Interaction of tone and phonation in Santiago Laxopa Zapotec

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1 Introduction

2 Tone and Phonation

Tone, as a linguistic phenomenon, is very wide spread and is present in many of the world's languages (Yip 2002). Most of the tonal languages that have received the most attention are languages from Africa and Asia with languages of the America's receiving some attention (Pike 1948, Silverman 1997, Campbell 2017a,b). Because of the focus on mostly African and Asian tonal languages certain assumptions are commonly held about what is possible for tonal languages. One of the assumptions that is made is that tone and phonation are heavily dependent on each other (Andruski & Ratliff 2000, Yip 2002, Garellek et al. 2013, Brunelle & Kirby 2016, Wee 2019, Hyman & Leben 2020, Garellek & Esposito 2021). For example, Mandarin tone three, which is produced as a dipping tone in careful speech and a falling tone in rapid speech, has creakiness throughout the vowel. This creakiness is often the sole clue to differentiate it from a normal falling tone (Duanmu 2007, Kuang 2017).

Oto-Manguean languages from Mexico clearly show that the behavior between tone and phonation in Asia is not the only way in which tone and phonation can interact. In fact, Oto-Manguean languages have what Silverman (1997) calls "laryngeally complex" vowels. These laryngeally ccomplex vowels are ones where tone and phonation are entirely independent from one another. This means that any tone can co-occur with any phonation type. Some work has been done that adequately shows this such as Avelino Becerra (2004), Chávez-Peón (2010), DiCanio (2012), and Uchihara (2016). One of the more detailed of these studies is Chávez-Peón (2010) who investigates the phonetic cues to tone, stress, and phonation in San Lucas Quiaviní Zapotec (SLQZ) a Valley Zapotec variety. Chávez-Peón shows how tone and phonation are mostly independent from each other with a notable exception being the restriction of Rising tone in SLQZ which can only appear with modal phonation. The distribution of tone and phonation type is presented in Table 1.

My qualifying paper will add to this lesser studied area of phonetics and phonology by investigating the interaction of tone and phonation in Santiago Laxopa Zapotec.

Table 1: SLQZ tone and phonation

	High	Low	Falling	Rising
Modal	✓	✓	✓	✓
Breathy	X	✓	✓	X
Creaky	✓	✓	✓	X
Interrupted	✓	✓	✓	X

3 Overview of Santiago Laxopa Zapotec

Santiago Laxopa Zapotec (SLZ) is a variety of Sierra Norte Zapotec, a member of the Oto-Manguean language family, and spoken by approximately 800 to 1200 people in the municipality of Santiago Laxopa, Oaxaca, Mexico (Adler et al. 2018, Sichel & Toosarvandani 2020). Similar to other Oto-Manguean languages, SLZ exhibits Silverman's (1997) "larnygeally complex vowels". In addition to its five-vowel inventory, SLZ makes further distinctions with the addition of breathy, checked,[1] and laryngealized[2] phonations. The different phonation types are also represented in the orthography for SLZ as seen in (1)

(1) Breathy: [a̤] <*ah*>
Checked: [aˀ] <*a'*>
Laryngealized: [aˀa] <*a'a*>

There are many words that are differentiated by only by phonation in SLZ. For example, the words for *snake* and *fish* are only distinguished by the presence of breathy phonation, (2) and Figure **??**.

(2) a. *behl* [bɛ̤l:¹³] 'snake'
b. *bel* [bɛl:¹³]'fish'

<INSERT FIGURES of behl and bel>

In addition to phonation, SLZ, along with all of the Oto-Manguean languages, is a tonal language (Brinkerhoff, Duff & Wax Cavallaro 2021). SLZ has three level tones of high, mid, and low, which are represented in the transcriptions with Pike's numbers, where x¹ is the highest tone and

[1]There are two ways in which this vowel can be analyzed. One is the traditional way where the glottal stop is considered inseparable from the vowel. The other is to treat this as a consonant which is restricted to only reside in codas (similar to how the sound /ŋ/ is restricted to codas in English). This second approach is the one taken by Avelino Becerra (2004). I will follow the traditional way of analyzing these vowels through this paper.

[2]Previous descriptions of the the vowel system of closely related languages have used various different terms for this vowel including broken, rearticulated, interrupted, and creaky (Long & Cruz 2005, Avelino 2010, Avelino Becerra 2004, Sonnenschein 2005, Adler & Morimoto 2016). In order to avoid confusion, I will use the term laryngealized following Avelino (2010).

x³ is the lowest (Pike 1948, Wee 2019). In addition to these three level tones, SLZ has two contour tones, a rising (x²¹) and a falling tone (x¹³). The number of tones were discovered by myself and two other researchers following the methods for tonal analysis in Pike (1948) and Snider (2018). An overview of the different tonal patterns are seen in Table 2.

Table 2: SLZ tones

High	a¹	*xha*	[ʐa¹]	'clothing.POSS'
Mid	a²	*lhill*	[ɾiʒ²]	'house.POSS'
Low	a³	*yu'*	[çuˀ³]	'earth'
Rising	a²¹	*yu'u*	[juˀu²¹]	'quicklime (Sp. cal)'
Falling	a¹³	*yu'u*	[juˀu¹³]	'house'

SLZ sits at an important crossroads of studying tone and phonation because it is a language that has both independent tone and phonation. This combination allows for a thorough investigation into how tone and phonation interact which is an area that is still not well understood. Additionally, SLZ allows for us to investigate the phonetic realization of phonological contrasts.

4 Methods and materials

In order to investigate what is occurring with SLZ tone and phonation, two SLZ speakers, who live in Santa Cruz, CA, were asked to produce approximately 200 words in SLZ in a carrier sentence three times. This allowed for a good overlap between tone and phonation type. Because data collection occurred during the COVID-19 pandemic two methods were used to elicit data. The first was using Zencastr[3], a professional podcasting website, to prevent potential exposure to each other. Once we were all vaccinated and it was deemed safe by myself and my consultants, we meet at in the backyard of the consultants and recording was done using a Zoom H4n audio recorder (44.1kh-16bit).

(3) Carrier Sentence
sh-ni=a'¹³ _____ cho²ne² las²
CONT-speak=1SG _____ three times
'I say _____ three times'

Once the recordings were made, the audio files were initially segmented using ELAN (Wittenburg et al. 2006) and then passed to PRAAT (Boersma & Weenink 2021) for segmenting the vowels and extracting them for analysis in VOICESAUCE (Shue, Keating & Vicenik 2009).

[3] https://zencastr.com/

5 Laryngeal Articulator Model

6 Conclusion

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