[SG] and Final Consonant Allophony in Tz'utujil

Maya C. Wax Cavallaro
University of California, Santa Cruz

1 Introduction

Much of the literature on final laryngeal phenomena has focused on neutralization (e.g. Lombardi 1995, Wetzels & Mascaró 2001, Iverson & Salmons 2006). Final obstruent devoicing is quite common cross-linguistically, and it often leads to partial or complete neutralization of a contrast between voiced and voiceless phonemes. Questions have arisen as to the nature of the laryngeal features at play in these neutralizations. It has been convincingly argued (e.g. Beckman et al. 2013) that Dutch, for example, has a true voicing distinction, contrasting voiced (negative VOT) phonemes with voiceless (positive VOT) counterparts, while closely-related German has an aspiration distinction. The latter contrast is a matter of [spread glottis] ([SG]), rather than [voice].

Sonorant devoicing differs from obstruent devoicing in that the default state of sonorants is generally believed to be [+voice] (i.e. sonorant devoicing is the emergence of a marked form). While all spoken languages have phonemes that could be described as voiceless stops, contrastive voiceless sonorants only occur in about 5% of languages (Blevins 2018). Sonorant devoicing is widely attested as an assimilation/coarticulation phenomenon. In English, for example, sonorants devoice immediately following [+SG] obstruents (voiceless aspirated stops) in words like *pray* and *clay*, while in Icelandic, sonorants devoice preceding [+SG] obstruents in a regressive assimilation pattern (Hansson 2003, Árnason 2011).

Sonorant devoicing is also attested phrase/utterance-finally, likely as part of a general pattern of phrase-final devoicing. Blevins (2006) describes a laryngeal spreading gesture used to mark the right edge of phrase-boundaries, while Ohala (1983) suggests that the glottis spreads due to coarticulation with an anticipated non-speech, relaxed-breathing pause. Myers and Padgett (2014) similarly discuss vocal fold spreading in anticipation of post-utterance breathing, as well as the decline over the course of the utterance of the subglottal pressure necessary to drive vocal fold vibration. They posit that word-final devoicing results from the phonologization of this phonetically-driven devoicing and generalization to the word-level (see §4 for further discussion).

Tz'utujil provides an intriguing case of sonorant devoicing. The phenomenon is not neutralizing, as there is no phonemic contrast between voiced and voiceless sonorants. There is no wider pattern of final devoicing in the language. (There are no voiced pulmonic obstruents.) Sonorant devoicing in Tz'utujil is not assimilatory. It is purely positional—that is to say it occurs syllable-finally, regardless of the laryngeal features of surrounding segments. The devoicing of Tz'utujil sonorants is also interesting in that it is not limited to utterance- or even word-final position. With the exception of nasals (which devoice word-finally but not word-internally), sonorants devoice in all syllable codas. This makes the process potentially difficult to justify on phonetic grounds (see §4).

Tz'utujil also differs from many of the languages featured in work on final devoicing and laryngeal neutralization in that its consonant inventory does not contain a straightforward binary contrast between either voiced and voiceless obstruents (a [voice] contrast) or aspirated and unaspirated obstruents (a [SG] contrast). Instead, Tz'utujil contrasts a set of 'simple' voiceless stops and affricates with a set of glottalized ([+constricted glottis]) ejectives and implosives (see §2 for consonant inventory). While [constricted glottis] ([CG]) is active in creating phonemic contrasts, it is not the laryngeal feature responsible for sonorant alternations. This raises questions about what it means for a feature to be active in the phonology of a language. I discuss this in terms of the Contrastivist Hypothesis (Hall 2007, Dresher 2009) in (§4) below.

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In Tz'utujil, sonorant devoicing patterns with final aspiration of simple stops and affricates. Because both devoiced sonorants and aspirated obstruents are produced with spread vocal folds (I discuss this further in §2), I propose an Optimality Theoretic (OT) analysis of both final devoicing and final aspiration in Tz'utujil in terms of positional constraints on [SG]. The analysis accounts for variation in these phenomena seen across the Mayan family and predicts an implicational typological relationship between final nasal devoicing, final sonorant devoicing, and final obstruent aspiration.

This paper is organized as follows. In §2 I provide some background on Tz'utujil and illustrate the phenomena in question with data from Dayley's (1985) grammar. I present my OT analysis in §3 and consider its typological implications. §4 contains brief discussion of Tz'utujil aspiration and devoicing as it relates to the Contrastivist Hypothesis, as well as potential phonetic motivations for these phenomena, and I conclude with some final remarks in §5.

