.

(15) CULMINATIVITY

For every prosodic word that has more than one primary stress, assign a violation.

(16) WEIGHT-TO-STRESS-PRINCIPLE -CVː (Henceforth: WSP-CVː)

For every syllable with a long vowel that is not stressed, assign a violation.

The canonical WSP constraint requires heavy syllables to be stressed. In Cebuano, both CVː and CVC are heavy. It has been shown through cross-linguistic survey that syllable weight conform to a hierarchy such that: CVː > CV[+son] > CV[–son] > CV (Gordon 2004). Hence it makes sense to split the WSP constraint into more specific constraints such as WSP-CVː, WSP-CVC, WSP-CV, etc. Indeed, with the data given, it seems that syllables of the shape CVː are heavier than CVC syllables in Cebuano. The evidence, which will be shown later, is that an unstressed CVː syllable is worse than an unstressed CVC syllable, despite both being heavy. Hence the constraint WSP-CVː is needed. WSP-CVC and WSP-CV are not listed here, since they are ranked so low that they do not contribute any crucial violations. With the constraint FTBIN-μ, which requires heavy syllables to be its own foot and hence receive stress, the general WSP is not necessary as well.

(17) NONFINALITY-C

For every final consonant that bears a mora, assign a violation.

(18) IDENT(stress)-LOAN-R

For every loanword in the surface form that is aligned with the right edge of the prosodic word and has a stressed syllable different from the underlying form, assign a violation.

As seen above, stress in loans is only retained when no suffix is attached. As it is not clear exactly what about the suffixes is forbidding the loanword to retain stress, the constraint is defined as above so that the analysis is also compatible with the limited data of suffixation.

(19) *Vː-FINAL

For every final vowel that is long, assign a violation.

(20) IDENT(long)

For every vowel in the surface form that has a different feature value for [long] from the underlying form, assign a violation.

The rankings of the constraints are summarized below.

(21) Rankings of all constraints employed

FTBIN-μ, CULMINATIVITY, NONFINALITY-C, IDENT(stress)-LOAN-R, IAMB, WSP-CVː >> *Vː-FINAL >> IDENT(long) >> ALIGN(FT, R, PRWD, R), PARSE-σ

As shown in tableaux (22-23) below, stress in Cebuano is iambic and right-aligned. No degenerate foot is allowed, hence FTBIN-μ dominates PARSE-σ. CULMINATIVITY ensures that each prosodic word has one and only one primary stress. Tableau (23) shows that a CVC antepenult (candidate (23d)) does not attract stress despite being heavy.

(22) [ka.ʔu.ˈsa]

/kaʔusa/	FTBIN-μ	CULMINATIVITY	IAMB	ALIGN(FT, R, PRWD, R)	PARSE-σ
☞ (a) ka.(ʔu.ˈsa)					*
(b) ka.ʔu.(ˈsa)	*!				**
(c) (ka.ʔu.ˈsa)	*!				
(d) ka.(ˈʔu.sa)			*!		*
(e) (ka.ˈʔu).sa				*!	*
(f) (ˈka.ʔu).sa			*!	*	*
(g) (ˈka.ʔu).(ˈsa)	*(!)	*(!)	*(!)	*	
(h) (ˈka).(ʔu.ˈsa)	*(!)	*(!)		**	

(23) [mag.da.ˈla]

/mag+dala/	FTBIN-μ	CULMINATIVITY	IAMB	ALIGN(FT, R, PRWD, R)	PARSE-σ
☞ (a) mag.(da.ˈla)					*
(b) mag.(ˈda.la)			*!		*
(c) (mag.ˈda).la	*!			*	*
(d) (ˈmag).da.la				*!*	*
(e) (ˈmag).(da.ˈla)		*!		**	
(f) (ˈmag.da).(ˈla)	*(!)	*(!)	*(!)	*	

For the following tableaux, candidates with more than one stress, i.e., violating CULMINATIVITY, are not shown. Harmonically bounded candidates are also omitted.

