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The Phonetics of Yucatec Maya and the Typology of Laryngeal Complexity*

Abstract

We examine the known typology of laryngeal complexity (SILVERMAN 1997a,b) in light of phonetic research (FRAZIER 2009) showing that Yucatec Maya uses contrastive tone and phonation type. The phonetic patterns in YM suggest that articulatory incompatibility is the most important factor in enforcing the phasing of tone and non-modal phonation, but that perceptual factors account for the distribution of phasing patterns. Furthermore, YM is similar to the unrelated languages Danish and Acoma which show that creaky voice conditions preceding high pitch. We motivate future research on cross-linguistic differences in the production of creak and its interaction with pitch and gender.

1. Introduction

Yucatec Maya (YM) is one of the few Mayan languages that is unambiguously tonal. Additionally, this language, like many other Mayan languages, has words such as *ta'ab* 'salt' and *a'al* 'speak' (see BRICKER ET AL. 1998) that have traditionally been described as having a "rearticulated" vowel (e.g. [vʔv]). Recent phonetic research on YM (FRAZIER 2009, 2011) shows that these vowels are best analyzed as long vowels that are marked for both high tone and creaky voice (such that the production of high pitch precedes the production of creak). According to SILVERMAN'S (1997a: 236) definition of *laryngeal complexity* – "vowels that possess both contrastive phonation and contrastive tone" – YM's "rearticulated" vowels (henceforth referred to as GLOTTALIZED, see §2.1) are laryngeally complex.

In this paper I discuss how YM fits in with the known typology of laryngeal complexity. YM is compatible with the patterns identified for other laryngeally complex languages in that tone and non-modal phonation are phased with respect to each other. However, the phasing pattern found in YM – post-tonal non-modal phonation – is predicted to only occur in languages that also have pre-tonal non-modal phonation. I argue that the phonetic patterns of YM show that articulatory incompatibility accounts for the existence of phasing, while perceptual factors account for the attested phasing patterns.

This paper is organized as follows. I first present the relevant aspects of the phonetics and phonology of YM in §2. This section includes details about the phonetics of pitch and glottalization as first documented in FRAZIER (2009, 2011),

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which show that GLOTTALIZED vowels are contrastive for pitch and glottalization. I then discuss the typology of laryngeal complexity in §3. This section looks at the phasing pattern of YM, the cross-linguistic tendency for high pitch to precede creaky voice, and the possibility of laryngeal complexity in other Mayan languages. Conclusions are presented in §4.

2. The Phonetics and Phonology of Yucatec Maya

In this section I present relevant background information on the phonemic inventory of YM, and I summarize the results of phonetic experimentation with regard to the production of pitch and glottalization. It is the results of this production experiment that indicate that YM is laryngeally complex.

2.1 Phonemic Inventory

Five vowel qualities are contrastive in YM: [i e a o u]. Additionally, each vowel quality is produced with one of four *vowel shapes*, which are bundles of suprasegmental features involving length, tone, and glottalization, yielding 20 contrastive syllable nuclei. The vowel shapes are described in (1) with an example minimal quadruplet presented in standard orthography.[1] Vowel shapes are identified by small capital letters throughout this paper so that these terms will not be confused with the same terms that refer to general phonetic and/or phonological properties (e.g. "GLOTTALIZED" is a phonological vowel shape in YM, whereas "glottalized" refers to the phonetic property of glottalization).

(1) vowel shape in YM (BRICKER ET AL. 1998, BLAIR & VERMONT SALAS 1965)

SHORT	/v/	chak 'red'	short, no tone, modal voice
LOW TONE	/v̀v/	chaak 'boil'	long, low tone, modal voice
HIGH TONE	/v́v/	cháak 'rain'	long, high tone, modal voice
GLOTTALIZED	/v́v̰/	cha'ak 'starch'	long, high tone, creaky voice

GLOTTALIZED vowels have traditionally been called "rearticulated" and represented by /vʔv/. The phonetic data presented in §2.2.1 shows that these vowels are most often produced with creaky voice and not a full glottal stop. For this reason, I refer to this vowel shape as GLOTTALIZED (rather than REARTICULATED) and use /v́v̰/ as the abstract phonological representation.[2, 3]

The consonantal inventory of YM includes the laryngeals [h ʔ]. Both laryngeal consonants can appear in onset and coda position: e.g. [ʔam] 'spider',

[1] BRICKER ET AL. (1998) and BLAIR & VERMONT SALAS (1965) refer to the SHORT vowels as "neutral" (indicating that these vowels are not tonal). I prefer SHORT because vowel length is the one factor that clearly distinguishes this vowel shape from the others.

[2] It is traditional in the literature on YM to use the term "glottalized" and not "laryngealized", and so this is the term I adopt for these vowels. In the discussion of laryngeal complexity in §3, I use "glottalized" and "laryngealized" interchangeably in describing this phonetic property.

[3] The tonal marker on GLOTTALIZED vowels is justified in §2.2.2.