2 Background

Tz'utujil is a K'ichean-branch Mayan language spoken by roughly 70,000 native speakers, mainly in the area to the south and west of Lake Atitlán in the Guatemalan highlands. The consonant inventory of Tz'utujil, shown in Figure 1, contrasts a set of 'simple' (voiceless pulmonic) stops and affricates with a corresponding set of glottalized (ejective and implosive) obstruents. It also includes voiceless fricatives and voiced sonorants.

	Bilabial	Alveolar	Alveo-affricate	Palato-alveolar	Velar	Uvular	Glottal
Obstruents							
Simple	p /p/	t /t/	tz /t͡s/	ch /t͡ʃ/	k /k/	q /q/	
Glottalized	b' /ɓ/	d' /ɗ/	tz' /t͡s'/	ch' /t͡ʃ'/	k' /k'/	q' /q'/	/ʔ/
Fricatives		s /s/		x /ʃ/		j /x/	
Sonorants							
Nasals	m /m/	n /n/					
Lateral		l /l/					
Trill		r /r/					
Glides	w /w/			y /j/			

Figure 1: Tz'utujil consonant phoneme inventory (orthography /IPA/)

As mentioned above, the inventory in Figure 1 does not contain any pairs of phonemes that differ only in their specifications for [voice], nor does it contain sounds that differ only in their specifications for [SG].

In Tz'utujil, simple stops and affricates are aspirated word-finally and before consonants (Dayley 1985), as shown in (1).

(1) Obstruent aspiration in Tz'utujil (Dayley 1985)

a.	*chikop*	[t͡ʃikɔ**pʰ**]	'animal'
b.	*tapq'iij*	[ta**pʰ**ɢ̆iːx]	'albino'
c.	*tut*	[tʊ**tʰ**]	'palmera'
d.	*utz*	[ʔʊ**t͡sʰ**]	'good'
e.	*kuuch*	[kuː**t͡ʃʰ**]	'pig'
f.	*kuuk*	[kuː**kʰ**]	'squirrel'
g.	*saq*	[sa**qʰ**]	'white'
h.	*saqb'ach*	[sa**qʰ**ɓa**t͡ʃʰ**]	'hailstone'

Liquids and approximants in (2) are devoiced syllable-finally.

(2) Liquid and approximant devoicing in Tz'utujil (Dayley 1985)

a.	*way*	[wa**j̥**]	'tortilla'
b.	*Moysees*	[mɔ**j̥**seːs]	'Moses'
c.	*kow*	[kɔ**ɸ**]	'hard'
d.	*tewlaj*	[tɛ**ɸ**lax]	'very cold'
e.	*jul*	[xʊ**l̥**]	'hole'
f.	*elnaq*	[ɛ**l̥**naqʰ]	'he has left'
g.	*q'or*	[qʔɔ**r̥**]	'lazy'
h.	*warnaq*	[wa**r̥**naqʰ]	'he has gone to sleep'

The coda sonorants in (2d), (2f), and (2h) all directly precede voiced consonants, yet they still devoice. This demonstrates that the devoicing is not assimilatory, but rather, it is associated with the coda position of syllables.

Nasal consonants in (3) devoice only word-finally and not word-internally.

(3) Nasal devoicing in Tz'utujil (Dayley 1985)

a.	*meem*	[meː**m͡m̥**]	'mute'
b.	*naan*	[naː**n͡n̥**]	'lady'
c.	*xinwa'i*	[ʃ**i**nwaʔi]	'I ate'[1]

While nasals pattern slightly differently, the distribution of aspirated stops and affricates in (1) and devoiced liquids and approximants in (2) is the same. Glottalized obstruents do not demonstrate comparable alternations, nor do fricatives.

Vaux (1998) argues that the unmarked state of voiceless fricatives is [+SG]. He bases this stance on phonetic evidence from Kingston (1990) and Stevens (1991) that voiceless fricatives are produced with a spread glottal gesture, as well as the phonological patterning of these sounds in several languages with rich systems of laryngeal contrasts. Voiceless fricatives tend to pattern with [+SG] voiceless aspirated obstruents. Vaux cites at least one language in which voiceless sonorants also pattern with voiceless aspirates and voiceless fricatives, noting that this supports the idea that voiceless sonorants are [+SG]. This is consistent with accounts of assimilatory sonorant devoicing, which tend to view it as spreading or sharing of a [SG] feature or spread glottal gesture from a [+SG] segment to a sonorant, resulting in a [+SG] voiceless sonorant. Essentially, devoicing is the sonorant equivalent of aspiration in obstruents.