As shown in tableaux (24-25), FTBIN-μ dominates ALIGN(FT, R, PRWD, R) to ensure that the penult receives stress if it is heavy. Compare tableau (23) with (24-25) and notice that FTBIN-μ dominating ALIGN(FT, R, PRWD, R) only favors the candidate with a stressed heavy penult but not one with a stressed heavy antepenult.

(24) [ʔa.ˈbaː.ga]

/ʔabaːga/	FTBIN-μ	IAMB	WSP-CVː	ALIGN(FT, R, PRWD, R)	PARSE-σ
☞ (a) ʔa.(ˈbaː).ga				*	**
(b) ʔa.(ˈbaː.ga)	*(!)	*(!)			*
(c) (ʔa.ˈbaː).ga	*!			*	*
(d) ʔa.baː.(ˈga)	*(!)		*(!)		**
(e) ʔa.(baː.ˈga)	*(!)		*(!)		*

(25) [mag.ˈsul.ti]

/mag+sulti/	FTBIN-μ	IAMB	ALIGN(FT, R, PRWD, R)	PARSE-σ
☞ (a) mag.(ˈsul).ti			*	**
(b) mag.(ˈsul.ti)	*(!)	*(!)		*
(c) (mag.ˈsul).ti	*!		*	*
(d) mag.(sul.ˈti)	*!			*
(e) (ˈmag).sul.ti			**!	**

Tableaux (26-28) demonstrate that the final consonant in Cebuano is extrametrical, i.e., not contributing to weight. For the following tableaux, the final consonant is either marked with a subscript 'μ', indicating that it bears a mora, or '0', indicating that it does not. This is guaranteed by NONFINALITY-C dominating ALIGN(FT, R, PRWD, R). Hence, whether the stress falls on the penult or the ultima is only dependent on the weight of the penult. When the penult is light, as in (26), stress falls on the ultima because of IAMB. When the penult is heavy, as in (27-28), stress always falls on the penult, whether the ultima is closed or not.

(26) [pa.ri.ˈsan]

/parisan/	FTBIN-μ	NONFINALITY-C	IAMB	ALIGN(FT, R, PRWD, R)	PARSE-σ
☞ (a) pa.(ri.ˈsan$_0$)					*
(b) pa.ri.(ˈsan$_μ$)		*!			**
(c) pa.(ri.ˈsan$_μ$)	*(!)	*(!)			*
(d) pa.(ˈri).san$_0$	*!			*	**
(e) pa.(ˈri.san$_0$)			*!		*
(f) (pa.ˈri).san$_0$				*!	*

(27) [gi.ˈha:.tag]

/gi+ha:tag/	FTBIN-μ	NONFINALITY-C	IAMB	WSP-CV:	ALIGN(FT, R, PRWD, R)	PARSE-σ
☞ (a) gi.(ˈha:).tag$_0$					*	**
(b) gi.(ˈha:).tag$_μ$		*!			*	**
(c) gi.(ˈha:.tag$_0$)	*(!)		*(!)			*
(d) (gi.ˈha:).tag$_0$	*!				*	*
(e) gi.ha:.(ˈtag$_μ$)		*(!)		*(!)		**
(f) gi.(ha:.ˈtag$_0$)	*(!)			*(!)		*

(28) [*mag*.ˈsum.bag]

/mag+sumbag/	FTBIN-μ	NONFINALITY-C	IAMB	ALIGN(FT, R, PRWD, R)	PARSE-σ
☞ (a) mag.(ˈsum).bag$_0$				*	**
(b) mag.(ˈsum).bag$_μ$		*!		*	**
(c) mag.(ˈsum.bag$_0$)	*(!)		*(!)		*
(d) (mag.ˈsum).bag$_0$	*!			*	*
(e) mag.sum.(ˈbag$_0$)	*!				**
(f) mag.sum.(ˈbag$_μ$)		*!			**
(g) mag.(sum.ˈbag$_0$)	*!				*
(h) (ˈmag).sum.bag$_0$				**!	**

