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The tonal morphology of the potential in Coatec Zapotec (Di'zhke'): Implications for early Zapotecan tone, *ʔ, and verb classes through internal and comparative reconstruction

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Abstract: While the phenomenon of tonogenesis is well represented in the literature, diachronic tone change in already-tonal languages has received less attention. This paper considers two types of tonal morphology used to mark the “potential” inflectional category on verbs in Coatec Zapotec (aka Di'zhke'). Some verbs are marked with upstep. Coatec upstepped tones are emergent tonal contrasts that are developing out of high register allotones which assimilated to a historical high tone on a now-deleted preceding syllable. Other verbs display patterns of tone ablaut such that a verb with underlying low or falling tone surfaces with high or rising in the potential. Both upstep and tone ablaut in Coatec can be traced to an earlier floating high tone that could dock onto different syllables according to a set of ranked constraints. Using a combination of internal and comparative reconstruction, details of the earlier tonal system are revealed. This is the first published treatment of Proto-Zapotec tone since Swadesh (1947) and the first paper to address tone in Proto-Zapotecan and Proto Core Zapotec. *ʔ is revealed to have been a consonant through the Core Zapotec period, suggesting that the complex systems of phonation contrasts found in some Central Zapotec languages are a recent development. Cases of tonal contrasts developing out of phonation contrasts are known from Southeast Asia, but Zapotec phonation contrasts arose out of interaction between the glottal consonant and pre-existing tonal contrasts. An exploration of the morphological environments conducive to upstep leads to new discoveries about Zapotecan derivational voice prefixes and reveals the origins of perfective allomorphy.

Key words: internal reconstruction, tone, Zapotec, verbal morphology, register, vowel loss, phonation

1. Introduction¹

Zapotec languages have a “potential” inflectional category marked on verbs. This form is used to express possible future events, polite commands, exhortatives, prohibitives, and some types of clausal complements. Throughout the Zapotec subfamily, there are categorical tone changes, such that a verb will surface with high or rising tone in the potential, even when it has a different underlying tone that surfaces in the rest of the paradigm. Such alternations are generally analyzed as the result of a floating high tone that marks the potential (Beam de Azcona 2004a; Broadwell 2015a: 84; Pérez Báez & Kaufman 2017: 224–225; Sicoli 2007, 2015: 192). In Di'zhke' [ði(ʔ)ʂkeʔ], or Coatec Zapotec, the historical loss of segmental contrasts has erased earlier environments that conditioned different tonal alternations, making it difficult to predict, based on the synchronic phonology, which tonal alternations a given verb will exhibit. Additionally, some verbs instead undergo a process of upstep to a higher register, without a categorical tone change. (1) shows three different patterns which occur on

¹ Cada apartado se explica en español en un video hecho por la autora. El video para este apartado está en <https://www.youtube.com/watch?v=1118GRWwVoY&t=263s>, donde en la descripción se encuentran ligas a los videos sobre los otros apartados.

phonologically similar forms, in this case consonant-initial, low-toned, open syllables. Though all three verbs have underlying low tone, which occurs in the rest of the paradigm, the potential of (1a) has high tone, (1b) has rising tone, and (1c) has an upstepped low tone.

(1) Potential marking on low-toned C-stems

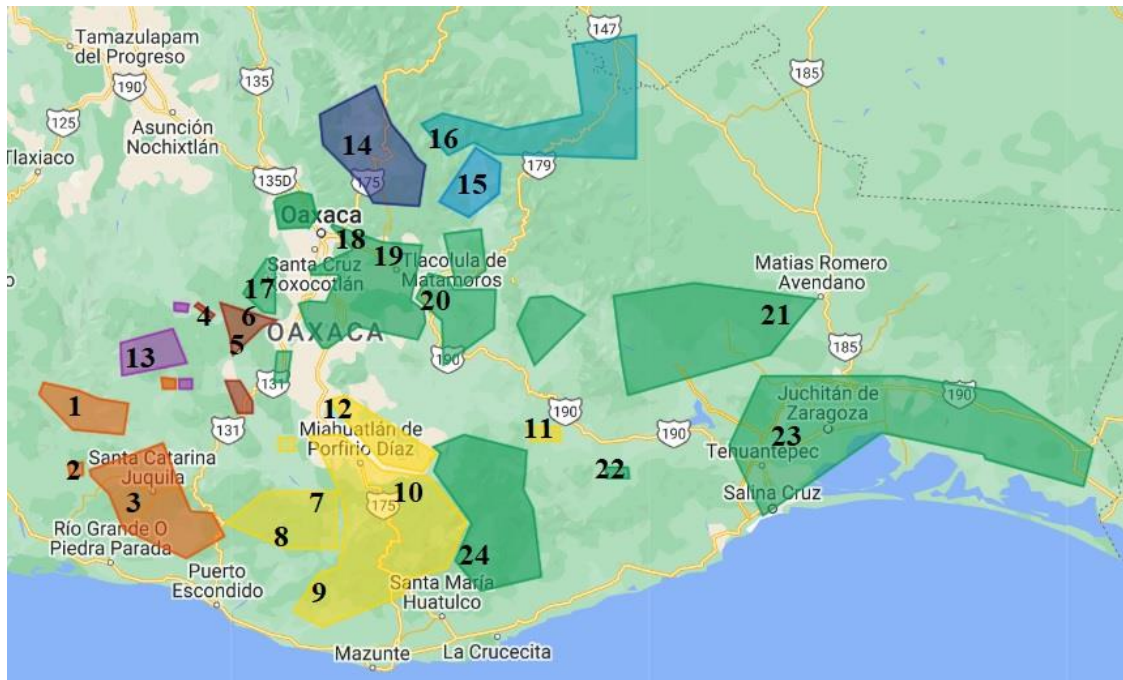
	Bare Root	Potential	
(a)	/zǝ̀/	/zǝ̀/	‘become full’
(b)	/zǝ̀/	/zǝ̀/	‘get burnt’
(c)	/tsà̀/	/↑wtsà̀/	‘cover or close something’

Today these patterns must be memorized by speakers and are best understood in a word-and-paradigm model (Matthews 1965; Blevins 2016), but I will argue that in an earlier system these words’ tonal behavior was phonologically predictable. Proto-Zapotecan words, excluding compounds, consisted of 1–3 syllables, and I will propose that in an ancestor of Coatec the floating high tone could dock onto the pre-tonic, tonic, and/or post-tonic syllable. Which syllable became host for the high tone depended on the word’s morphological structure, the number of syllables, and the underlying tonal melody. This paper contributes to Zapotecan linguistics by making new proposals about early verbal morphology and tone systems, but the broader contribution to historical linguistics is by adding to the relatively scant literature on tone change beyond tonogenesis.

Zapotecan languages use tone and phonation contrasts to distinguish between lexical items and grammatical categories. I estimate that there are approximately 27 Zapotecan languages spoken today (another two having gone dormant in the last two centuries) and perhaps fewer than ten of these have published, reliable, and in-depth descriptions of their suprasegmental phonology and morphology, though this is gradually improving. A preliminary reconstruction of Proto-Zapotec tone was made by Swadesh (1947) based on two languages. Some work has been published on suprasegmental reconstruction for the Chatino (Campbell 2021, 2022) and Southern Zapotec (Beam de Azcona 2008, 2013) subgroups, but suprasegmental phonology and morphology remain neglected in the reconstruction of Proto-Zapotec and Proto-Zapotecan. This paper looks at four morphological patterns in which changes in the surface tone of a verb mark the potential in Coatec. These patterns, along with comparative evidence, suggest inferences about the behavior of morphological tone in earlier forms of Zapotec and how the tonal system may change due to vowel loss.

Map 1 shows the Zapotecan languages in Oaxaca, Mexico. Numbers have been assigned to those varieties mentioned in this paper, whose genetic affiliation is indicated in Figure 1, a simplified version of the classification in Beam de Azcona (2023, Forthcoming, In Preparation). The Macro-Zapotec subgroup is introduced here based on a morphological reduction discussed in Section 4.5.1.

The tonal morphology of the potential in Coatec Zapotec (Di'zhke')



Map 1. Location of Varieties and Languages Referred to in this Paper (Map data: Google)

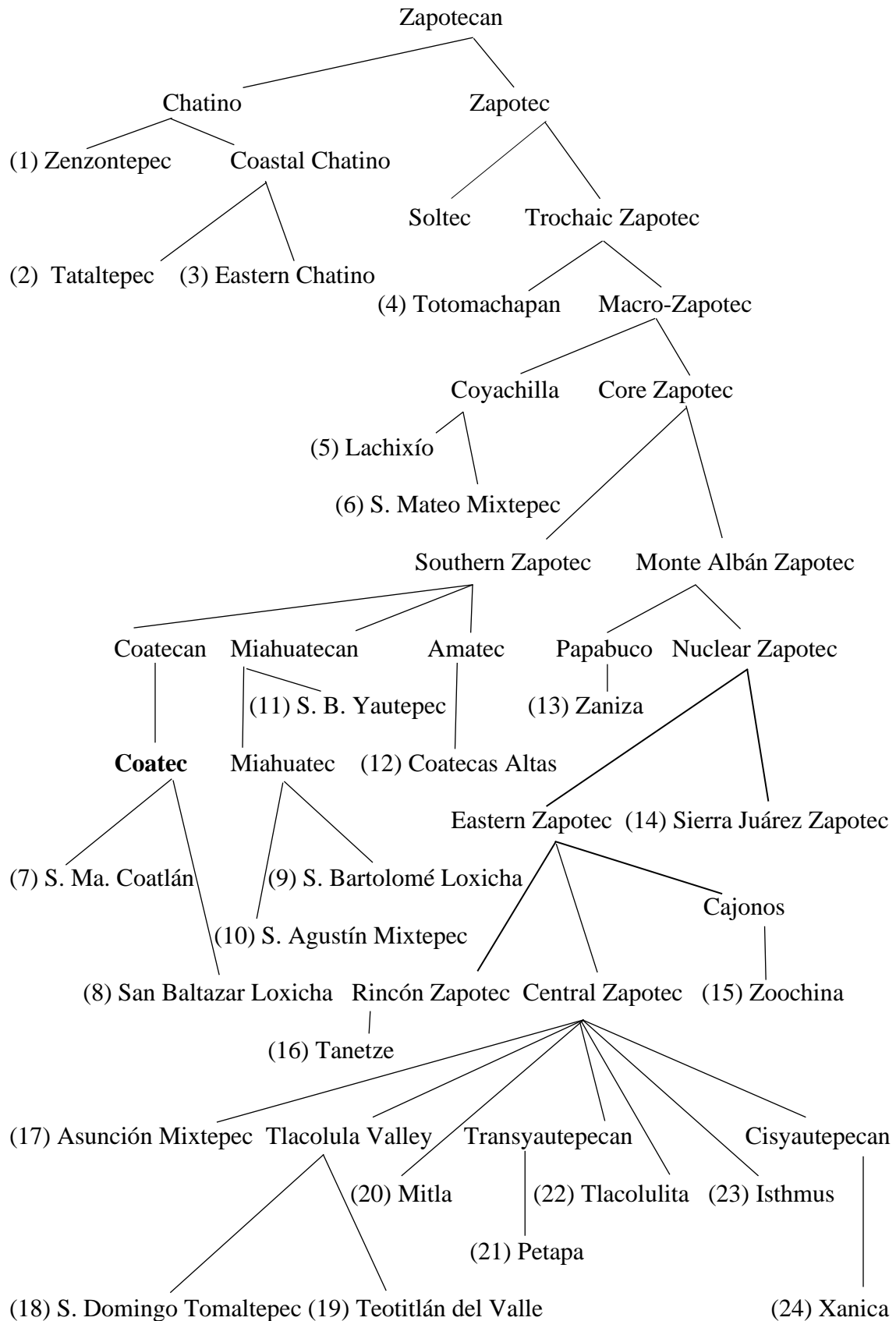


Figure 1. Genetic Affiliation of Languages and Varieties Mentioned in this Paper

Coatec is spoken by a handful of elderly speakers in each of six municipalities: Santa María, San Miguel, San Sebastián, and San Jerónimo Coatlán in the district of Miahuatlán; and Santa Catarina and San Baltazar Loxicha in the district of Pochutla. The patterns described here were originally worked out through collaboration with Lázaro Díaz Pacheco, of San Baltazar Loxicha, and were subsequently confirmed and supplemented using recordings I had previously made with Javier Santos Velásquez of Santa María Coatlán as part of the Project for the Documentation of the Languages of Meso-America, and by later recordings made of additional speakers in both these towns as part of the Survey of Zapotec and Chatino Languages (Sicoli & Kaufman 2010), found using the online search tool (Sicoli & Ko 2016). This paper can be considered a case study of how internal reconstruction of a highly endangered language can have important implications for the reconstruction of earlier tonal systems (on this point, see also Campbell 2022).