I propose that both sonorant devoicing and simple obstruent aspiration in Tz'utujil are the result of positional constraints on [SG]. A [SG] feature associated with the right edge of syllables causes two seemingly different phenomena to occur in the same positions. In the next section, I will describe the active constraints in this language and how they predict an implicational relationship between final nasal devoicing, final sonorant devoicing, and final obstruent aspiration. These constraints can account for a variety of observed patterns of aspiration and devoicing across the Mayan family and beyond.

3 Analysis

This analysis needs to account not only for the fact that sonorants devoice and simple obstruents aspirate in coda position, but also for the slightly different distribution of nasal devoicing. While nasal consonants do not devoice word-internally, there are no sounds that devoice or aspirate word-internally but not word-finally. This suggests that there are constraints affecting all codas (including word-final) and constraints affecting only word-final consonants. This will be important in accounting for typological variation in §3.1.

[1] Dayley (1985) does not provide phonetic transcriptions for any examples with word-internal nasal codas, but, according to his description, the /n/ in the first-person singular absolutive prefix, *in-*, in *x-in-wa'-i* 'I ate' should not devoice.

I considered using alignment constraints (McCarthy & Prince 1993a, Ito & Mester 1994) to say that [+SG] is aligned with the right edge of the syllable and word in Tz'utujil. Such an analysis would need to account for the facts that 1) voiceless fricatives can occur in both onsets and codas, and 2) vowels do not devoice in open syllables. I believe this type of analysis is possible, but for simplicity's sake, I propose the markedness constraint in (4) against syllable-final consonants that are [-SG]. This constraint is rather similar to No-Voiced-Coda (Kager 1999, McCarthy 2008), but it restricts the distribution of [SG], rather than [voice].

*[-SG]Coda eliminates the problem of accounting for fricatives if, like Vaux (1998), we consider voiceless fricatives to be [+SG]. There is no active constraint against [+SG] onsets, and *[-SG]CODA is not violated by fricative codas because Tz'utujil's voiceless fricatives are not [-SG]. Open syllables are unaffected because the constraint refers to codas specifically. In §4 I discuss some possible phonetic motivations for final [SG], including enhancement of contrasts and generalization of phrase-final phenomena. My analysis also includes a faithfulness constraint that preserves underlying values for [SG].

(4) *[-SG]CODA
Assign one violation mark for every consonant that occurs in the coda of a syllable and is [-SG].

IDENT([SG])
Let input = $i_1 i_2 i_3 \ldots i_n$ and output = $o_1 o_2 o_3 \ldots o_m$.
Assign one violation mark for every pair (i_x, o_y), where i_x ℜ o_y and i_x and o_y have different values for [SG].

If IDENT([SG]) is dominated by *[-SG]CODA, as well as other faithfulness constraints like MAX (no deletion) and DEP (no epenthesis), then final sonorant devoicing and final obstruent aspiration will occur.

(5) Sonorant devoicing in /xul/ → [xu̥l] 'hole'

/xul/	DEP	MAX	*[-SG]CODA	ID([SG])
a. xul			*W	L
b. ☞ xu̥l				*
c. xu		*W		L
d. xulu	*W			L

The input in (5) has a violation of *[-SG]CODA. It is possible to repair this violation using deletion (5c) or epenthesis (5d), however these repairs are dispreferred as long as the lowest-ranked faithfulness constraint is ID([SG]).

Like fricatives, glottalized consonants can occur in codas without undergoing alternations. They remain [+CG] and, therefore, [-SG] syllable-finally (and elsewhere). To account for this, I propose an undominated faithfulness constraint, in (6), preserving [CG] values.

(6) IDENT([CG])
Let input = $i_1 i_2 i_3 \ldots i_n$ and output = $o_1 o_2 o_3 \ldots o_m$.
Assign one violation mark for every pair (i_x, o_y), where i_x ℜ o_y and i_x and o_y have different values for [constricted glottis].

This constraint may not be necessary if one's theory of features does not require these phonemes to be specified for [SG], but for now I will assume they are [-SG]. As long as IDENT([CG]) is undominated, as in (7), ejectives and implosives will remain [-SG] and [+CG].