[siʔ] ‘firewood’, [hun] ‘one’, [koh] ‘tooth’. These consonants can appear before or after any vowel shape, though lexical items with a long vowel (HIGH TONE, LOW TONE, or GLOTTALIZED) followed by a glottal stop are rare and are most often found in dialects where [ɓ] becomes [ʔ] word-finally (e.g. *ta’ab* [táa̱ɓ] ~ [táa̱ʔ] ‘salt’, *tsuub* [tsùuɓ] ~ [tsùuʔ] ‘agouti’, *tsáab* [tsáaɓ] ~ [tsáaʔ] ‘rattlesnake’). [4]

2.2 Production Experiment

In this section, I review the results of a production experiment designed to examine the phonetics of vowel shape in YM. This experiment was conducted in Yucatan, Mexico and involved 24 participants from Mérida (6 males – ages 33, 39, 40, 41, 47, 47 and 1 female - age 39), Santa Elena (5 males – ages 22, 25, 43, 63, 68 and 7 females – ages 19, 20, 25, 30, 33, 35, 63, and Sisbicchén (2 males – ages 30, 41 and 3 females – ages 24, 29, 30), Yucatan, Mexico. All participants except for the 3 females from Sisbicchén are fluent in Spanish; these 3 females understand Spanish but do not use it. Two participants are also fluent in English. All participants use YM in the home and in daily life.

The participants were recorded while they read 100 words in isolation, mostly of the form CVC. They were presented with a note card that displayed a word in Yucatec Maya along with its Spanish translation (due to the fact that many participants did not regularly read Yucatec Maya) and were asked to say aloud the Yucatec Maya word. The word list used for speakers from Santa Elena differed slightly from the word list for speakers from Mérida and Sisbicchén in that the former included some polysyllabic forms such that measurements are taken from a vowel in a non-final syllable.[5] Both word lists included 25 words with each vowel shape. Some of the words were nonce forms, and these words are excluded from analysis here. Measurements from non-final syllables (Santa Elena speakers only) are included in the data on glottalization in §2.2.1 but they are not included in data on pitch in §2.2.2. The full word list (excluding nonce forms) is in Appendix A.

Dialect variation in terms of the sound system of this language is not well documented. FRAZIER (2009, 2011) presents significant differences in the production of pitch and vowel length between speakers from Sisbicchén (on the eastern side of Yucatan) and speakers from Mérida and Santa Elena (on the western side of Yucatan). Speakers from the Mérida and Santa Elena produce pitch contours that closely resemble the claims about tone in the previous literature, whereas the speakers from Sisbicchén that I recorded did not produce different pitch values for HIGH TONE and LOW TONE vowels. To what extent these differences represent broader dialectal trends is unknown at this time. Due to their unique pronunciations, participants from Sisbicchén are excluded from the analysis of pitch presented in §2.2.2.

To summarize, after excluding the appropriate tokens, the data on glottalization comes from 19 tokens with GLOTTALIZED vowels as spoken by each

[4] One example of a word with a long vowel followed by a glottal stop is *ti’i’* [tíi̱ʔ] ‘there’. This word is bimorphemic in origin – *ti’-i’* ‘there-LOCATIVE’.

[5] This word list difference was due to the fact that speakers from Santa Elena do not pronounce the labial implosive in word-final position (see FRAZIER 2009, 2011 for further discussion).

of the 24 participants. The data on pitch comes from 19 tokens with GLOTTALIZED vowels, 20 with HIGH TONE, 21 with LOW TONE, and 22 with SHORT vowels as spoken by each participant from Mérida and from 15 tokens with GLOTTALIZED vowels, 16 with HIGH TONE, 18 with LOW TONE, and 20 with SHORT vowels as spoken by each participant from Santa Elena.

The reader is referred to FRAZIER (2009) for the full methodology and results of this experiment.

2.2.1 Production of Glottalization

The GLOTTALIZED vowels of YM have traditionally been assumed to be of the form /vʔv/. However, the results of this experiment show that a full glottal stop is rarely produced. Instead, the canonical production of this vowel shape is one where creaky voice occurs during the medial portion or final half of the long vowel.[6]

Some examples of waveforms for tokens that are produced with creaky voice are shown in Figure 1. Here we see a great deal of variability in terms of the visible indicators of creak. The tokens in the top row show all the canonical signs of creaky voice (aperiodicity and widely and irregularly spaced glottal pulses (see GORDON & LADEFOGED 2001)). These two tokens differ in the placement of creak: the token on the left shows a return to modal voice before the end of vowel production, while, in the token on the right, creaky voice continues to the end of vowel production. The tokens in the middle row show a significant decrease in intensity but the waveform is periodic throughout and there is only a slight F0 decrease (with the latter not visible in this figure). Such tokens are quite common in YM. FRAZIER (2009) found that a decrease in intensity is the most consistent cue to a departure from modal voice in YM.[7] The token in the bottom row shows only a brief dip in intensity. It is clear in this token that there is some portion of the vowel produced with non-modal voice, but the main indicators of creaky voice are not present and the dip in intensity is very short. In §3.1.1, I return to the different acoustic patterns of creaky voice in YM.

[6] In FRAZIER (2009), creaky voice is divided into two categories: creak and "weak glottalization". Both categories represent a departure from modal voice. Because the distinction between these two categories is not relevant here, I have conflated the two groups into one, identifying both as "creaky voice".

[7] This acoustic pattern is similar but not identical to that found for creak in Coatzospan Mixtec (GERFEN & BAKER 2005).