I begin with information about Zapotec verbs in Section 2, followed by Coatec potential-marking suprasegmental morphology in Section 3. In Section 4, I propose historical explanations for the different patterns, before concluding in Section 5.

2. Zapotec verbs

There is not much difference between Proto-Zapotecan and Proto-Zapotec (currently I posit one sound change, *s > *ʃ, between the two). All modern Zapotec languages descend from Proto Trochaic Zapotec (PTZ). Proto-Zapotec and PTZ differ due to a stress shift that is reflected in all modern languages but which philological evidence indicates did not occur in Soltec. However, a number of other features are ambiguous as to whether they emerged in Proto-Zapotec or PTZ, because of the lack of information about Soltec. To posit a given variable in Proto-Zapotec, that variable has to also be attested in Chatino (or a related family like Popolocan), making it reconstructable to Proto-Zapotecan as well, or should be attested in Soltec as well as a modern Zapotec language. We have no tonal data for Soltec, and very little information about Soltec verbal morphology. When discussing reconstructed features in this section, the segmental reconstructions can be traced to the Proto-Zapotecan time depth, whereas the prosodic features, like root-initial stress and a floating high tone to mark the potential, can only be traced as far back as PTZ.

Relevant to the topics discussed in this paper are three general points about Zapotec verbs: the prosodic patterns of their roots and stems (Section 2.1), the inflectional classes they fall into (Section 2.2), and the voice prefixes used to derive verbs in antiquity (Section 2.3).

2.1 Prosody of Proto Trochaic Zapotec roots and stems

Throughout the paper, I will be referring to the idea that Zapotec inflectional stems can begin in vowels, hereafter “V-stems,” or in consonants, hereafter “C-stems.” Since PTZ times, the root-initial syllable has been the most prominent in the phonological word. This syllable is stressed by Hyman’s (2006: 231) definition. I will refer to stressed syllables as “tonic syllables” and to the unstressed syllables that precede and follow as “pre-tonic” and “post-tonic.”

PTZ roots consisted minimally of a single, tonic vowel. This vowel was normally, but not always, preceded by a consonant and usually, but not always, followed by a post-tonic syllable in the same root, as shown in (2), where the symbol ' marks the beginning

of the tonic syllable. The bare root itself usually served as the base to which derivational prefixes could attach. An inflectional stem could be the bare root or could include derivational morphology, as shown in (3). All surface forms of main verbs were obligatorily inflected with an aspect or mood prefix, which always had a consonant and sometimes had a vowel. Thus, an inflected verb had the underlying shape shown in (4) as exemplified by the perfective² form of ‘eat.’

- | | | | | |
|-----|--------------------------------------|-------------------|-------|--------------------|
| (2) | *'(C)V(CV) | Bare root | e.g., | *'aku ³ |
| (3) | *(V-)(C-)'(C)V(CV) | Inflectional stem | e.g., | *'θ-aku |
| (4) | *C(V)-(V-)(C-)'(C)V(CV) ⁴ | Conjugated verb | e.g., | *ku-'θ-aku |

When a syllabic prefix attaches to a consonant-initial form, as in (4), it is always pre-tonic. However, when a syllabic prefix concatenates with a stem or base that begins in a tonic vowel, the prefix will fuse with the root and become part of the tonic syllable. For example, I reconstruct the PTZ root ‘die’ as *'akθi. The perfective prefix *ku- concatenated with *θ-aku in (4) is pre-tonic, but the perfective form of ‘die’ is *'kukθi, where presumably *a deletes and *ku becomes the tonic syllable, taking on the prominence of the deleted *a. Table 1 is slightly simplified but shows the basic shapes of surface forms for inflected verbs.

Table 1. Shapes of Inflected Verbs in Proto-Zapotec

Prefix shape	Stem shape	Surface form
*C-	*'V(CV)	*'CV(CV)
*C-	*'CV(CV)	*'CCV(CV)
*C-	*V'CV(CV)	*CV'CVCV
*CV-	*'V(CV)	*'CV(CV)
*CV-	*'CV(CV)	*CV'CV(CV)
*CV-	*V'CV(CV)	*CV'CV(CV)

Notice that some inflected verb forms in PTZ had a pre- and/or post-tonic syllable, while others did not. In Section 4, I will be referring to the pre-tonic, tonic, and post-tonic syllables of earlier Zapotec languages as possible hosts for the floating high tone that marks the potential. A majority of modern Zapotec languages, including Coatec, have lost at least some unstressed vowels (see Uchihara 2021 on conditioning factors for vowel loss in Central Zapotec), but a few languages retain them all.

2.2 Verb classes

Kaufman (1989, 2016) proposed that Proto-Zapotec verbs fell into the four classes shown in Table 2. Some patterns of tonal morphology discussed below are restricted by class membership. In Kaufman’s model, these classes are distinguished minimally by their potential and perfective allomorphs and the presence or absence of replacive prefixes. The latter refers to patterns of partial suppletion as in Coatec ‘scream’ with imperfective /n-b-êz/ and perfective /ŋw-t-êz/. Here /b/ and /t/ are prefixes that *replace* each other within the paradigm by occurring in the same position, after the TAM prefix and before the root.

² Often referred to as “completive” in the Zapotecan literature.

³ Reconstructed forms throughout are my own except where otherwise stated.

⁴ This canonical word shape is slightly simplified in that it ignores the possible coda consonants *k and *ʔ, vowel nasalization, and tone.

Table 2. Proto-Zapotec Verb Classes Based on Kaufman (1989, 2016)

	A	B	C	D
Potential	*ki- [H] ⁵	*ki- [H]	*k- [H]	*k- [H]
Perfective	*kwe-	*ko-	*ko-	*ko-
Replacives	--	--	--	✓

In this paper, I propose several adjustments to Kaufman's model. Some will be introduced in Section 4.5.1, but already here it is necessary to introduce three changes.

Table 3. First-Third Amendments to Kaufman's Model for Proto Trochaic Zapotec Verbs

	A	B	C	D
Potential	[H]	[H]	[H]	[H]
Irrealis	*ki-	*ki-	*k-	*k-
Perfective	*kwe-	*ku-	*ku-	*ku-
Replacives	--	--	--	✓

Table 3 contains three adjustments, justified below: the back rounded vowel is represented as *u rather than *o (Section 2.2.1), and the segmental and tonal markers formerly grouped together as marking the potential have been divided into irrealis mood and potential modality (Section 2.2.2). The third amendment is to label this table as relevant to Proto Trochaic Zapotec. Because the potential floating high tone is included, this model cannot be applied to Proto-Zapotecan, since this floating tone is absent in Chatino, nor to Proto-Zapotec, since we don't have tonal data for Soltec.

2.2.1 *The height of *u*

Kaufman (2016) reconstructed *o and *u as contrastive phonemes, but Beam de Azcona et al. (2018) argued that [o] and [u] did not contrast in Proto-Zapotec. This back rounded vowel was realized as *[u] in unstressed syllables (Fernández de Miranda 1995 [1965]). In stressed syllables, it was realized as *[u] when preceding a high vowel (*i or *[u]) in the following syllable, or as *[o] when preceding post-tonic *a or *e. A following *ʔ may have also influenced the vowel quality, though this needs further research. Beam de Azcona et al. represent this phoneme as *o, regarding *[u] as a conditioned allophone. However, in this paper I will represent it as *u. This is justified by the fact that *[u] occurred in more environments, and the fact that an /*i, *e, *a, *u/ inventory makes better use of the vowel space than a lop-sided /*i, *e, *a, *o/ inventory. Treating the back rounded vowel as high will also prove more advantageous for the analysis I propose below in Section 4.5.1.

2.2.2 *Irrealis and potential*

Up until now, the prefixes *k- and *ki- as well as the floating high tone *[H] have been treated as marking the same inflectional category, labelled by one group of researchers

⁵ I heard Kaufman say orally that a floating high tone was part of the marking of the potential, though this does not appear in his manuscripts. However, Sicoli does attribute a floating high tone to the potential in Proto-Zapotecan (Sicoli 2015: 192).

as “potential” (Beam de Azcona 2004a; Campbell 2011; Cruz 2011; Operstein 2014; Antonio Ramos 2015; McIntosh 2015; Pérez Báez 2015; Sicoli 2015; Sullivant 2015; Villard 2015; Kaufman 2016; Woodbury 2019; Alonso Ortiz 2020; Gutiérrez Lorenzo 2021) and by another set of scholars as “irrealis” (Munro 2007; Broadwell 2015b; Galant 2015; López Nicolás 2016; Foreman & Lillehaugen 2017). As I argue in a separate paper (Beam de Azcona Forthcoming), the segmental morphology goes back to at least Proto-Zapotecan, where it marked the irrealis mood. Irrealis encompasses two temporal-modal domains, counterfactual and potential (von Prince 2017, 2019; von Prince, Krajinović & Krifka 2022). These were not differentiated morphologically in Proto-Zapotecan, but Proto Trochaic Zapotec innovated tonal marking that distinguished the potential from the counterfactual, shown in (5).

- (5) The two temporal-modal domains of irrealis mood
- | | |
|--|---|
| (a) Potential inflection | (b) Counterfactual construction |
| $[\overset{\circ}{\text{H}}]_{\text{POTENTIAL}}$ | |
| $*[\text{k}]_{\text{IRREALIS}} \text{-VERB}$ | $*[\text{n}^{\text{c}}]_{\text{NEGATION}} = *[\text{k}]_{\text{IRREALIS}} \text{-VERB}$ |

From here on, I will use the term “irrealis” if referring specifically to the irrealis prefix *k- or its reflexes, but I will use the term “potential” when talking specifically about the tonal phenomena which mark this category, due to the *[H] suprafix, or when referring to verb forms that include both irrealis and potential morphology.

2.3 Voice distinctions

Zapotec languages have at least three morpholexical prefixes that derive one verb from another: causative *u-, restorative *e(j)-, and anticausative *i-/j- (Smith Stark 2008; Operstein 2015a: 33–34, 43–44; Kaufman 2016). There is variation in the meaning of the verbs derived with these prefixes. Some authors (Foreman & Dooley 2015; Uchihara & Gutiérrez 2020a) consider that *u has more to do with agentivity than causation. What Smith Stark termed the “restorative” (2002) has also been called the “repetitive” (Kaufman 2016) or “frequentative” (Bartholomew 1983), and Uchihara and Gutiérrez (2020a) consider that it would more appropriately be termed “middle voice.” I will use *causative*, *restorative*, and *anticausative* as cover terms.