(7) /siːk'/ → [siːk'] 'tobacco'

/siːk'/	ID([CG])	*[-SG]CODA	ID([SG])
a. ☞ siːk'		*	
b. siːk^{h}	*W	L	*W

Without ID([CG]) in (7), the velar ejective would become an aspirated simple stop. ID([CG]) correctly preserves the glottalized/simple obstruent contrast in all positions.

To account for the nasal devoicing pattern, two additional markedness constraints are needed, given in (8). A constraint against word-final [-SG] consonants (*FINAL[-SG]) is similar to, but less stringent than the *[-SG]CODA constraint above. *N̥ penalizes voiceless nasals, as the unmarked state of nasal consonants is voiced. Ranking a markedness constraint such as *N̥ between the less-stringent *FINAL[-SG] and more-stringent *[-SG]CODA will allow the marked form to surface only word-finally, but not word-internally.

(8) *FINAL[-SG]
Assign one violation mark for every consonant that occurs word-finally and is [-SG].

*VOICELESSNASAL (*N̥)
Assign one violation mark for every nasal consonant that is [-voice].

To produce Tz'utujil's word-final nasal devoicing, *N̥ must dominate *[-SG]CODA and be dominated by *FINAL[-SG], as in (9) and (10).

(9) /ʃinwaʔi/ → [ʃinwaʔi] 'I ate'

/ʃinwaʔi/	*FINAL[-SG]	*N̥	*[-SG]CODA	ID([SG])
a. ☞ ʃinwaʔi			*	
b. ʃin͡n̥waʔi		*W	L	*W

(10) /naːn/ → [naːn͡n̥] 'lady'

/naːn/	*FINAL[-SG]	*N̥	*[-SG]CODA	ID([SG])
a. naːn	*W	L	*W	L
b. ☞ naːn͡n̥		*		*

In (9), the ranking of *N̥ >> *[-SG]CODA prevents the word-internal coda nasal from devoicing. In contrast, the final nasal in (10) devoices because of the ranking of *FINAL[-SG] >> *N̥.

3.1 *Typology and predictions* Kaqchikel, a closely-related K'ichean (Mayan) language, shares a consonant inventory with Tz'utujil and shows nearly the same patterns of simple stop/affricate aspiration and sonorant devoicing. In Kaqchikel, however, nasal consonants do not devoice in any context. A difference in constraint rankings between these two neighboring varieties can account for this difference.

While Tz'utujil has a ranking of *FINAL[-SG] >> *N̥ >> *[-SG]CODA, *N̥ is undominated in Kaqchikel. The tableaux in (11) and (12) show how this slight difference in constraint rankings allows Tz'utujil to devoice the word-final nasal while Kaqchikel preserves nasal voicing in the cognate words for 'mute'.

(11) /meːm/ → [meːm͡m̥] 'mute' in Tz'utujil; *FINAL[-SG] >> *N̥ >> *[-SG]CODA

/meːm/	*FINAL[-SG]	*N̥	*[-SG]CODA	ID([SG])
a. meːm	*W	L	*W	L
b. ☞ meːm͡m̥		*		*

(12) /mem/ → [mem] 'mute' in Kaqchikel; *N̥ >> *FINAL[-SG], *[-SG]CODA

/mem/	*N̥	*FINAL[-SG]	*[-SG]CODA	ID([SG])
a. ☞ mem		*	*	
b. mem͡m̥	*W	L	L	*W

In both languages *[-SG]CODA dominates ID([SG]), so coda obstruents will aspirate and coda sonorants will devoice. ID([CG]) is undominated, so glottalized consonants will not become [+SG] pulmonic consonants syllable-finally. The difference in constraint rankings between Kaqchikel and Tz'utujil can be seen in the Hasse diagrams in Figure 2 below.

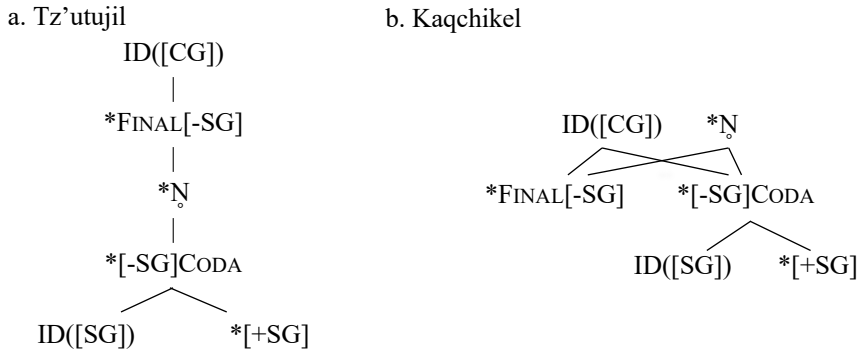

Figure 2: Hasse diagrams for Tz'utujil (left) and Kaqchikel (right)

