Tone and phonation in Santiago Laxopa Zapotec

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Contents

1 Introduction

- Most work on the interaction of tone and phonation has been based on descriptions of southeast and far east Asian languages.
- This lead to strong claims on the interaction between tone and phonation (Masica 1976, Thurgood 2002, Yip 2002, Enfield 2005, Michaud 2012, Brunelle & Kirby 2016).
- Main claim from these authors is that tone and phonation are codependent. This is often referred to as a register system.
  - Meaning that we only observe certain tones with certain phonations.
  - Mandarin Tone 3 is always associated with creaky voice (Duanmu 2007).
- This claim has also been made in the reverse that certain phonation types are associated with specific tonal patterns.
  - Breathy voice stereotypically appears with high pitch and creaky voice sterotypically appears with low pitch (Esling et al. 2019).
    - TODO: Look for earlier references to these claims.
  - This is often born out with research into register systems.

  - Also found in pathological voice quality (Klatt & Klatt 1990, Titze 2000, Esling et al. 2019).

- Research into Mesoamerican languages, however, shows that these claims are too strong or exaggerated (Suárez 1983, Campbell, Kaufman & Smith-Stark 1986, Silverman 1997, DiCanio 2008, Esposito 2010, Campbell 2017a,b).

- Most languages of the Oto-Manguean language family exhibits independent tone and phonation.

  - Tone and phonation freely co-occur or exhibit a much freer distribution than what is found in register languages.
  - San Lucas Quiaviní Zapotec is one such example.

Table 1: SLQZ tone and phonation

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

- This paper adds to this debate by:

  - Providing another description of a language that uses tone and phonation
  - Evaluates the claims of

2 Santiago Laxopa Zapotec

- Spoken by approxiametly 1000 speakers in the municipality of Santiago Laxopa, Ixtlan, Oaxaca, Mexico (Adler & Morimoto 2016, Adler et al. 2018, Foley, Kalivoda & Toosarvandani 2018, Foley & Toosarvandani 2020).

- Member of the Northern Zapotec branch of the Oto-Manguean language family.

- Data for SLZ was collected from two native language speakers of SLZ, who live in Santa Cruz, CA.

  - Based on data from approximately 200 nouns
  - Collected between Spring 2020 and Fall 2022

Table 2: SLZ tones

High	a^{1}	*xha*	[z̨a^{1}]	'clothing.POSS'
Mid	a^{2}	*lhill*	[ɾiʒ^{2}]	'house.POSS'
Low	a^{3}	*yu'*	[çuˀ^{3}]	'earth'
Rising	a^{21}	*yu'u*	[juˀu^{21}]	'quicklime (Sp. cal)'
Falling	a^{13}	*yu'u*	[juˀu^{13}]	'house'

2.1 Tone in SLZ

- SLZ has five surface tones as represented in Table 2.

- Following discussion from [Brinkerhoff, Duff, & Wax Cavallaro (2022)], these tones are limited in their appearance.

- It is true that all five patterns can surface on a syllable but there is a restriction in what tonal patterns are allowed to surface on words that are larger than bimoraic.

- The patterns that we observe on bimoraic nominals are:
  - HL
  - MH
  - LL

- This has the appearance of being a prototypical "word tone" language following Pike's (1948) categorization.

- However, recent work from Shih & Inkelas (2019) and McPherson (In press) has argued that the "word tone" description is epiphenomenal and can be derived via surface constraints on tone.

- What is important to take away from this is that there are still five distinct tonal patterns that are productive in the speakers.

2.2 Phonation in SLZ

- SLZ has four different contrastive phonation types on the vowels.