In Coatec, *u- survives as the tonic vowel of transitive (and some agentive intransitive) class A V-stems and as a portmanteau irrealis-causative prefix w- in transitive class A C-stems. The vowel-initial pattern is exemplified in (6), where *u derives the verb ‘kill’ from *akθi ‘die.’ (7) shows the transitive verb ‘seat, set, place’, derived from the consonant-initial root ‘sit.’

- (6) Potential form of causative ‘kill’ with vowel-initial base
 Underlying PTZ $*[\text{k}[\text{u}-[\text{ak}\theta\text{i}]_{\text{ROOT/BASE}}]_{\text{STEM}}]_{\text{INFLECTED VERB}}$
 \downarrow
 Surface PTZ *'kukθi > Modern Coatec /gũθ/
- (7) Potential form of causative ‘seat’ with consonant-initial base
 Underlying PTZ $*[\text{k}[\text{u}-[\text{tukwa}]_{\text{ROOT/BASE}}]_{\text{STEM}}]_{\text{INFLECTED VERB}}$
 \downarrow
 Surface PTZ *ku'tukwa > Modern Coatec /wzöb/

Kaufman (2016) reconstructs **i/*j* as an “intransitive/versive” marker. Campbell (2014) calls this the “intransitivizer.” Operstein (2015a: 43) only lists the glide and calls this morpheme “anticausative.”

It may be attached to both transitive and intransitive vowel-initial verbs, and the meanings of the resulting verbs can range from passive to middle, to reflexive, to inchoative and to resultative. (Operstein 2015a: 43)

I follow Kaufman in reconstructing two allomorphs, **i* before consonants and **j* before vowels, but I follow Operstein in the “anticausative” label, which is more appropriate than “versive” when talking about verbs derived from other verbs, and better than “intransitivizer” if in some cases both the original and the derived verb are intransitive.

The restorative prefix is reconstructed by Kaufman (2016) as **e(j)*, where the **j* would only occur before vowels. This prefix occurs today variously as /e/ (Foreman & Dooley 2015) or as /a/ (Smith Stark 2002; Uchihara & Gutiérrez 2020a; Solá-Llonch 2021), but is absent synchronically in Coatec due to pre-tonic vowel loss.

These voice prefixes are relevant for their ability to bear the high tone of the potential.

3. Tonal contrasts and potential-marking tonal morphology in Coatec

Zapotec languages usually have an inventory of 2–4 tones, always including high and low. These languages minimally contrast modal and glottalized syllables, and sometimes have additional phonation contrasts. The number of tonal contrasts is often greater on modal syllables. In Coatec, tonal contrasts have neutralized completely on glottalized syllables, such that the glottal feature enters into a direct contrast with the tonal categories and itself becomes part of the inventory of “tonal” contrasts. The minimal set in (8) illustrates the five contrasts found on prominent syllables in Coatec.

(8) Coatec tones

High	(H)	/mbé/	‘crab’
Low	(L)	/mbè/	‘mist’
Falling	(HL)	/mbê/	‘spider’
Rising	(LH)	/mbě/	‘turtle’
Glottal	(?)	/mbeʔ/	‘moon; butterfly’

Every phonological word in Coatec has a single prominent syllable, which bears one of these five tones. Other than loanwords (e.g., /esko'pét/ ‘shotgun’) and compounds (e.g., /jitʃèk/ ‘hair on the head’ from /jitʃ/ ‘hair’ + /jèk/ ‘head’), most words are monosyllabic due to the loss of unstressed vowels (e.g., *kekθa > /jàèθ/ ‘tortilla’).

Only verbs with low or falling tone undergo a categorical tone change to high or rising in the potential (Section 3.1), though not all verbs with these tones exhibit this change. Upstep (Section 3.2) is found in abundance on verbs with low, falling, and glottal tone. Verbs with underlying high or rising tone do not change their tone in the potential.

3.1 Tone ablaut

Categorical tone changes in Coatec always produce high or rising tone in the potential. The patterns are not entirely predictable by the synchronic phonological environment. A verb with high tone in the potential could have underlying low or falling and a verb with underlying low could have high or rising in the potential. As with vowel ablaut on English strong verbs, speakers must memorize the correct pattern for a given lexical item, leading Woodbury (2019) to term such alternations *tone ablaut* in Chatino.

3.1.1 *Falling to high*

Not all falling-toned verbs undergo tone ablaut in the potential, but when they do the result is almost always⁶ a high tone, as in (9). This verb has falling tone throughout its paradigm, including additional forms not shown here, but has high tone in the potential.

(9)	Root:	/jûb/
	Gloss:	‘fall’
	Potential:	/júb/
	Imperfective:	/nd-jûb/ ⁷
	Perfective:	/mb-jûb/

All verbs that undergo this tonal change are intransitive. A single auxiliary verb belonging to class D, /b-ê/,⁸ has the falling/high alternation. All other falling-toned verbs that surface with high in the potential are j-stems. Nearly all belong to class A but ‘go’ belongs to class C. If a class A intransitive verb has falling tone but begins in another consonant, it will not undergo this alternation but will instead exhibit upstep.

3.1.2 *Low to rising*

By far the most common pattern of tone ablaut in the potential in Coatec is when a low-toned verb surfaces with rising in the potential, as shown in (10).

(10)	Root:	/àp/
	Gloss:	‘rise’
	Potential:	/g-ǎp/
	Imperfective:	/nd-àp/
	Perfective:	/ŋw-àp/

The low/rising alternation is found in nearly all classes, regardless of transitivity or stem-initial segment, with the lone exception of transitive class A C-stems.

⁶ I am aware of one irregular, intransitive positional verb /jô/ ‘be placed on something’ in class B which surfaces with rising in the potential. This verb is related to a transitive class D verb /ò/ ‘place on something’ with underlying low tone that also takes rising in the potential, and it’s possible that the unexpected form is based on analogy.

⁷ NC prefixed sequences like /nd-/ and /mb-/ shown here in the imperfective and perfective are morphologically complex strings of a nasal realis mood prefix (Campbell 2017; Beam de Azcona Forthcoming) followed by the aspect marker. I have simplified the representation to avoid distraction.

⁸ This is the positional verb ‘squat’ but is more often used as an auxiliary verb in the progressive construction.

Table 4 shows five verbs belonging to class A. The low/rising alternation is found on ‘kill,’ a causative V-stem, and on the intransitive C-stems ‘get bent’ and ‘get burnt.’ Two causative verbs, ‘bend (something)’ and ‘burn (something)’ have been derived from the intransitive verbs via fortition (from earlier *k-) of the stem-initial consonant.⁹ Like their intransitive counterparts, these causative verbs are C-stems with low tone, but whereas the intransitive verbs undergo the tonal alternation, the transitive ones are instead upstepped (indicated here by ↑) in the potential, as described in Section 3.2.

Table 4. Low-Toned Class A Verbs With and Without Rising Tone in the Potential

	‘kill’	‘get bent’	‘bend’	‘get burnt’	‘burn’
BARE STEM	/ùθ/	/jìt/	/kìt/	/zù/	/tʃù/
POTENTIAL	/g-ùθ/	/jìt/	/w-↑kìt/	/zǔ/	/w-↑tʃù/
IMPERFECTIVE	/nd-ùθ/	/nd-jìt/	/n-kìt/	/n-zù/	/n-tʃù/
PERFECTIVE	/mbiθ/	/mb-jìt/	/m-kìt/	/mb-zù/	/m-tʃù

Besides the fortition seen on the C-stems, all three causative verbs in Table 4 are derived from intransitive verbs by the addition of *u-. As discussed in Sections 2.1 and 2.3, *u- was pre-tonic when added to consonant-initial bases, where it survives as the /w-/ prefix in the potential form, but was and is the tonic vowel when added to a vowel-initial base, as in ‘kill’ (derived from intransitive ‘die’ /âθ/). In other words, of the causative verbs in Table 4, only those in which *u- was pre-tonic display upstep, while the verb with tonic *u instead has the low/rising alternation.

3.1.3 Low to high

Most verbs with underlying low tone surface with rising in the potential, if they exhibit tone ablaut, but a small number of verbs instead surface with high. Table 5 shows one class B verb, ‘end,’ and four class A intransitive C-stems. All verbs with the low/high alternation are open syllables, but the verb ‘get burnt’ is included to show that synchronic open syllables do not always have the low/high alternation.

Table 5. Tone Ablaut on Low-Toned Open Syllables

	‘end’	‘become full’	‘melt’	‘run out’	‘get burnt’
POTENTIAL	ní	zǽ	jǽ	tǽ	zǔ
IMPERFECTIVE	nji	n-zǽ	nd-jǽ	n-tǽ	n-zù
PERFECTIVE	ŋgw-nì	mb-zǽ	mb-jǽ	m-tǽ	mb-zù

The crucial difference between ‘get burnt’ and the other verbs in Table 5 is the fact that ‘get burnt’ was historically a disyllable, as I will show in Section 4.1.2.

⁹ The stem-initial /j/ in the intransitive verb ‘bend’ was singleton *k > *g historically but palatalized to /j/ before the front vowel. The transitive verb underwent fortition due to the causative *k- prefix, creating geminate *kk > *k, which did not palatalize. In ‘burn’ the singleton affricate in the intransitive verb voiced and reduced to a fricative, whereas the sequence *k-tʃ became a geminate affricate and remains a voiceless affricate today.

3.2 Upstep

In San Baltazar Loxicha, the difference between the five tonal contrasts is best defined not in terms of their absolute measurement in Hz but according to pitch *patterns*, such as whether they are level (the low tone) or have a phonetic contour (the rest), whether they rise (rising and glottal) or fall (high and falling), and whether the contour is more dramatic (rising and falling) or less so (glottal and high). Some verbs do not undergo tone ablaut but instead surface with upstepped versions of their underlying tones in the potential. Glottal and low tones retain the same pattern as when not upstepped but play out at higher levels of F_0 . The falling tone begins higher when upstepped but ends at around the same level of F_0 as when not upstepped, suggesting that the falling tone is a composite of two tone levels HL, and only the first tone in the sequence is upstepped. High and rising toned verbs retain their underlying tones unchanged in the potential.

I recorded various verbs in two inflected forms, the potential and the perfective, and measured them acoustically. I elicited these pairs in different orders to show that the difference is not just declination. Figures 2–4 give potential and perfective forms, in different orders, for verbs with glottal, falling and low tone respectively.