In the case of Kaqchikel in Figure 2b, *FINAL[-SG] is essentially rendered inactive due to its stringency relation with *[-SG]CODA and the fact that no constraints are dominated only by the former but not the latter. Any sounds that aspirate/devoice word-finally will also aspirate/devoice in all codas. It is, however, still important that ID([CG]) and *N̥ are not dominated by *FINAL[-SG]. *FINAL[-SG] plays a more active role in Tz'utujil because a constraint (*N̥) is ranked in between *FINAL[-SG] and *[-SG]CODA.

I have included a constraint penalizing [+SG] segments (*[+SG]) in Figure 2. If ranked high enough—above *[-SG]CODA or *FINAL[-SG]—such a constraint would prevent both sonorant devoicing and obstruent aspiration. *[+SG] predicts, for example, that there are languages with no aspirated stops, as is believed to be the case in true voicing distinction languages such as Spanish. Vaux and Samuels (2005), however, argue that voiceless aspirates are actually less-marked than plain voiceless stops. If this is the case, perhaps *[+SG] does not exist in CON.

In the Mayan language family, final aspiration is much more widely attested than final sonorant devoicing. While all but two of the roughly thirty Mayan languages spoken today have predictable final

aspiration, sonorant devoicing is found only in the K'ichean, Greater Tseltalan, and Huastecan branches of the language family (Bennett 2016). To account for aspiration-only languages, I introduce a constraint against voiceless sonorants (*R̥) in (13). This constraint makes sense because, as discussed above, voiced is the unmarked state for sonorants.

(13) *VOICELESSSONORANT (*R̥)
Assign one violation mark for every sonorant consonant that is [-voice].

Just as a ranking of *N̥ >> {*FINAL[-SG], *[-SG]CODA} bans nasal devoicing in Kaqchikel, a ranking of *R̥ >> {*FINAL[-SG], *[-SG]CODA} will prevent any voiceless sonorants from surfacing.

Because of the stringency relation between *FINAL[-SG] and *[-SG]CODA, these constraints predict that if a language allows word-internal aspiration or devoicing, it will allow that phenomenon word-finally as well. There could also be languages that allow only final, but not word-internal, aspiration/devoicing. This is the case in, for example, Popti' (Jiménez Camposeco et al. 2001), a Mayan language that has final aspiration, but not word-internal aspiration. What would not be expected is a language allowing word-medial, but not word-final, coda devoicing/aspiration.

The diagram in Figure 3 shows a constraint-ranking for a language with both word-medial and word-final aspiration, but no sonorant devoicing. Figure 4 shows a language with only word-final aspiration and no sonorant devoicing. Both of these types of languages are attested.

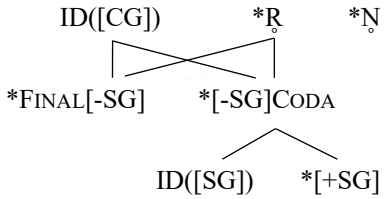

Figure 3: Hasse diagram - coda obstruent aspiration, no sonorant devoicing

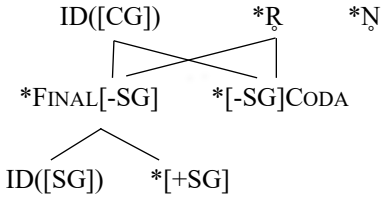

Figure 4: Hasse diagram - word-final aspiration, no sonorant devoicing

*N̥ is rendered inactive in these languages because of its stringency relation with the undominated *R̥. If there are no voiceless sonorants, there can be no voiceless nasals. If *[-SG]CODA dominates both ID([SG]) and *[+SG], as in Figure 3, all simple coda stops and affricates should aspirate. If *FINAL[-SG] dominates ID([SG]) and *[+SG], but *[-SG]CODA is dominated by either ID([SG]) or *[+SG], then there will be word-final aspiration, but not word-medial aspiration. The diagram in Figure 4 is simply meant to show that *[-SG]CODA does not dominate ID([SG]) and *[+SG] (though it could dominate one or the other).