Tableau (29) shows that a CV: antepenult attracts stress through the dominance of ALIGN(FT, R, PRWD, R) by WSP-CV: and IDENT(long). The reduplicant is assumed to have an underlying long vowel.[5] Compare tableau (29) with (30) to see the need for the constraint WSP-CV:. Notice that a CV: antepenult attracts stress but not a CVC one. In other words, an unstressed CV: is worse than an unstressed CVC, indicating that CV: is regarded as heavier than CVC, which is consistent with typology. The general WSP is incapable of accounting for the data. If WSP were to dominate ALIGN(FT, R, PRWD, R), *[ma.ˈhar.li.ka], (30b), would wrongly surface. If it were to be dominated by the alignment constraint, *[mag.da:.da.ˈru], (29b), would wrongly surface. Only WSP-CV: dominating ALIGN(FT, R, PRWD, R) can ensure that both [mag.ˈda:.da.ru] and [ma.har.li.ˈka] surface with the observed stress assignment.

[5] Lengthening in reduplication is frequently observed in Tagalog. The vowel lengthening is part of morphology and thus not dealt with here in detail. However, the reduplicant should be underlyingly long as words ending in /CV.CV.CV/ all show final stress. Hence if the antepenult is short it would receive final stress. It is also unlikely for the antepenult to be underlyingly short and surface as long, since no constraint favors such lengthening.

(29) [mag.ˈdaː.da.ru]

/mag+RED+daru/	CULMINATIVITY	WSP-CV:	IDENT(long)	ALIGN(FT, R, PRWD, R)	PARSE-σ
☞ (a) mag.(ˈdaː).da.ru				**	***
(b) mag.daː.(da.ˈru)		*!			**
(c) mag.da.(da.ˈru)			*!		**
(d) (ˈmag).daː.da.ru		*!		***	***
(e) mag.(ˈdaː).(da.ˈru)	*!				*

(30) [ma.har.li.ˈka]

/maharlika/	CULMINATIVITY	WSP-CV:	IDENT(long)	ALIGN(FT, R, PRWD, R)	PARSE-σ
☞ (a) ma.har.(li.ˈka)					**
(b) ma.(ˈhar).li.ka				*(!)*	***(!)

As demonstrated in tableau (31), loanwords do not necessarily follow the stress pattern established above. Instead, these loans can retain the stress from the original language, in this case, Spanish. This is accounted for by the constraint IDENT(stress)-LOAN-R. The word surfaces with a long vowel in the ultima, with IDENT(stress)-LOAN-R dominating IDENT(long) and *Vː-FINAL, in order to satisfy the undominated constraints FTBIN-μ and NONFINALITY-C. ALIGN(FT, R, PRWD, R) and PARSE-σ are also violated by the candidates, but they are not shown in the tableau because they do not contribute any fatal violations (they are dominated by IDENT(long)) and also in consideration of the limited space.

(31) [mu.man.ˈdaːr]

/mu+manˈdar$_{Loan}$/	FTBIN-μ	NONFINALITY-C	IDENT(stress)-LOAN-R	IAMB	*Vː-FINAL	IDENT(long)
☞ (a) mu.man.(ˈdaːr$_0$)					*	*
(b) mu.man.(ˈdar$_μ$)		*!				
(c) mu.(man.ˈdar$_0$)	*!					
(d) mu.(ˈman).dar$_0$			*!			
(e) mu.(ˈman.dar$_0$)	*(!)		*(!)	*(!)		
(f) (mu.ˈman).dar$_0$	*(!)		*(!)			

Compare tableau (32) and (33) to see the need for IDENT(stress)-LOAN-R instead of the more general IDENT(stress)-LOAN. IDENT(stress)-LOAN would guarantee that the stress in loan faithfully surfaces in [gi.ʔis.ˈtur.ja], yet it also retains the stress in *[ʔis.ˈtur.jaː.ha], giving the wrong winning candidate. IDENT(stress)-LOAN-R only applies when the loan morpheme is aligned with the right edge of the prosodic word, i.e., when no suffix is attached, hence would not assign any violation to [ʔis.tur.ˈjaː.ha], allowing it to surface as the winning candidate. The final vowel of the loan morpheme is analyzed to be underlyingly long, which accounts for the penultimate stress in the word [ʔis.tur.ˈjaː.ha].