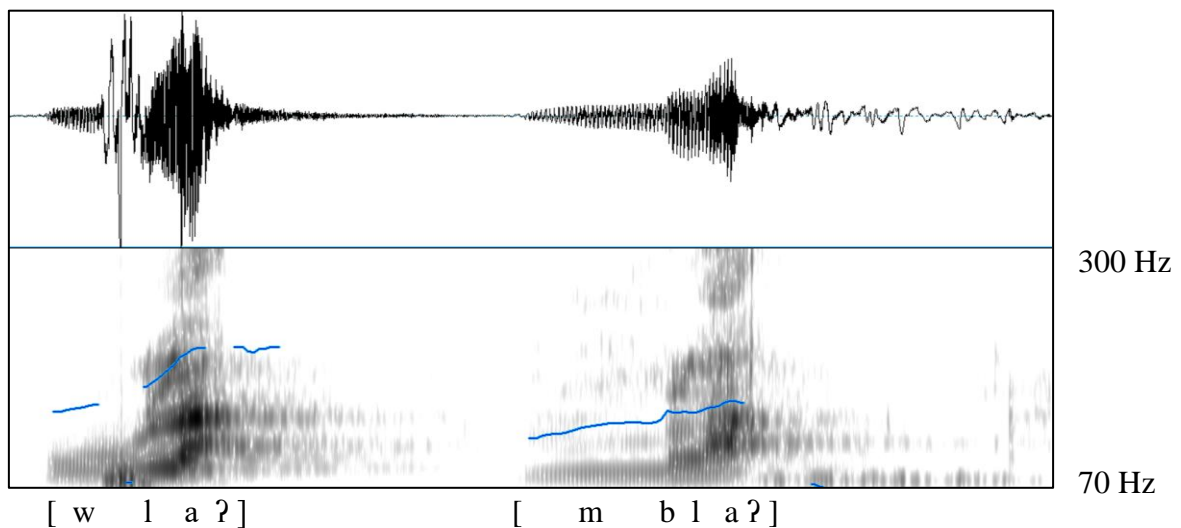


Figure 2. /-laʔ/: IRR.CAUS-POT.put.down, PFV-put.down

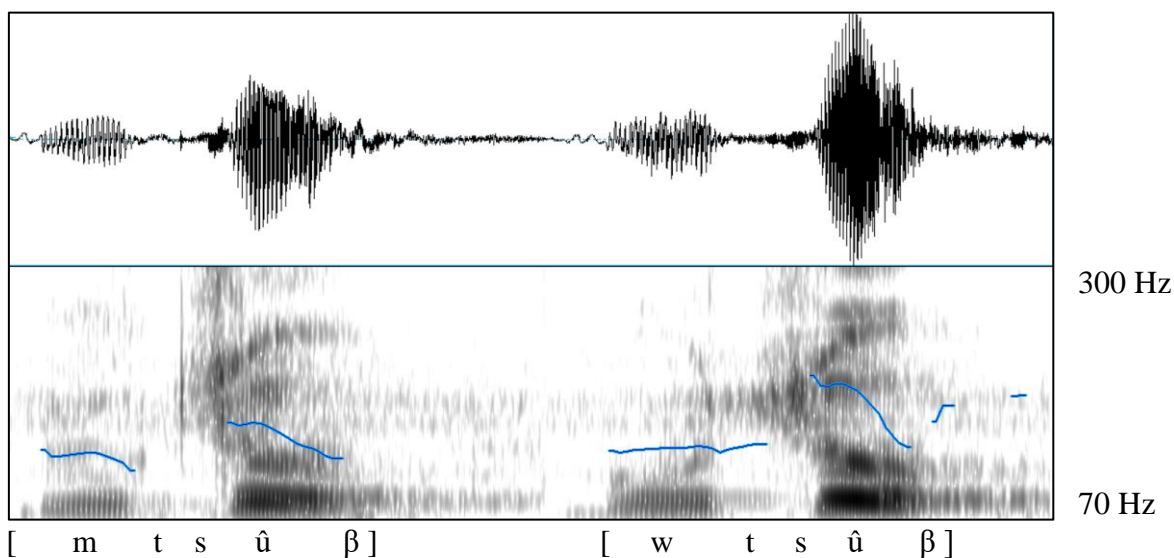


Figure 3. /-tsûb/: PFV-knock.over, IRR.CAUS-POT.knock.over

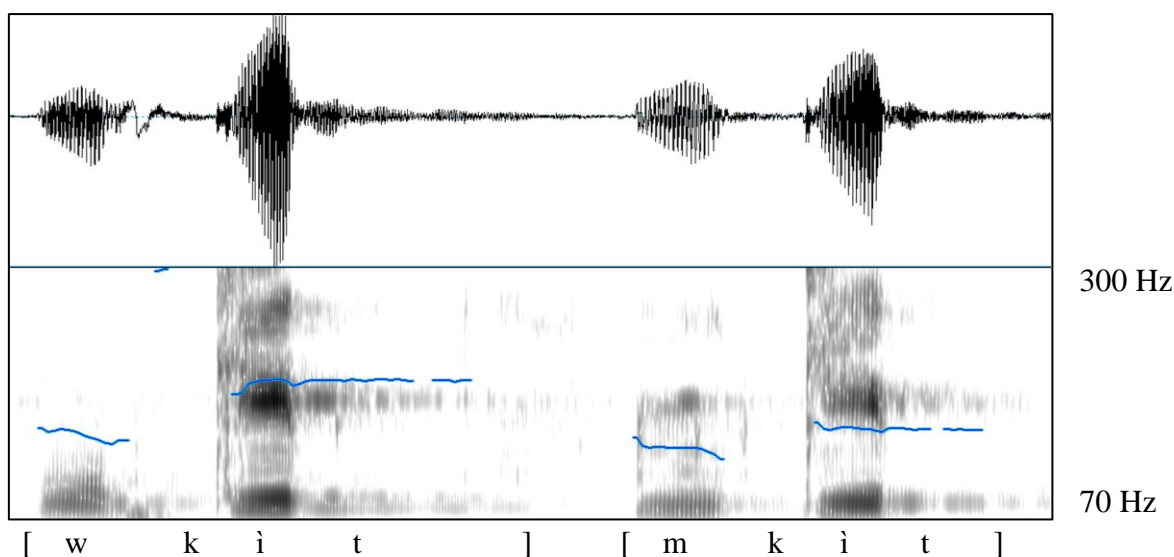


Figure 4. /-kìt/: IRR.CAUS-POT.fold, PFV-fold

Comparing these pairs of inflected forms, we can see that the potential forms have higher F_0 than the perfective forms. Figure 2 shows a glottal toned verb, ‘put down’. If excluding the rise in pitch that takes place during the onset, F_0 rises from 193 to 204Hz on the potential form /wlaʔ/ and from 146 to 152Hz on the perfective form, /mblaʔ/. Figure 3 shows the falling toned verb ‘knock over’ in the opposite order: perfective first, then potential. The perfective form, /mtsûb/, falls from 159 to 126Hz while the potential form, /wtsûb/, begins 35Hz higher, falling from 194 to 137Hz. Figure 4 shows the verb /kìt/ ‘fold’. The hallmark of the low tone in the San Baltazar Loxicha variety of Coatec is that it is exceptionally level. The potential here, /wkìt/, hovers around 198Hz, while the perfective, /mkìt/, stays near 155Hz.

Upstep in Coatec is different than tone ablaut because the verb surfaces with the same categorical tone contrast throughout the paradigm. In the remainder of the paper, I will argue that both phenomena in Coatec can be traced to the same source: the floating high tone that marks the potential throughout modern Zapotec.

4. The historical origins of Coatec potential-marking tonal morphology

As mentioned in the introduction, a floating high tone is reported to mark the potential across modern Zapotec languages. In this section, I provide diachronic explanations for how this one contrast could lead to the different morphophonological patterns described throughout Section 3 for Coatec.

This section is mainly about internal reconstruction of forms ancestral to modern Coatec verbs. These generalizations could apply only to a recent ancestor (Proto-Coatecan), an intermediate one (Proto Southern Zapotec or Proto Core Zapotec), and/or a distant one (PTZ or Proto-Zapotecan). Different hypotheses may apply to different stages in prehistory. In some cases, comparative and philological data can narrow down the time frame. Except where otherwise labeled, reconstructed forms in this section can be understood as “Pre-Coatec,” with all the ambiguities this entails.

My goal is to explain the four patterns described in Section 3. These patterns are summarized in Table 6. Verbs with underlying high and rising tone are omitted because they exhibit neither ablaut nor upstep in the potential. Other verbs are divided according to underlying tone, stem shape, class membership, and transitivity. Rather than divide these data according to synchronic open vs. closed syllables, I show the patterns according to whether the verb stem was historically a monosyllable or a disyllable. This organization reveals more regular patterns, because, while all modern closed syllables come from historical disyllables, modern open syllables come from both historical monosyllables and disyllables, in the latter case due to the loss of weak medial consonants. A dash -- indicates either the inexistence of a certain combination or that there is insufficient evidence to determine whether there is upstep or not. A question mark indicates that there are conflicting patterns or ambiguities in the documentation. A checkmark indicates that there is no tonal change in the potential. When a pattern is represented by a single verb, the gloss is shown in parentheses. Upstep is represented by a vertical arrow, whereas categorical tone changes are represented by capital letters. Class “Ch” was not mentioned in Section 2.2 because it is currently not posited for PTZ, but it is a pattern that exists in Coatec and neighboring varieties of Miahuatec, characterized by palatalization and paradigmatic alternations of the stem-initial consonant.

Table 6. Tonal Marking of the Potential across Coatec Verb Classes

Underlying tone:		L		HL		?	
Historical shape:		*(C)V	*(C)VCV	*(C)V	*(C)VCV	*(C)V	*(C)VCV
V-stems	vA ¹⁰	--	LH	--	--	--	? (‘cry’)
	vC	--	LH	--	?	--	✓
j-stems	viA	H	LH	--	H	--	↑ (‘stay’)
C-stems	vtA	↑	↑	--	↑	↑	↑

¹⁰ Where I list *v* rather than *vi* or *vt*, both transitive and intransitive verbs exist.

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	viA	H	LH	--	↑	--	↑
	vB	H	LH	(‘lower’ & ‘stand’ Section 4.4.2)	↑	--	↑
	vCh	H	LH	--	--	↑	↑
mixed	vtD	--	LH	--	--	↑ (‘take out’)	--

The patterns shown in Table 6 are explained diachronically below. First, I sketch out some general hypotheses in Section 4.1. One regular pattern is the productivity of upstep on transitive class A C-stems, which I connect to an interaction between potential and causative morphology in Section 4.2. All other verbs with low tone undergo ablaut, covered in Section 4.3. Section 4.4 covers some historical peculiarities of glottalized verbs. Section 4.5 proposes reanalyses of Zapotecan verbal morphology. Section 4.6 considers a set of ranked constraints that explain the remaining patterns.

4.1 General hypotheses

As opposed to many Asian tone languages, where tonogenesis can be straightforwardly traced back to segmental and phonation contrasts (Haudricort 1961; Matisoff 1973), the Otomanguean stock, which includes Zapotecan, has likely been tonal for several thousand years, and it is probably impossible to trace the genesis of Otomanguean tone with such a time depth.

The differences one finds in one vs. another part of the world are largely due not only to the nature of the tonogenetic processes, but also to the relative maturity (time-depth) of the tone system (and ultimate independence from the laryngeal origins): with time, pitch takes over from phonation and acquires a life of its own, both building up and breaking down.
(Hyman 2018: 204)

Otomanguean tone probably predates Proto-Zapotecan by thousands of years, so the pitch contrasts themselves may have interacted in such a way as to condition the emergence of new tonal patterns. Commenting on cases where languages with a binary tone contrast developed additional tone heights, Hyman remarks:

The development proceeds in two steps: First a tone is raised or lowered in the context of another tone. Then, when the latter loses its tone-bearing unit (TBU), the conditioned raised or lower tone becomes contrastive on the surface.
(Hyman 2018: 207)

Considering the antiquity of Otomanguean tone, I expect tonal conditioning environments to be relevant to tonal changes in Zapotecan. I have four basic hypotheses, fleshed out below, about the development of the different patterns seen above in Table 6: 1) upstep resulted historically from progressive assimilation when there was a high tone on a pre-tonic syllable; 2) tone ablaut comes from a floating high tone that replaced or added to the underlying tonal melody of the root; 3) modern contour tones in Coatec preserve the tonal melodies of earlier disyllables but remap the tone of the deleted post-tonic syllable onto the surviving monosyllabic root; and 4) unexpected morphological patterns may be due to analogy.