  1. Modal: [a] <*a*>
  2. Breathy: [a̤] <*ah*>
  3. Checked: [aˀ] <*a'*>
  4. Laryngealized: [aˀa] <*a'a*>

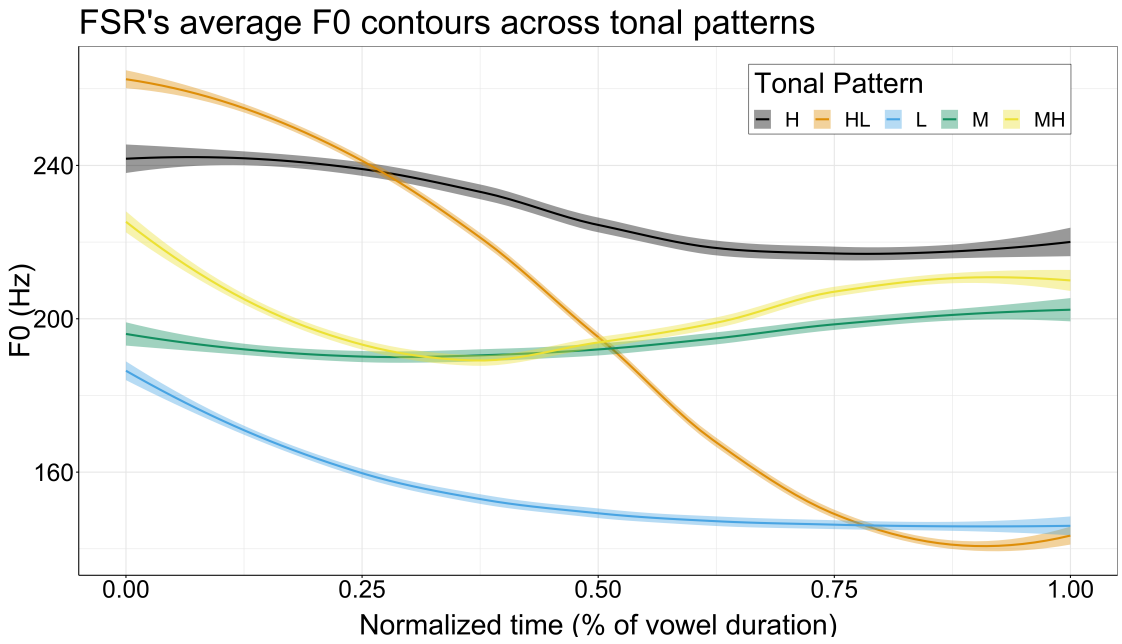

Figure 1: Tonal contrasts for FSR averaged and time normalized.