(32) [gi.ʔis.ˈtur.ja]

/gi+ʔisˈturjaː$_{\text{Loan}}$/	FtBin-μ	Ident(stress)-Loan-R	WSP-CVː	*Vː-Final	Ident(long)
☞ (a) gi.ʔis.(ˈtur).ja					*
(b) gi.ʔis.(ˈtur).jaː			*!	*	
(c) gi.ʔis.tur.(ˈjaː)		*!		*	
(d) gi.ʔis.tur.(ˈja)	*(!)	*(!)			*
(e) gi.ʔis.(tur.ˈja)	*(!)	*(!)			*

(33) [ʔis.tur.ˈjaː.ha]

/ʔisˈturjaː$_{\text{Loan}}$+ha/	FtBin-μ	Ident(stress)-Loan-R	Iamb	WSP-CVː	*Vː-Final	Ident(long)
☞ (a) ʔis.tur.(ˈjaː).ha						
(b) ʔis.(ˈtur).jaː.ha				*!		
(c) ʔis.tur.(jaː.ˈha)	*(!)			*(!)		
(d) ʔis.tur.(ˈjaː.ha)	*(!)		*(!)			
(e) ʔis.tur.(ja.ˈha)						*!

The antepenultimate stress in Spanish loanwords such as [pu.ˈliː.ti.ka] is accounted for with Ident(stress)-Loan-R dominating Align(Ft, R, PrWd, R) (Ident(stress)-Loan-R dominates Ident(long) which dominates Align(Ft, R, PrWd, R)).

The tableaux above have shown cases where the ultima is CV and where it is CVC. OT assumes Richness of the Base, so what if the ultima, not in a loanword which has an underlying stress, were underlyingly CVː? As shown in tableau (34-36), an underlying final vowel never surfaces as long with *Vː-Final (and WSP-CVː for words with a CVː penult) dominating Ident(long), Align(Ft, R, PrWd, R), and Parse-σ.

(34) /kaʔusaː/ -> [ka.ʔu.ˈsa]

/kaʔusaː/	*Vː-Final	Ident(long)	Parse-σ
☞ (a) ka.(ʔu.ˈsa)		*	*
(b) ka.ʔu.(ˈsaː)	*!		**

(35) /mag+sultiː/ -> [mag.ˈsul.ti]

/mag+sultiː/	*Vː-Final	Ident(long)	Align(Ft, R, PrWd, R)	Parse-σ
☞ (a) mag.(ˈsul).ti		*	*	**
(b) mag.sul.(ˈtiː)	*!			**

(36) /ʔaba:ga:/ -> [ʔa.ˈba:.ga]

/ʔaba:ga:/	WSP-CV:	*V:-FINAL	IDENT(long)	ALIGN(FT, R, PRWD, R)	PARSE-σ
☞ (a) ʔa.(ˈba:).ga			*	*	**
(b) ʔa.ba:.(ˈga:)	*!	*			**
(c) ʔa.ba.(ˈga:)		*!	*		**
(d) ʔa.(ba.ˈga)			**!		*

5 Discussion

Recall that the constraint IDENT(stress)-LOAN-R is invented to account for the fact that stress in loans is only retained if no suffix is attached. This constraint is not optimal for two reasons. For one thing, it is more descriptive than explanatory. It says that stress in loans should faithfully surface unless a suffix is attached, but does not give an explanation of why suffixation forbids an underlying stress from surfacing faithfully. In addition, the constraint ideally would be less specific so that it can account for more data in other languages, as OT assumes Universal Grammar. When stress shift caused by suffixation is better understood, the general IDENT(stress)-LOAN would be used to account for data where stress in loans is retained, and a different constraint would be found to dominate IDENT(stress)-LOAN, accounting for data where stress is shifted.