4.1.1 *Upstep: The vestiges of pre-tonic tone*

A general question about tone in earlier forms of Zapotec is whether tones contrasted on unstressed syllables. In this section, I consider comparative evidence that suggests that pre-tonic syllables may have been underlyingly toneless but could attract floating tones.

In Coatec, pre-tonic syllables mostly occur in compounds and loanwords, and tonal contrasts are often neutralized in these syllables. Likewise, in other Zapotec languages it is common for pre-tonic syllables to be toneless. Such toneless syllables are usually realized with an unmarked (mid) pitch, as in (11a–c), and are susceptible to vowel loss, as in (11d). The word in (11) is an old compound that is synchronically unanalyzable.

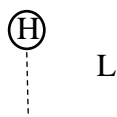
(11)		‘festival’	
(a) Tanetze ¹¹	[laʔ'ni:ʔ]	/la'ní/	
(b) Coatecas Altas ¹²	[laʔ'ni:ʔ]	/la'nî/	
(c) Petapa ¹³	[leʔ'ni:ʔ]	/le'nî/	
(d) San Agustín Mixtepec ¹⁴	[lni:ʔ]	/lnî:/	

In at least some languages which retain unstressed vowels, potential forms with a pre-tonic syllable may have high tone on that syllable. In the Sierra Juárez Zapotec grammar, all pre-tonic syllables found in potential verb forms (treated in the grammar as prefix allomorphs) are listed with high tone, which is mostly absent from other prefixes.

- (12) Sierra Juárez verbal prefixes (Bartholomew 1983: 387)
 “Future” (Irrealis/Potential): *gú-*, *w-*, *í-*, *é-*, *ø-*, *gá-*, *g-*, *ts-*, *tʃ-*, *kká-*, *tá-*
 “Present” (Imperfective): *ru-*, *ri-*, *re-*, *rá-*, *r-*, *kka-*, *rita-*
 “Preterite” (Perfective): *be-*, *bi-*, *gu-*, *gut-*, *w-*, *wi-*, *ukkwa-*, *tà-*

In the Petapa variety of Transyautepecan Zapotec, pre-tonic prefixes are generally toneless and surface with mid-level pitch, but, exceptionally, potential verb forms with pre-tonic prefixes have been recorded with high tone on the prefix and the verb’s underlying tone left intact on the verb root. I analyze this as the floating high tone docking onto the pre-tonic syllable, as shown in (13). (13) shows different morphemes on different tiers before a process of tier conflation (McCarthy 1981, 1986; Pulleyblank 1988). This is not strictly necessary to account for the Petapa data discussed here, but it will be useful going forward as we consider the floating H tone in pre-Coatec.

- (13) Petapa: POT-turn.around, viA



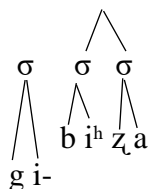
¹¹ Data from this variety of Dídza Xidza or Rincón Zapotec come from my collaboration with Nelson Martínez Pérez.

¹² Data from this variety of Dí'zhzêh or Amatec Zapotec come from my collaboration with Brígida Juárez Santiago.

¹³ Data from this variety of Transyautepecan Zapotec come from my collaboration with Rómulo Martínez Tonel.

¹⁴ Data from this variety Dí'istèh or Miahuatec Zapotec come from my collaboration with the late Edmundo Palomec Hernández.

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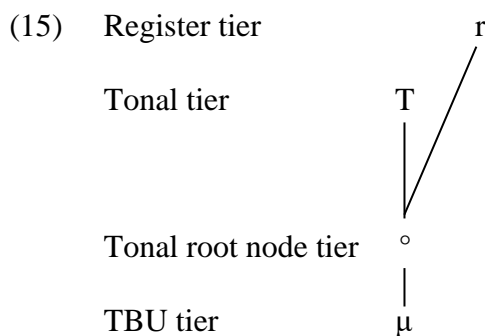
Coatec is distantly related to Acatlán Mixtec, a language described as having upstep following a high tone (Pike & Wistrand 1974). I hypothesize that a high-toned pre-tonic syllable could have conditioned upstep on the tonic syllable in the prehistory of Coatec. I have recorded such a phenomenon in Petapa:

(14) Petapa Zapotec

- | | |
|-----------------------------|--|
| (a) PFV-crack | (b) POT-crack |
| [biɬ'ɾja ^h ɬsaɬ] | [giɬ'ɾja ^h ɬsa] ¹⁵ |

In (14), the verb root ‘crack’, which is normally realized with low level tone, such as in the perfective form in (a), is pronounced with slightly higher pitch when it follows the high tone of the pre-tonic syllable in (b). Since this language does not have a contrastive mid tone, we can consider the pronunciation of the tonic syllable in (b) to be a higher-than-normal realization of the low tone. This is akin to the upstep found in Coatec.

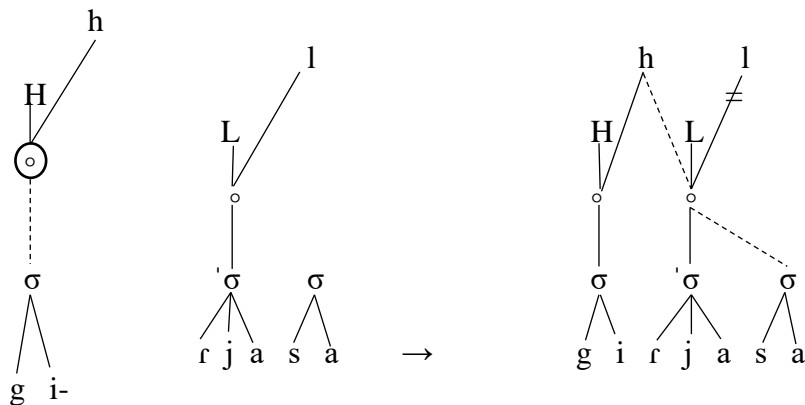
The upstepped tones in Coatec and Petapa can be conceived of as maintaining their categorical identities but being realized in a higher register. Snider (1999) uses a version of autosegmental phonology called Register Tier Theory (RTT) to represent register on a separate plane from tone, with both intersecting at a tonal root node tier that can be thought of as representing the interconnection between all the features that are part of tone. In Snider’s representation, registers are indicated with lower case letters on a register tier while tones are indicated with capital letters on a tonal tier:



RTT allows us to treat upstep as a type of spreading that takes place on the register tier. The progressive assimilation seen in (14b) can be represented as in (16). I omit the aspiration for simplicity.

¹⁵ In my fieldnotes, I did not record the pitch of the final syllable of this word. Tone is most salient on the tonic syllable in this language, and the pitch of the final syllable tends to be level and maintain the pitch on which the previous syllable ended.

(16) Upstep in the Petapa potential of ‘crack’



In Petapa and some, but not all, Zapotec varieties, the high tone is realized as extra-high. I represent it as H tone with h register. Here I show the floating high tone that marks the potential as docking onto an underlyingly toneless pre-tonic syllable. After tier conflation, I treat the predictable upstep as a surface phonetic process whereby the pre-tonic and tonic syllables maintain different contrasts on the tonal tier, but the tonic syllable assimilates to the high register of the pre-tonic syllable. I also show the underlyingly toneless post-tonic syllable as acquiring the tone of the tonic syllable through another case of progressive assimilation. Note that here the domain for upstep is the phonological word. Future research could explore whether related phenomena take place in the phonological phrase.

According to the hypothesis that upstep was historically conditioned by a high-toned pre-tonic syllable, we should now see upstep only on verbs which had potential forms with a pre-tonic syllable historically, other than exceptional cases due to analogy.

4.1.2 *Tone ablaut in historical perspective*

I begin this section by considering whether post-tonic syllables could bear tone in earlier forms of Zapotec. Of the minority of Zapotec languages that preserve post-tonic syllables, the varieties I know best are Petapa and Tanetze. In both these languages, the post-tonic syllable is realized phonetically with a level pitch that is close to the ending F_0 of the tonic syllable. However, Chatino varieties which retain unstressed vowels (Campbell 2014; Sullivant 2015; Villard 2015) can have complex tonal melodies such that each syllable may have a different tone. The same is reported for Isthmus Zapotec (Pickett 1978), Sierra Juárez Zapotec (Bartholomew 1983: 341), Asunción Mixtepec Zapotec, and Lachixío Zapotec (Sicoli 2007). Popolocan (Nakamoto 2017a, 2020) and Mixtecan (Dürr 1987) languages, Zapotecan's probable closest relatives, also can have different tones associated with different moras. The preponderance of the evidence suggests that early forms of Zapotec could have separate tonal contrasts on each syllable.

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Though the task of thoroughly establishing correspondence sets will have to wait for future work, (17) shows pairs of cognates in which Coatec has a rising tone but other languages are reported to have an LH melody that is divided between two syllables.

- (17) Some LH cognates between Coatec and languages with disyllabic roots
- (a) ‘animal’
 Coatec /mǎn/
 Isthmus Zapotec /màníʔ/ (Pickett 1978)
- (b) ‘lime (mineral)’
 Coatec /jǐ/
 Sierra Juárez Zapotec /iʔjú/ (Nellis & Goodner de Nellis 1983)
- (c) ‘person’
 Coatec /měň/
 Lachixío /bèné/ (Sicoli 2007: 136)

Based on correspondences like those in (17), I hypothesize that wherever Coatec has a contour tone, an earlier form of Zapotec had a disyllable with separate tones on each syllable. I repeat the minimal set from (8) here in (18), now with reconstructions included. Of the six words shown here, neither of the words reconstructed as monosyllables in Proto-Zapotecan have contour tones, whereas both words that today have contour tones are reconstructed as earlier disyllables.