The analysis in this section is able to account for variation in final obstruent aspiration and final sonorant devoicing across the Mayan language family. As summarized in (14), the current constraint set predicts that if a language allows final sonorant devoicing, it will also have final obstruent aspiration, and that if a language devoices final nasals, it will also devoice other final sonorants.

(14) Implicational prediction
final nasal devoicing ⇒ final sonorant devoicing ⇒ final obstruent aspiration

There are languages that show similar final aspiration phenomena, but not final sonorant devoicing, such as Nuntajɨiyi (Elson 1947) and Kashmiri (Vaux and Samuels 2005). Whether there are languages that challenge this prediction remains a question for further research.

If there was a markedness constraint against aspirated obstruents specifically (*T^{h}), rather than [+SG] segments in general, then there could theoretically be languages that allow sonorant devoicing but not obstruent aspiration (undominated *T^{h}) or sonorant devoicing in more contexts than obstruent aspiration. For example, a ranking of *FINAL[-SG] >> *T^{h} >> *[-SG]CODA >> {*R̥, *N̥, *[+SG]} would allow sonorant devoicing in all codas, but stop/affricate aspiration only word-finally. So far, I have found no typological evidence for such a constraint.

3.2 *Alternative analysis* Up to this point, I have somewhat oversimplified the distribution of stop/affricate aspiration in Tz'utujil. Dayley (1985) says that simple stops and affricates aspirate word-finally and before consonants, rather than just syllable-finally, because of words like those in (15).

(15) Obstruent aspiration in Tz'utujil (Dayle 1985)

a.	*tkami*	[t^{h}kami]	'that he die'
b.	*chpaan*	[t͡ʃ^{h}paːnn̥]	'in it'

In what appear to be onset clusters, simple stops and affricates aspirate before other consonants. Another way to describe this generalization would be to say that simple stops and affricates are only unaspirated before vowels. Aspirated stops and affricates appear to be the more general case. This might suggest that these consonants are underlyingly aspirated, which would be consistent with Vaux and Samuels' (2005) claim that voiceless aspirates may be less marked than 'plain' voiceless consonants. Most accounts of Mayan aspiration (e.g. Bennett 2010), however, assume that aspiration is phonetically-motivated allophony and that the underlying representation is unaspirated (see §4 for more on phonetic motivation).

The analysis above can still account for final aspiration and devoicing in Tz'utujil, regardless of whether stops and affricates are underlyingly [+SG], with the addition of a constraint against prevocalic aspirated consonants like *T^{h}V in (16).

(16) *T^{h}V
Assign one violation mark for every aspirated consonant directly preceding a vowel within the same word.

Such a constraint would effectively account for forms like those in (15), as demonstrated in (17).

(17) /t^{h}k^{h}ami/ → [t^{h}kami] 'that he die'; *T^{h}V >> ID([SG])

	/t^{h}k^{h}ami/	*T^{h}V	ID([SG])
a.	t^{h}k^{h}ami	*W	L
b. ☞	t^{h}kami		*
c.	tkami		**W

An appealing consequence of *T^{h}V is that its addition to the active constraints will produce the attested Tz'utujil aspiration patterns, regardless of whether the input is underlyingly aspirated or unaspirated. While this constraint is effective, it is not necessarily well-justified phonetically or typologically. Many languages, such as English, have prevocalic aspiration but not coda aspiration.

It may also be possible to account for the data in (15) without an additional constraint like *T^{h}V or underlying [+SG] stops and affricates. The onset clusters in (15) are morphologically complex and may even be the result of historical deletion. If we can somehow analyze them as coda-like, the prior analysis stands, as shown in (18). Here, our definitions of codas and [SG] constraints are important. If, for example, the *t-*

prefix in *tkami* is considered syllabic, then it is coda-like in that it is a consonant at the right edge of the syllable. If *[-SG]CODA is defined in terms of right-edge [-SG] consonants, then it should apply to syllabic *t-*. It is also possible that *t-* was historically in a coda position, and it retained a sort of coda feature as the rest of the morpheme underwent deletion.

(18) /tkami/ → [tʰkami] 'that he die'

	/t.ka.mi/	*[-SG]CODA	ID([SG])
a.	t.ka.mi	*W	L
b. ☞	tʰ.ka.mi		*
c.	tʰ.kʰa.mi		**W

It is worth noting that in at least one variety of Tz'utujil, this type of cluster can be evaded altogether via vowel epenthesis. In San Juan la Laguna, 'that he die' is realized as [tikami], though this is optional for some speakers (Dayley 1985:48).