In this analysis, the partially reduplicated word [mag.ˈda:.da.ru] receives antepenultimate stress because of the undominated constraint WSP-CV:, which penalizes any unstressed syllable with a long vowel. This is supported by typology which shows that cross-linguistically CV: are heavier than CVC. However, since antepenultimate stress is only observed in reduplicated words, one may propose an alternative explanation where the antepenult attracts stress due to its identity as the reduplicant. For instance, the reduplicant may be linked to a [+stress] feature, in other words, it may be underlyingly stressed. To see if this is true, one needs to look more closely to the nature of the reduplicants. In particular, it is crucial to find a word with a stressed reduplicant in the antepenult that is underlyingly CV. An underlyingly light reduplicant in the antepenult receiving primary stress would prove that what attracts stress to the antepenult is not the heavy long vowel, but the reduplicant itself. For the time being, with the limited data available, the analysis currently employed, where an antepenult with a long vowel attracts stress due to its greater syllable weight, is capable of fully accounting for the data and is more theoretically motivated.

Similarly, an alternative explanation analysis exists for the observation that long vowels and stress always occur together. The weight-to-stress analysis, i.e., that underlying long vowel attracts stress, is adopted here. Another possibility is that underlying stress causes vowel lengthening, i.e., stress-to-weight. To prove that it is stress-to-weight instead of weight-to-stress, stress must be shown to be contrastive, i.e., a minimal stress pair is required. Since no such minimal pair is known for the time being, a weight-to-stress analysis should be the better choice.

6 Conclusion

Previous studies of Cebuano stress are rare and with little phonetic base. No known work has focused on the acoustic correlates of Cebuano stress, although studies of stress in Tagalog (Klimenko et al. 2010) and Ilokano (Talavera et al. 2013), languages that are closely related to Cebuano, conclude that duration contributes most to the perception of stress in these languages. This paper presents a phonetic measurement of carefully chosen and recorded words in Cebuano and shows that, among duration, pitch (f0), vowel quality (F1 and F2), and intensity, duration and vowel quality, i.e., F1 and F2, are both significant phonetic cues of Cebuano stress. This finding not only is the result of a first investigation into the phonetic correlates of Cebuano stress, but also prove~~shows~~ that languages that are genetically related to one another are likely to have similar acoustic cues for stress.

The second part of the paper presents data to show that stress in Cebuano is weight-sensitive, iambic, extrametrical, and assigned from right to left, with certain loanwords being the exceptions, in accordance with that claimed in Shryock (1993). The paper also performs an analysis of the stress pattern in OT, employing ten constraints in total. Most crucially, underlying vowel length distinction is posited to account for the different stress assignment for words with the seemingly same syllable structure, such as those with open penult and ultima. In addition, loanwords are analyzed to retain the stress of their counterparts in the loaner language, but only when no suffix is attached. This part of the paper presents data of stress pattern in Cebuano that is well based in phonetics, and also presents the first OT analysis of Cebuano stress, which, without the need to delete and reparse feet and reassign stress, is in a sense simpler than a rule-based analysis. For instance, Shryock explains words like [gi.paŋ.ˈkan.ta] by assuming that they are first footed as [(gi.paŋ).(kan).(ta)], then refooted as [gi.paŋ.(kan).<(ta)>] by applying the rules Foot Extrametricality in Clash and Deweighting (of heavy syllables) in Clash, later refooted again as [(gi).(paŋ.kan).<(ta)>] by first reparsing the second stray syllable and then reparsing the initial stray syllable, and lastly assigning primary stress to the penult with End Rule Right. The OT analysis above handles words like this with the constraint FTBIN-μ dominating ALIGN(FT, R, PRWD, R) and PARSE-σ to favor the candidate with the heavy penult alone parsed into a foot and receiving primary stress.

Further study may measure more acoustic correlates of Cebuano stress, such as H1*-H2*, and see if there are better acoustic cues. In addition, more loanwords can be checked for a fuller study on the stress assignment of loanwords in Cebuano. Furthermore, this study only focuses on the assignment of primary stress, and a follow-up study may extend the investigation to secondary stress and stress shift caused by suffixation in Cebuano.