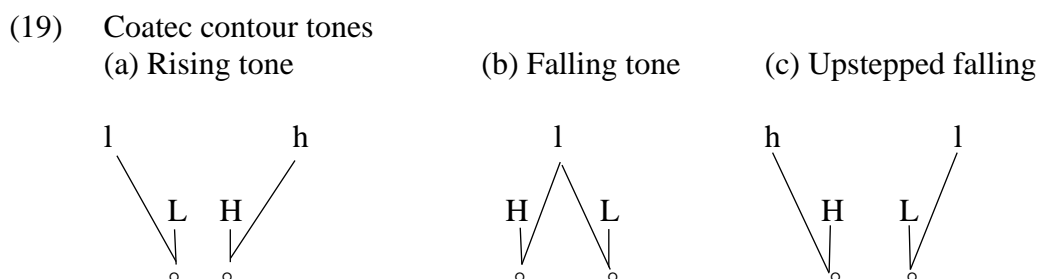
(18)		Coatec	Pre-Coatec	Proto-Zapotecan	
High	(H)	/mbé/	*mbé	*kweʔ	‘crab’
Low	(L)	/mbè/	*mbèju	*kwejuk	‘mist’
Falling	(HL)	/mbê/	*mbéjùʔ	*kwejuʔ	‘spider’
Rising	(LH)	/mbě/	*mbègú	*kwekũ	‘turtle’
Glottal	(ʔ)	/mbeʔ/	*mbeʔjuʔ	*kweʔjuʔ	‘moon’
		/mbeʔ/	*mbeʔ	*kweʔ	‘butterfly’

As shown in Table 6, the low/high tonal alternation is found exclusively on CV roots that have always been monosyllabic, whereas the low/rising alternation is only found on historical disyllables. I hypothesize that a form of Zapotec ancestral to Coatec had the syllable as the TBU and allowed only one tone per syllable. For modal syllables, every tonic syllable had either H or L. The same was probably true of glottalized syllables until tonal contrasts were neutralized in this environment. For non-tonic syllables, the possibilities were H, L or underlying \emptyset .¹⁶ Under this set of hypotheses, early

¹⁶ In the related Chatino languages, both tonic and non-tonic syllables can be toneless (Campbell & Woodbury 2010; Cruz 2011; Campbell 2014; McIntosh 2015; Sullivant 2015). Toneless words are reported for the Lachixío variety of the conservative Coyachilla Zapotec language, but the examples cited appear to include only grammatical words (Sicoli 2007). In Coatec, since some low-toned words change to rising and others to high in the potential, as shown in Sections 3.1.2 and 3.1.3, one might argue that those with the rising pattern are underlyingly low and those with high are underlyingly toneless. However, this analysis is nullified by the fact that the two patterns are predictable based on whether the word was historically a monosyllable or a disyllable. Thus far, it appears that Zapotec languages always have an underlying tone on the tonic syllables of content words, whereas Chatino languages do not.

monosyllables would have been either high or low, but disyllables had one of four possible tonal melodies: H, L, HL, LH. In fact, these melodies are the same ones reconstructed as “basic” tonal melodies for bimoraic feet in Proto-Mixtec (Dürr 1987; see also McKendry 2013; Swanton & Mendoza Ruiz 2021 for more recent work). The loss of post-tonic vowels led to these four melodies contrasting on CVC monosyllables, and the loss of some post-tonic consonants led to the four melodies contrasting on CV monosyllables like those shown in (18).

In his RTT model, Snider (1999: 56–57) distinguishes between composite contour tones and unitary contour tones by representing them with two vs. one tonal root node(s) respectively. He comments that “many composite contours are the result of a historical loss in which a TBU at the edge of the morpheme or word is deleted,” in line with the hypothesis about the development of contour tones in Coatec. I treat both rising and falling as composite contours. There is some evidence, beyond the scope of this paper, that the rising tone triggers high register spreading (i.e., upstep) within the phonological phrase. The ending of the rising tone is also acoustically higher than any other tone in Coatec. I consider that the high portion of the rising tone is in a high register. The falling-toned verb in Figure 3 above begins more than 30Hz higher in the potential than in the perfective, but both forms end within around 10Hz of one another, suggesting that upstep only affects the beginning portion of this tone. I assume that the high portion of the falling tone is in a low register when not upstepped, as formalized in (19).

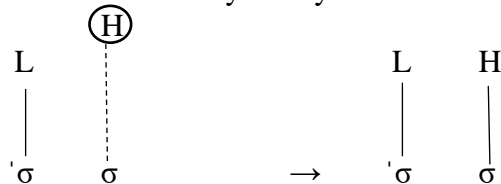


That the H in the rising tone remains in the high register, while the H in the falling tone is in the low register when not upstepped, may indicate that speakers have come to treat these tones as different categories, rather than different combinations of the same tones.

Synchronically, tone ablaut is best conceived of in a word-and-paradigm approach, since the alternations are no longer predictable by the phonological environment. However, I hypothesize that an earlier system, prior to segmental loss, had more transparent and productive morphophonological rules. Uncovering the earlier system reveals more authentically the *why* of the modern patterns than does any attempt to characterize these patterns as synchronically productive cognitive processes.

I propose that in an earlier system the floating H tone that marked the potential could be added to an underlyingly toneless syllable, as in (20). If no toneless syllables were available, floating H could replace the underlying tone, as in (21). If the floating H were to replace an underlying tone, this preferably took place on the post-tonic syllable, but if none were available, it could take place on the tonic syllable, as in (22).

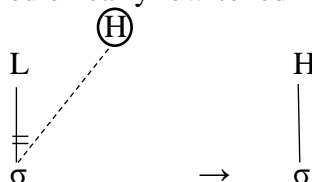
(20) Potential marked on early L disyllable



(21) Potential marked on early HL disyllable



(22) Potential marked on early low-toned monosyllable



The modern forms and the Pre-Coatec forms have the same melodies. The difference is the number of syllables. The L/H alternation did and does occur only on CV monosyllables, whereas the L/LH and HL/H alternations occur on former disyllables which are now monosyllables. This is not predictable today when you can have different patterns on CV forms like ‘become full’ /zæ̀/ (< Proto-Zapotecan *tsã?) and ‘get burnt’ /zù/ (< Proto Core Zapotec *e-tsuwi?).

When, in an ancestor of Coatec, the floating high tone docked onto the pre-tonic syllable, this led to upstep, and when it docked onto a root syllable, this led to tone ablaut. Thus, upstep and tone ablaut ultimately share the same source, the floating high tone that marks the potential. These patterns would have been predictable with a set of ranked constraints but became opaque with the loss of unstressed vowels. My proposal that the floating high tone could dock onto both pre- and post-tonic syllables would violate Goldsmith’s (1976) prohibition against line-crossing if the floating tone were underlyingly represented on the same tier(s) as the tones of the verb root. This is why I represent inflectional morphemes as beginning on separate tiers from root morphemes (McCarthy 1981, 1986; Pulleyblank 1988).

4.2 Upstep from pre-tonic, causative *u

One of the most regular patterns from Table 6 is the occurrence of upstep in transitive class A C-stems, repeated here in Table 7.

Table 7. Upstep in Transitive C-Stems of Class A

Underlying tone:	L	HL	?
------------------	---	----	---

Historical shape:	*(C)V	*(C)VCV	*(C)V	*(C)VCV	*(C)V	*(C)VCV
C-stems	vtA	↑	↑	↑	↑	↑

In Kaufman’s (2016) reconstruction, every class A verb except ‘come’ begins in a back rounded vowel which we can equate with causative *u-. Kaufman (1989) proposed Proto-Zapotec had a constraint against surface vowel clusters so that in bimorphemic V₁V₂ sequences one vowel deleted according to a vowel hierarchy. By Kaufman’s own proposal, an *i in the irrealis prefix never would have been realized before causative *u. This means that either the reconstruction of *ki- for class A is wrong, or class A included non-causative verbs, or both.

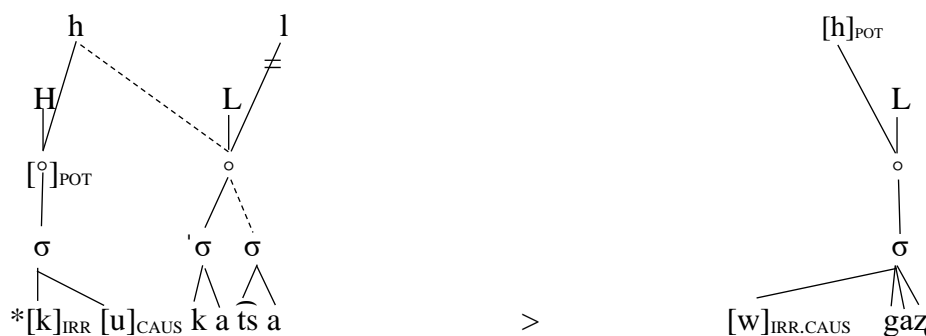
For now, let us simply stipulate that the surface form of the irrealis prefix was *k- when it occurred before *u. In Coatec, transitive class A C-stems have w- and undergo upstep in the potential form. /w-/ is the reflex of word-initial, pre-tonic *k-u-. High tone on pre-tonic *u in the potential form of a causative verb probably triggered upstep on the following syllable, as we saw in Petapa in (14b). After pre-tonic vowels were lost, upstep became phonologically unpredictable and thus morphologically significant. There are no minimal pairs differentiated only by upstep, because potential forms are never segmentally identical to other inflected forms, yet upstep is a salient part of how the potential is marked. Upstep in modern Coatec is somewhere along the path from subphonemic alternation to emergent tonal contrast. In (23), I show upstep as progressive assimilation in a surface form after tier conflation for an early stage of Pre-Coatec, similar to the Petapa form in (16) above, and how this form is reflected in the modern language.

(23) Upstep becomes opaque in class A transitive C-stems

*k-ú- 'k-âtsa

IRR-CAUS.POT-CAUS-get.wet

‘will make wet’



Presumably some generation of Coatec speakers with a non-syllabic causative prefix acquired their L1 from older speakers who still had mental representations of pre-tonic *u with high tone and who perhaps pronounced both reduced and unreduced forms in free variation, upstepping the tonic syllable in both. Class A transitive C-stems undergo upstep in the potential because they all had pre-tonic *u. The *gú-* prefix listed by Bartholomew as a “future” allomorph in Sierra Juárez Zapotec, shown in (12) above, is likewise the concatenation of irrealis *k- and causative *u, onto which potential *[H] is docked. According to Figure 1, the last common ancestor of Coatec and Sierra Juárez is Core Zapotec, so we can hypothesize that the floating high tone of the potential docked onto pre-tonic causative *u in Proto Core Zapotec. Reconstructing this pattern any

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earlier is difficult because the floating high that marked the potential is not attested in Chatino or Soltec, and the next earliest diverging Zapotec languages, those outside of Core Zapotec, seem to have lost pre-tonic *u. For example, Sicoli (2015: 197) states that in Lachixío “the **o-causative* pattern is rare. There are no cases with consonant initial verbs.”

4.3 Tone ablaut on low-toned roots

Also regular are the patterns of tone ablaut on low-toned roots, repeated in Table 8.

Table 8. Potential Tonal Morphology on Verbs with Underlying Low Tone

Underlying tone:		L	
Historical shape:		*(C)V	*(C)VCV
V-stems	vA	--	LH
	vC	--	LH
j-stems	viA	H	LH
C-stems	vtA	↑	↑
	viA	H	LH
	vB	H	LH
	vCh	H	LH
mixed	vtD	--	LH

Except for the transitive class A C-stems covered in the last section, all low-toned verbs undergo diachronically predictable alternations, surfacing with high in the potential if they have always been monosyllabic but rising if they were historical disyllables.

In Table 5, we saw that ‘become full’ /zàè/ has the potential form /zǎè/ with high tone, whereas ‘get burnt’ /zù/ has the potential form /zǔ/ with rising. Here comparative data is illuminating. Consider the reconstructions and cognates, as well as the Coatec tonal alternations for each verb in (24–28).

- (24) ‘become full’ viA
 Proto Trochaic Zapotec *e-tsã?
 Lachixío Zapotec /tʃe?/ (Sicoli 2020)
 Coatec bare root /zǎè/, POT /zǎè/
 Tlacolulita Zapotec /tʃɛ?/¹⁷
- (25) ‘run out, go out of stock, become scarce’ viA
 Proto-Zapotecan *i-tiã:
 Zenzontepec Chatino POT /tja:/, HAB /ntja:/, PFV /nkwitja:/ PROG
 /nteta:/ (Campbell & Carleton In Press)
 Coatec PFV /mtǎè/, POT /tǎè/
 Tlacolulita PFV /bi're/, POT /i're/
- (26) ‘get burnt’ viA
 Proto Core Zapotec *e-tsuwi?
 Coatec PFV /mbzù/, POT /zǔ/
- (27) ‘drink’ vtC

¹⁷ Tlacolulita data come from my collaboration with Roque Julián de la Rosa.