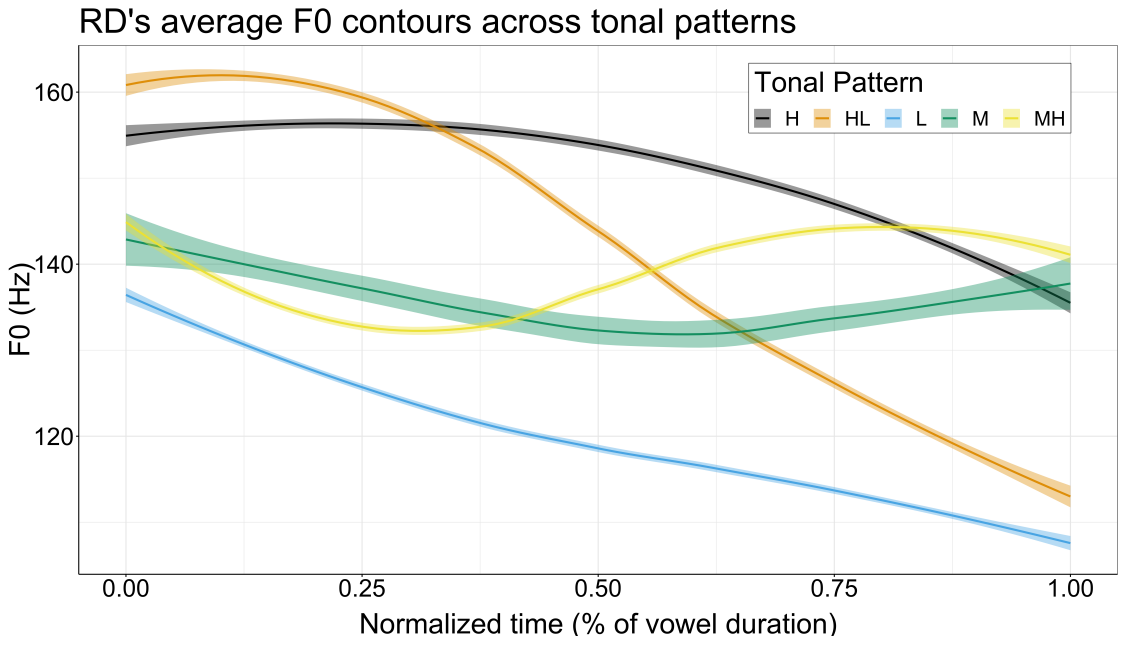

Figure 2: Tonal contrasts for RD averaged and time normalized.

- Even though all of these contrastive phonation involve varying degrees of laryngealization, different configurations of the larynx, I choice to use the term laryngealized to refer to one of the phonation contrasts following the arguments from Avelino (2010).
  - Laryngealized vowels do not have one consistent production across speakers.
  - One consultant used only creaky voice and the other consultant used a rearticulated

phonation or a creaky phonation for L toned words.

3 Interaction of Tone and Phonation

- Discuss what observations have been found in other languages.
- Table 3 shows the observed patterns between tone and phonation in SLZ.

Table 3: Distribution of tone and voice quality in SLZ on a syllable

	Modal	**Breathy**	**Checked**	**Laryngealized**
H	✓	–	✓	✓
M	✓	✓	✓	✓
L	✓	✓	✓	✓
HL	✓	✓	✓	✓
MH	✓	✓	–	✓

- The striking observations that we find is that there are some gaps in where breathy is allowed to occur. This is also true for the checked phonation.

3.1 Acoustic Measurements

- Spectral measurements have been found to be very useful measure of phonation in a wide number of different languages [ADD REFERENCES FROM ESPOSITO].
- Most of these have been focused on H1-H2, however, relationships with H1 compared to higher harmonics have also been found to be useful.
- Most previous studies have not used corrected or normalized measure but have been focused on a single vowel /a/ because it minimizes the effects of the F1.
  - Using corrected values is a way to mitigate the effects of the formants on the vowels.
- Describe how acoustic measurements are taken using Garellek (2019) as a basis for how the measurements are taken.
  - maybe use SoE as well?
  - Additionally, describe the patterns that we expect to see.
- Following Esposito (2010), I use H1-H2 and H1-A3.
- Additionally, CPP is a useful measurement for modal versus a modal phonation (Garellek & Esposito 2021).
- Figure out what which charts are useful. Might be useful to follow Esposito (2010) in taking measurements from a certain portion of the vowels.