While I will assume these segments are not underlyingly [+SG] for now, I do not want to discount entirely the possibility that simple stops and affricates could be underlyingly [+SG]. If evidence arose supporting such an analysis, then, as shown in this section, constraints could be adjusted accordingly. Underlying [+SG] stops and affricates might, however, have consequences for the discussion of features and contrast below.

4 Discussion

4.1 *Features and contrast* My above analysis of aspiration and devoicing as [SG] phenomena could potentially provide a puzzle for the Contrastivist Hypothesis (Hall 2007, Dresher 2009) in (19), which claims that the only features active in a language's phonology are those active in creating phonemic contrasts in that language.

(19) The Contrastivist Hypothesis and its corollary (Dresher 2015)
- A. The Contrastivist Hypothesis (Hall 2007)
  The phonological component of a language L operates only on those features which are necessary to distinguish the phonemes of L from one another.
- B. Corollary to the Contrastivist Hypothesis
  If a feature is phonologically active, then it must be contrastive.

At a glance, the consonant phoneme inventory of Tz'utujil does not appear to have [SG] (or [voice]) contrasts. It contrasts a set of [+CG] glottalized stops and affricates (/ɓ, ɗ, kʼ, qʼ, t͡sʼ, t͡ʃʼ, ʔ/) with a set of corresponding 'simple' stops and affricates (/p, t, k, q, t͡s, t͡ʃ/) and also includes voiceless fricatives (/s, ʃ, x/) and voiced sonorants (/m, n, l, r, w, j/). It is possible to say that none of these sounds are [+SG] underlyingly, though I believe that at least the voiceless fricatives are [+SG] (see §2 for discussion).

Even if we assume simple stops and affricates are underlyingly [+SG], there is redundancy in the contrast between those obstruents and the set of glottalized obstruents. One cannot clearly say that the difference between those sets is a matter of [+SG] vs. [−SG] because they also have a [+CG] vs. [-CG] contrast. Similarly, while the fricatives contrast with stops and affricates with corresponding places of articulation, they contrast not only in terms of [±SG], but also manner of articulation ([±continuant]).

Dresher (2009), however, warns that contrastive feature specifications are not always simple to ascertain at first glance. He proposes the Successive Division Algorithm (SDA) in (20) to derive language-specific hierarchies of contrastive features, in which phonemes are specified only for those features that serve to distinguish them from one another.

(20) The Successive Division Algorithm (Dresher 2009)
- A. Begin with no feature specifications: assume all sounds are allophones of a single undifferentiated phoneme.
- B. If the set is found to consist of more than one contrasting member, select a feature and divide the set into as many subsets as the feature allows for.
- C. Repeat step (b) in each subset: keep dividing up the inventory into sets, applying successive features in turn, until every set has only one member.

While the SDA seems straightforward, it does little to prescribe any particular order of divisions, and it is thus possible to create a great number of feature hierarchies for any given language. Identifying the right hierarchy comes down to finding the feature specifications that work best with the phonological facts of a given language, which can be somewhat tricky. It is possible to derive a hierarchy of contrastive features for Tz'utujil in which simple stops and affricates and sonorants are all specified [-SG], allowing for the analysis in §3, as long as we assume that some sounds are underlyingly [+SG]. If, for example, the hierarchy has [SG] at the top, contrasting [+SG] voiceless fricatives with the other [-SG] consonants, the resulting feature specification could look something like (21).

(21) Possible feature specifications for Tz'utujil - [SG] > [sonorant] > {[CG], [nasal]}

fricatives	nasals	liquids /approx.	simple obstruents	glot. obstruents
[+SG]	[-SG]	[-SG]	[-SG]	[-SG]
	[+sonorant]	[+sonorant]	[-sonorant]	[-sonorant]
	[+nasal]	[-nasal]	[-CG]	[+CG]

It is also possible, however, to create feature hierarchies for Tz'utujil in which [SG] is not considered contrastive at all, or in which [SG] is contrastive for stops and affricates but not sonorants (or vice versa). Simply replacing [SG] with [continuant] in (21), for example, would eliminate [SG] from the hierarchy.

For my analysis in §3 to work under the Contrastivist Hypothesis, a hierarchy with [SG] at or near the top, like that in (21), would be desirable. The Contrastivist Hypothesis does, however, allow for non-contrastive features to surface post-phonologically for purposes of phonetically enhancing phonological contrasts. Dresher (2009) gives the example of the common three-vowel inventory, /i, a, u/. If there is evidence that [round] and [low] are active in the phonology (for example, if /u/ causes phonological rounding), the vowels could be said to have the contrastive specifications given in (22).