Proto-Zapotecan *uwi?
 Coatec IPVF /ndò/, POT /gǒ/
 Tanetze PFV /guʔi/

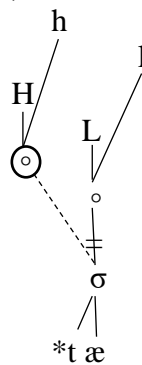
(28) ‘eat’ vtD

Proto-Zapotecan *aku
 Zenzontepec Chatino (root) /aku/ (Campbell & Carleton *ibid*)
 Lachixío Zapotec PFV /odàko/, POT /áko/ (Sicoli 2007: 71)
 Coatec PFV /ŋgdà/, POT /wǎ/
 Coatecas Altas HAB /ndžàw/, POT /gǎw/
 Zaniza (Papabuco), bare root /aw/ (Operstein 2015b)

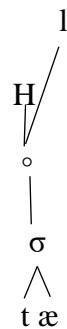
According to the hypotheses presented in Section 4.1.2, tone ablaut results when the floating H tone historically docked onto the post-tonic syllable of a disyllable, or the tonic syllable of monosyllables. (26–28) show that Coatec has open monosyllables in some words due to the loss of both the post-tonic vowel and a weak intervocalic consonant, usually *k, *w, or *j. The potential forms of ‘become scarce,’ an earlier monosyllabic root (shown in (25) preceded by a pre-tonic voice prefix that was later lost), and ‘eat,’ an earlier disyllable, are traced from some ancestor of Coatec to the modern language in (29). Note that the high tone in modern Coatec (and the neighboring varieties of Miahuatec) is not phonetically as high as the high tone in some other Zapotec varieties, where it is realized as extra high. I posit a phonetic change such that the H tone used to be realized in the high register at the time when it triggered upstep, but the modern H tone is realized in the low register.

(29) Diachronic sources of categorical tone ablaut on low-toned roots

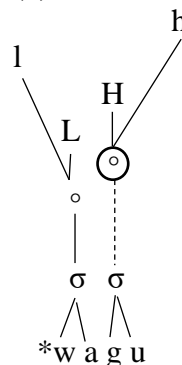
(a) ‘become scarce’



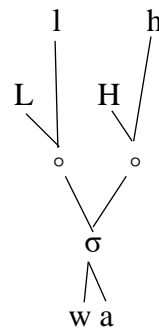
>



(b) ‘eat’



>



In (29b), ‘eat’ was disyllabic with a simplex L melody. The floating tone docked on the post-tonic syllable, leaving the tone of the tonic syllable in situ. ‘Become scarce’ also had an L melody, but it lacked a post-tonic syllable, so the floating tone could only dock on the tonic syllable. A constraint which hypothetically allowed only one tone per syllable, NOCONTOUR in terms of Optimality Theory (Yip 2002: 83), caused the underlying low tone to delink when the high tone associated with the same syllable.

When post-tonic vowels were deleted, the tones associated with them were remapped onto the surviving tonic syllable, causing a change in the language’s tonotactics such that NOCONTOUR is now ranked so low as to be inconsequential, and contour tones

abound. While this analysis is apparent for words with modal vowels, there are some differences when we consider glottalized verbs.

4.4 Glottalized verbs

Glottal contrasts in Zapotecan languages may be analyzed as consonants (Campbell 2014) or as suprasegmentals associated with some element such as the syllable, mora, or vowel (Beam de Azcona 2004a; Hernández Luna 2019; Covarrubias Acosta 2020; among others). The glottal contrast can block other phonological processes, including umlaut (Beam de Azcona et al. 2018: 66–67). Glottal contrasts interact with the tone system in different ways. Campbell (2021) points out that some Chatino words have high tone in a position in which Kaufman (2016) reconstructs a glottal stop for Proto-Zapotecan but in which no glottal stop survives in Chatino, such that high tone in some Chatino words could have arisen due to the acoustic effects of the glottal stop historically. As we saw in Section 3, Coatec has neutralized tonal contrasts on glottalized words. In certain Central Zapotec languages, it is common for phonation, tonal, and consonantal contrasts to interact in such a way that they partially condition and predict one other, but not entirely. Thus, there are several complex issues surrounding glottal contrasts in Zapotecan phonology. This limited study of Coatec verbs can make some contributions to the larger topic. I divide the discussion depending on whether the glottalization is maintained synchronically or not.

4.4.1 *Synchronically glottalized verbs*

Above I hypothesized that earlier complex melodies on disyllables survive today as contour tones. Some evidence suggests that in Southern Zapotec the tone on the post-tonic syllable could not map onto the tonic syllable when it was glottalized.

- (30) ‘meat’
 Proto-Zapotecan *kweʔnã
 Proto-Chatino *kwená? (Campbell 2021)
 Proto Trochaic Zapotec *kwéʔlà?
 San Mateo Mixtepec [βél:à] (Sicoli & Ko 2016)
 Proto Southern Zapotec *bǎéʔl
 Coatec /bǎéʔl/
 San Agustín Mixtepec /bǎéʔǎl/
 Coatecas Altas /bǎéʔl/
 Asunción Mixtepec /bélà/ (Sicoli 2007)
- (31) ‘snake’
 Proto-Zapotecan *kweʔknã
 Proto-Chatino *kwená (Campbell 2021)
 Proto Trochaic Zapotec *kwèʔkn[d]ǎ
 Lachixío /bélǎ/ (Sicoli 2007)
 Proto Southern Zapotec *mbǎéʔl
 Coatec /mbǎéʔl/
 Miahuatec /mbǎéʔl/
 Coatecas Altas /mbǎéʔl/
 Santo Domingo Tomaltepec [bèld] (Erasto Galván, p.c.)
 Asunción Mixtepec /bélǎ/ (Sicoli 2007)

In (30), we see that San Mateo and Asunción Mixtepec have an HL melody on a disyllable. The glottalization in this word is lost in both these languages but is present in all Southern Zapotec languages. Both the San Agustín Mixtepec variety of Miahuatec and the Coatecas Altas variety of Amatec have this word documented with a high tone and a glottalized syllable. San Agustín Mixtepec lacks a falling tone in general, but Coatecas Altas has the same tonal inventory as Coatec when it comes to modal vowels. This is to say that Coatecas Altas has a falling tone on many or most of the same words that have a falling tone in Coatec, presumably from an HL melody on an earlier disyllable. However, while San Mateo and Asunción Mixtepec varieties point to an earlier HL melody on this disyllable, Coatecas Altas only has high tone.

In (31), the correspondence with Chatino is more transparent. Proto-Chatino is reconstructed as having the initial syllable as underlyingly toneless and the final syllable as high. Toneless syllables in Zenzontepec Chatino vary their pronunciation between mid-to-low falling and low level (Campbell & Carleton In Press). This is the same as the pronunciation of the low tone in most Zapotec languages. Thus, Lachixío's LH melody here corresponds nicely with Chatino's ØH melody. Amatec and Miahuatec both have a rising tone that occurs on modal syllables but have a low tone on this glottalized word.

Future work should look at more cognate sets to examine these correspondences systematically, but it appears that *ʔ in the tonic syllable prevented the association of the post-tonic tone with the tonic syllable when post-tonic vowels were deleted in Southern Zapotec. As observed by Silverman (1997: 236), "tone is most perceptually salient when occurring with plain or 'modal' phonation." Phonetically, the glottal stop is the interruption of F₀ and could prevent the pitch from one part of the word from affecting another. Coatecas Altas, and at least the San Bartolomé Loxicha variety of Miahuatec, only have low and high tone on glottalized syllables, even though they have a larger inventory on modal vowels. If contour tones were only created through post-tonic vowel loss, and *ʔ blocked the association of the post-tonic tone with the tonic syllable, then no contour tones could be created on glottalized syllables in Southern Zapotec.¹⁸

Since both Amatec and Miahuatec contrast low and high tone on glottalized syllables and Coatec doesn't, it seems that an earlier form of Southern Zapotec did have tonal contrasts that have been neutralized on glottalized syllables in Coatec. We can hypothesize that if the floating high tone docked onto either the tonic or the post-tonic syllable in antiquity, any resulting tonal alternations would be neutralized on glottalized verbs in Coatec, which explains the lack of tone ablaut on such verbs in the potential. Upstep, on the other hand, is compatible with the glottal contrast in Coatec. Since the glottal stop is realized at the end of the tonic vowel, in earlier forms of Zapotec it intervened between the tonic and post-tonic syllable, but not between the pre-tonic syllable and the modal portion of the tonic vowel.

¹⁸ Both the San Agustín Mixtepec variety of Miahuatec (Beam de Azcona 2004b) and the language of San Bartolo Yautepec (Covarrubias Acosta 2020: 101) have examples of rising tone on glottalized words. However, these two communities have been more heavily influenced by contact with the neighboring Central Zapotec language, Cisyautepecan, than have other forms of Southern Zapotec.

The tonal morphology of the potential in Coatec Zapotec (Di'zhke')

Since tonal contrasts were neutralized on glottalized syllables in Coatec, we might wonder why the difference between upstepped and non-upstepped versions of these syllables remain distinct. This may have to do with the relative timing of the neutralization of tone on glottal syllables and the loss of pre-tonic vowels. If phonological tonal contrasts were neutralized first, and pre-tonic vowels still existed, the pitch difference (from upstep) on the glottalized tonic syllable would have been merely phonetic and thus not targeted by the phonological merger that neutralized tonal contrasts on glottalized syllables. Later, when the pre-tonic vowels were lost or reduced and upstep became morphologically significant, the neutralization of tonal contrasts on glottalized syllables may have no longer been an active process, and the upstep was able to persist. To the extent that upstepped tones are emergent contrasts in Coatec, this phenomenon is reintroducing a tonal contrast on glottalized syllables.

Table 9 repeats the patterns for glottalized verbs from Table 6.

Table 9. Patterns of Tonal Morphology for Glottalized Verbs

Underlying tone:	?		
Historical shape:	*CV	*CVCV	
V-stems	vA	--	? ('cry')
	vC	--	✓
j-stems	viA	--	↑ ('stay')
C-stems	vtA	↑	↑
	viA	--	↑
	vB	--	↑
	vCh	↑	↑
mixed	vtD	↑ ('take out')	--

The hypotheses mentioned thus far predict there will be no tone change on glottalized verbs when there was no pre-tonic syllable historically. This is the case for class C V-stems, which would have never had a pre-tonic syllable. The same should be true for class A V-stems, class D verbs, and j-stems (see Section 4.5.2), but the limited data present conflicts. In a recording made as part of the Survey of Zapotec and Chatino languages (Sicoli & Kaufman 2010; Sicoli & Ko 2016), a speaker from San Baltazar Loxicha can be heard pronouncing the potential form of 'cry' without upstep, as predicted. However, as part of the same survey, a speaker from Santa María Coatlán instead has a deglottalized pronunciation of this verb in which he applies the low/rising ablaut pattern. José Santos Velásquez, also from Santa María Coatlán, produces the verb as glottalized but upstepped in the potential in a recording I made in 1996 as part of the Project for the Documentation of the Languages of Meso-America. Similarly for the class D verb 'take out,' no upstep has been recorded in San Baltazar Loxicha, but Javier Santos Velásquez had a glottalized form that was 10Hz higher in the potential, and the Santa María Coatlán consultant in the survey recordings produces a more markedly upstepped potential form. Since the shift to Spanish is more advanced in Santa María Coatlán, one possibility is that speakers there are more likely to produce innovative patterns due to analogy since there are fewer opportunities to hear the language on a regular basis there. The verb 'stay' could have a similar explanation.