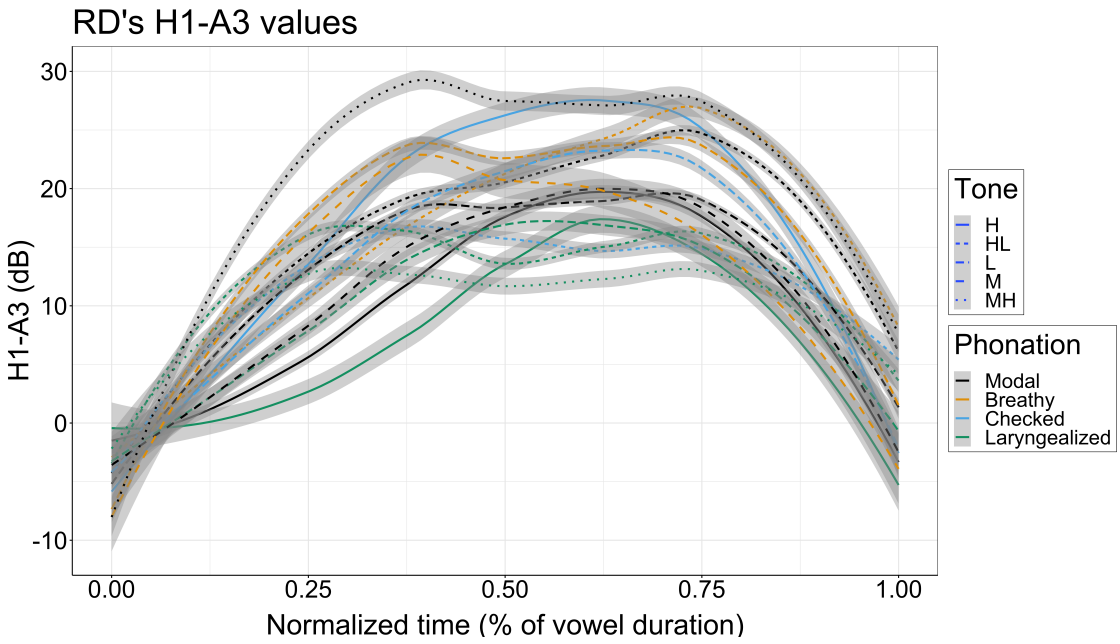

Figure 3: RD's H1-A3 values.

- Might be useful to validate h1-h2 and h1-a3 measurements as useful diagnostics.
- What do the measurements show me?
  - FSR shows a timing difference between checked and rearticulated in h1-h2.
  - RD shows the differences we expect to see in h1-a3 but not

4 Challenges to theories

- How does this support or detract from Silverman's (1997) claims?
  - Do we see the gestural timing that Silverman (1997) claims to exist?
- Issues with breathy not present with H.
- Additionally there is this question about why we are seeing laryngealized vowels in H tone
  - Could Esling et al.'s (2019) model of interactions be used to explain what we are seeing?

5 Conclusion

6 Other discussion points

6.1 Esposito 2010

- Esposito investigates variation in Santa Ana del Valle Zapotec for variation due to gender, F0 and prosodic position.
- Results were inconclusive as to whether or not gender was creakier or breathier though the acoustic measurements (H1-H2 and H1-A3) suggest that there is a difference in PRODUCTION.
- Strong effects of F0 were observed
- The phonation contrasts were present in all positions but were not always well-defined.
- There has been a wide number of studies that have observed phonation differences based on gender, F0, and position. For example females are often described as being breathier than males (though this was not true all the time) and prosodic position produced different phonations. Additionally, all of these cases involve allophonic or suprasegmental phonation (i.e., non-phonemic)
- Very little work has investigated languages with phonemic phonation contrasts
- Jalapa Mazatec and San Lucas Quiaviní Zapotec are some of the few that have seen some study.
- In those studies females were breathier than the male speaker.
- SADVZ is an ideal language to study the variation in phonation because it has relatively free word order and the contrastive phonation that exists.
- Spectral measurements have been found to be very useful measure of phonation in a wide number of different languages.
- Most of these have been focused on H1-H2, however, relationships with H1 compared to higher harmonics have also been found to be useful.
- Most previous studies have not used corrected or normalized measure but have been focused on a single vowel /a/ because it minimizes the effects of the F1
- Esposito focuses on H1-H2 (open quotient) and H1-A3 (speed of vocal fold closure) based on a pilot study she ran in 2003.
- Vowel measurements were made by splitting the vowel into four equal parts and h1-h2 and h1-h3 measurements were made in the last quarter of each vowel.
- H1-A3 and H1*-A3* were effective in distinguishing the different phonation types in males. The difference between corrected and uncorrected were not significant.

- H1-H2 was effective for females speakers.
- The fact that h1-h2 was effective for females and h1-a3 for males suggests that they are using different laryngeal settings. Female speakers are making more use of open-quotient whereas male speakers are using the speed of vocal fold closure to distinguish the different phonation types.
- When looking at whether or not there is an effect for prosodic position it was observed that F0 had more of an effect than position.
- What was found was that all three contrasts were maintained but differed in how clearly they are produced.

6.2 Jaye Meeting

- Happy with the progress
- The biggest thing that Jaye suggested was to go through Silverman (1997) and see where my data supports or refutes the claims made by Silverman
  - Pay attention to H and L for checked and laryngealized.
- Additionally, Jaye suggests that it might be useful to look at SoE measurements (Hillenbrand, Cleveland & Erickson 1994, Hillenbrand & Houde 1996).

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