(22) Contrastive feature specifications for /i, a, u/ inventory (Dresher 2009)

a	u	i
[+low]	[-low]	[-low]
	[+round]	[-round]

While [high] and [back] are not considered contrastive in this inventory, Dresher claims that the contrastively [+round] vowel is enhanced by the noncontrastive feature [back] and the contrastively non-low vowels are enhanced by [high], resulting in this dispersed inventory that is much more typologically common than less-dispersed inventories. (See Hall 2011 for a Contrastivist account of dispersedness.)

Under the Contrastivist Hypothesis, therefore, there are four possible accounts for the Tz'utujil phenomena in question.

(23) Possible accounts for Tz'utujil devoicing and aspiration under the Contrastivist Hypothesis
- a. [SG] is contrastive for all relevant phonemes, and the analysis in §3 holds.
- b. [SG] is contrastive for obstruents but not sonorants. Sonorant devoicing is either post-phonological contrast-enhancement or, perhaps, a phonological [voice] alternation.
- c. [SG] is contrastive for sonorants, but not stops or affricates. Aspiration is a post-phonological contrast-enhancement.
- d. [SG] is not contrastive for sonorants or stops/affricates, and aspiration/devoicing are post-phonological contrast-enhancement processes.

This is not a particularly satisfying analysis. A consonant inventory like that of Tz'utujil provides a great deal of room for interpretation under the Contrastivist Hypothesis because it is not entirely clear which laryngeal features are at play. Which of these accounts best fits the phonetic and phonological facts of this language is beyond the scope of this paper and will be left for future work. For now, I turn my focus to possible phonetic pressures that could be motivating final aspiration and devoicing, whether these phenomena are considered phonological or not.

4.2 *Phonetic motivation* In his dispersion-based analysis of final stop aspiration in Tz'utujil, Bennet (2010) claims that aspiration enhances both place of articulation and laryngeal state contrasts in positions in which the phonetic cues to those contrasts are weaker (i.e. codas). Bennett's account is not a post-phonological one, but rather a matter of phonetically-motivated phonology. One could, however, apply his analysis to a Contrastivist account such as (23c). Given a contrastive feature hierarchy in which [SG] is not specified for stops/affricates, one could argue that [SG] surfaces phonetically to enhance place of articulation features and the contrast between [+CG] and [-CG] obstruents. Bennett (2010) does not, however, account for sonorant devoicing. It would be interesting to see if somehow adding [+SG] to sonorants could enhance any cues to contrast.

Another potential phonetic motivation for final sonorant devoicing could be domain generalization. As mentioned in §1, Myers and Padgett (2014) claim that there is a phonetic basis for utterance-final devoicing, but not word-final devoicing. The former is motivated by a decline in the subglottal pressure necessary to maintain voicing over the course of an utterance, as well as an anticipatory spreading of the vocal folds as speakers prepare to breathe. If this spreading of the vocal folds is interpreted as [SG], this analysis could be applied to both aspiration and devoicing. Learners, as Myers and Padgett show, will generalize rules from the phrase-level to the word-level because of a bias towards word-level phonology. Tz'utujil aspiration and devoicing, however, would be examples of generalization from the phrase-level to the syllable-level. This may be possible under certain theories of domain generalization.

5 Conclusion

Positional sonorant devoicing in Tz'utujil is both typologically rare and tricky to account for in terms of phonetic motivation. The spreading of the vocal folds associated with both sonorant devoicing and obstruent aspiration, as well as the fact they pattern together, supports an analysis of both phenomena in terms of [SG]. The analysis in §3 predicts that final obstruent aspiration should be typologically more widely attested than final sonorant devoicing and that languages which allow the latter will also allow the former. This is the case within the Mayan language family, and it seems plausible cross-linguistically.

It is still somewhat contentious whether voiceless fricatives are, or can be, specified [+SG], and it is not readily apparent whether Tz'utujil simple stops and affricates are underlyingly [+SG]. This uncertainty about the laryngeal features involved in the phonemic inventory of Tz'utujil makes the language difficult to analyze with regards to a framework such as the Contrastivist Hypothesis. Perhaps Tz'utujil and the Mayan language family can help to shed light on the typology of laryngeal features and alternations, as well as the role of contrast in phonology.

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