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8 Appendix

8.1 Items used in the phonetic measurements

a. Cá.CaC

pápap	sound of a low-pitched car horn
pápas	erase, obliterate s.t
pásas	raisins
pátas	even up a score, debt, wrong
pátak	for a large number of things to be scatters over an area
pátag	for an area to be flat and level
bábag	lie across a path
básag	large, rectangular bamboo hamper for storing dirty clothes
bátas	cut down bamboo poles
tápak	patch
tákas	escape from prison
tágak	cause s.t. to fall straight down
dápat	bring s.t. into contact with s.t. else
dágat	sea
kábat	reach up to an amount or length of time
kátag	spread, scatter out, cause s.t. to be scattered
gápas	k.o. medium-sized tree which produces cotton.
gátas	milk

b. Ca.CáC

babad	turn around on its axis
bakak	be a lie, false
tapat	be true and loyal to s.o.
tapas	dress yarn for weaving by starching and combing it to eliminate fluff or lint and give it a degree of stiffness
tatak	label indicating the make of sth; tattoo
takad	step on a line or specific area
tagad	give attention to, mind
dasag	thrust a mass forcefully against s.t. else
datag	level land
sapak	apt, exact, just the right one
sabat	speak after s.o. has spoken
sasag	k.o. exterior walling made of bamboo slats and palm thatch, nailed to wooden studs
sakab	k.o. fishing trap of shallow waters put directly over the fish to be trapped
kabad	run or walk instantly without hesitation
kasap	not being able to taste
kasag	k.o. edible salt-water crab growing to 4″
kagat	bite to inflict injury, grab, or hold s.t.
gabas	saw

c. Cú.CuC

púpus	coming to its end
púpug	break s.t. brittle into tiny pieces
púsud	navel
púgud	for a bud to form and swell
tútut	say beep-beep in pretending to blow one's horn
tútuk	stand upright unaided or on one's own; w2: v stare
túsup	suck the juice out of s.t.
túsuk	pierce s.t. through s.t. else, skewer; 2 make a hole in the earlobe
túsug	for s.t. sharp to pierce and get stuck into sth
túdus	all, everyone, everybody
túkud	brace, prop
súput	general name for bags, esp. paper bags
súbuk	pith
súgud	start, begin s.t.
súguk	for liquid to rush and gather s.w.
kúkug	shove s.t. slender into an opening just about big enough for it and work it around
kúkuk	k.o. bird, the Philippine coucal
kúkus	curl up
kúgus	carry s.t. in the arms
gútus	walk some distance

d. Cu.CúC

putut	full-grown person that is short
putud	sever with a bladed instrument or by snapping
putus	wrapper
putuk	small arms, esp. a handgun (slang)
pusut	for liquid to spurt out
pugus	compel s.o. to do s.t.
tubud	flow in a steady stream
tubus	redeem, save from
tubuk	commit suicide
tutub	cover the mouth of a container securely by laying s.t. over it and tying it
tuduk	sprout, grow from the surface; n 1 sprout
tusud	squash s.t. between the two thumbnails
sukud	take measurements
kuput	hold
kubut	handle
kubus	low in amount
kutub	having wrinkles sewn into it
kutud	for liquids to slow down or stop flowing at the source
kusug	fast, rapid
gubut	tangled

8.2 Glossing

ADF	/mag-/	active durative future
ADFS	/magka-/	active durative future of verbs referring to a state
APF	/mu-/	active punctual future/subjunctive
APoF	/maka-/	active potential future
APoFP	/makig-/	active potential future of verbs bearing pakig-
cau	/pa-/	causative
DPF	/-un/	direct passive punctual future
DPP	/gi-/	direct/instrumental punctual past
DPS	/-a/	direct passive punctual subjunctive
instr	/paŋ-/	instrumental
IP	/pakig-/	interactive potential
IPF	/ʔi-/	instrumental passive punctual future/subjunctive
LPF	/-an, -anan/	local passive punctual future