The other verbs shown with upstep in Tables 6 and 9 are C-stems belonging to classes A, B, and Ch. Table 6 shows that verbs in these classes also undergo upstep with falling

tone, so this appears to indicate the former presence of a pre-tonic vowel. Section 4.2 covered upstep on causative verbs. Upstep on intransitive verbs will be covered in Section 4.5.

4.4.2 *Historically glottalized verbs*

As mentioned above, glottalization is usually analyzed as a suprasegmental contrast in Zapotec but as a consonant segment in Chatino. If both types of analysis are correct for individual modern languages, the question arises of which branch is innovative and when the segmental contrast was reanalyzed as suprasegmental or vice versa.

I have hypothesized that Coatec contour tones arose from historical disyllables, and I have shown that historical disyllables with the weak medial consonants *k, *w, and *j can present as modern CV monosyllables with contour tones due to historical consonant loss (as well as post-tonic vowel loss). However, this does not explain all the CV monosyllables with contour tones. A significant number of modern CV monosyllables with contour tones can be reconstructed as *CVʔV, as shown in (32–40), which is not an exhaustive list.

- (32) ‘insert’
 Proto-Zapotecan *uʔu vtD
 Zenzontepec Chatino /u-t-ũʔú/ vtAu
 Totomachapan [juʔ.u]
 Lachixío PFV /o-doʔòʔ/ (Sicoli 2020)
 Coatec ‘lay eggs, put, toss in’ vtD POT /kǒ/, IPFV /n-gò/
- (33) ‘be sold’
 Proto Core Zapotec *i'θoʔo viA
 Coatec /djǒ/¹⁹
 Tlacolulita /doʔ/
- (34) ‘get toasted, get roasted’
 Proto-Zapotecan *kiʔi
 Zenzontepec Chatino /kiʔi/ viBc (Campbell & Carleton In Press)
 Coatec /jî/ viA
- (35) ‘get warm’
 Proto-Zapotecan *tsãʔã viC
 Lachixío STA-hot /ne-zɛʔe/ (Sicoli 2020)
 Coatec /zæ̃/ viA
 Zaniza ‘hot’ /zaʔ/ (Operstein 2015b)

¹⁹ Throughout this paper, I represent as /b, d, g/ a series of obstruents whose unconditioned allophones are [β, ð, γ]. These occur as voiced stops following homorganic nasals, which are frequent. A representation as /β, ð, γ/ would be more accurate, but would force awkward transcriptions like “/nð/” and “/mβ/.” However, “/d/” is misleading here in (33). The other two members of this series are reflexes of the singleton stops *kw > *p > *b > β and *k > *g > γ, but in the case of [ð], here represented as “/d/,” it’s the modern voiced reflex of a sound that I reconstruct as Proto-Zapotecan *θ and has probably never gone through a stop phase, except when it occurs following [n].

The tonal morphology of the potential in Coatec Zapotec (Di'zhke')

Sierra Juárez 'hot' /dzaʔa/ (Ciriaco Alavez, p.c.)
 Petapa 'STA-lukewarm' /na-dzèʔ/

- (36) 'end, be completed' (used for units of time and tasks)
 Proto-Zapotecan *taʔa viA
 Zenzontepec Chatino /ē-taʔa/ vA2 (Campbell & Carleton In Press)
 Coatec /zâ/ viA
- (37) 'see'
 Proto-Zapotecan *nãʔã
 Proto-Chatino /nãʔã/ (Campbell 2021)
 Zenzontepec Chatino /naʔa/ vtAc, POT & IPFV /njaʔa/, PFV /nkã-naʔa/ (Campbell & Carleton In Press)
 Proto-Zapotec *nãʔã
 Coatec vB POT /jâ/, IPFV /njâ/, PFV /ɲwnâ/
 Coatecas Altas vB POT /nê/, IPFV /ninê/, PFV /wnê/
 Tlacolulita PFV /wnaʔ/
 Xanica IPFV /mæʔæ/, PFV /ngwnæʔæ/ (Piper 1995)
- (38) 'be contained'
 Proto-Zapotecan *juʔu
 Zenzontepec Chatino 'get put inside' /juʔu/ viBy (Campbell & Carleton In Press)
 Lachixío POT-CAUS-enter [t̪s̪óʔo] from underlying [H]-g-joʔo (Sicoli 2020)
 Coatec 'exist, for there to be' PFV /ɲgjô/
 San Agustín Mixtepec PFV /ɲgòʔo/
 Zaniza /juʔ/ (Operstein 2012)
 Tlacolulita PFV /goʔ/
 Zoochina 'inserted' /jóʔó/ (López Nicolás 2016)
- (39) 'deny'
 Proto-Zapotecan *u-k-kaʔa
 Zenzontepec Chatino /kaʔa/ vtAu (Campbell & Carleton In Press)
 Lachixío /kà/ (Sicoli 2020)
 Coatec /kâ/ vtA
- (40) 'bark, howl'
 Proto-Zapotecan *u-k-siʔa
 Zenzontepec Chatino 'howl, scream' /fãʔã/ (Campbell & Carleton In Press)
 Lachixío POT /ʃá/, PFV /oʃa/ (Sicoli 2007: 97)
 Coatec 'bark, howl' /fî/ vtA
 San Bartolomé Loxicha 'bark' /fóʔ/ vtA

All the Coatec verbs in (32–40) are open CV monosyllables with modal vowels. In (32), Coatec has a verb with underlying low tone that takes rising tone in the potential, an alternation described in Section 4.3 as developing exclusively on disyllables. In (33),

the verb has rising tone throughout the Coatec paradigm. The verbs in (34–40) all have underlying falling tone in Coatec. Thus, there are modern open monosyllables that have a contour tone in one or more paradigmatic forms, and which reconstruct as *CV?V in ancestral forms of Zapotecan. If earlier *CV?V counts as a single syllable, as it would in many modern Zapotec languages, then this is a problem for the hypothesis presented in Section 4.1.2, that contour tones developed from contour melodies on disyllables. In Chatino languages, /ʔ/ is analyzed as a consonant phoneme (Cruz 2011; Campbell 2014; McIntosh 2015; Sullivant 2015; Villard 2015). If an ancestor of Coatec treated *CV?V as two syllables, and thus able to bear two tones, this would explain why the words in (32–40) and similar forms, which today have lost *ʔ, are able to bear contour tones.²⁰

The Chatino analysis of *ʔ as a consonant proves advantageous for some ancestor(s) of Coatec. This could either be because *ʔ had the status of consonant in Proto-Zapotecan, only becoming a suprasegmental contrast in more recent daughter languages, or it could be attributed to contact between Coatec and Chatino. Coatec neighbors Eastern Chatino and shows evidence of significant contact, perhaps including substrate effects. One possibility is if interference from Chatino caused some speakers to treat *V?V as disyllabic. However, I favor the genetic analysis. All Southern Zapotec languages show some influence from Chatino (Beam de Azcona Forthcoming), but Coatecas Altas is the variety least affected by this influence. The verb ‘see’ in (37) has developed a falling tone in Coatecas Altas, the same as in Coatec. Considering that the more distantly related Rincón Zapotec treats intervocalic /ʔ/ as a consonant (Doroteo Velasco In Preparation), I propose that *ʔ was a consonant until well after the Core Zapotec time depth. The new implications for Proto-Zapotecan phonology are that this language allowed the consonants /*ʔ, *k/ to appear in coda and that *ʔ was the only consonant that could not occur word-initially. An implication for Coatec prehistory is that the list of weak medial consonants which deleted, forming CV monosyllables from historical disyllables, grows to /*k, *w, *j, *ʔ/. This deletion must have occurred before post-tonic vowel loss, since we saw in the previous section that post-tonic tones did not survive on glottalized roots, but we do find contour tones on former *(C)V?V roots that lost medial *ʔ.

4.5 Voice prefixes as hosts for floating high tone

Looking at Table 6, the remaining questions are 1) why C-stems of classes B, Ch, and viA have tone ablaut on low-toned verbs but undergo upstep when falling or glottal and 2) why j-stems behave differently than C-stems for falling-toned verbs of class viA.

I hypothesize that, outside of a few cases of analogy, wherever we see systematic upstep, there was a pre-tonic vowel in the potential form historically. In Section 4.5.1, I

²⁰ There are two CV verbs in Coatec, ‘to get down from somewhere’ /lâ/ and ‘stand’ /zô/, both intransitive verbs of class B, which to the best of my knowledge lack glottalization in all Zapotecan languages and appear to reconstruct as monosyllables. Though belonging to the same verb class and having the same synchronic shape and underlying tone, these two verbs also differ as to patterns of tonal morphology with the potential, since ‘get down’ exhibits upstep and ‘stand’ has tone ablaut. Because these verbs display historically unexpected patterns, and because all other CV monosyllables with contour tones for which I have found cognates show comparative evidence of a history as disyllables with weak medial consonants, I suspect that these two forms may result from analogy.

argue that the only pre-tonic vowels in historical potential forms were voice prefixes. The discussion includes a novel reanalysis of Kaufman's *ki- "potential" allomorph as bimorphemic. In Section 4.5.2, I show that stem-initial /j/ is a non-syllabic version of the anticausative prefix, causing such verbs to lack a pre-tonic vowel in the potential, thus explaining their lack of upstep. In Section 4.5.3, I argue that causative *u was more likely than other voice prefixes to attract the floating tone of the potential because of its early status as an auxiliary verb.

4.5.1 A partial typology of pre-tonic vowels in Zapotec

In Section 2, we saw that when syllabic prefixes are added to a consonant-initial base or stem they are pre-tonic. Since I have argued that high tone on a pre-tonic vowel is the ultimate source of potential upstep, that pre-tonic vowel could hypothetically be part of either a voice prefix or the irrealis mood prefix. Kaufman (2016) reconstructs the "potential" (in my terms "irrealis") allomorph *ki- for classes A and B. However, in this section, I propose that the irrealis was always marked segmentally with *k- and that the only pre-tonic vowels in potential forms were those of voice prefixes (other than the vowels of roots in compound verbs, which are not the focus here). In this section, I look at the evidence for pre-tonic vowels in the groups of verbs that undergo upstep. This will have secondary repercussions for prefix allomorphy and verb classification.

All class A verbs in Kaufman's reconstruction, but one, have causative *u. According to Kaufman's (1989) vowel hierarchy, *i always deletes before another vowel. It seems pointless to reconstruct the irrealis allomorph *ki- for class A if the *i *always* deletes in class A. There are two ways to fix this problem. One is to say that class A included non-causative verbs, and to consider whether these could have borne pre-tonic *ki-. Another is to say that the irrealis prefix was *k- and not *ki-. I begin with the former.

Kaufman (2016) reconstructs only three intransitive verbs belonging to class A and two of these begin in *u, making them look morphologically like causative verbs, which leaves only one non-causative class A verb in his reconstruction. In my comparative Zapotecan database I have seventeen intransitive verbs reconstructed for class A so far. Only three of these begin in *u: 'sing,' 'dance,' and 'cry.' Rather than "causative," these might be better considered agentive, as others have suggested (Foreman & Dooley 2015; Sicoli 2015: 195–198; Uchihara & Gutiérrez 2020a). The other fourteen entries show no evidence of *u but do have the reflexes of class A morphology in at least some modern languages. Recall Kaufman's reconstruction of the class A perfective marker as *kwe-. Proto-Zapotecan *kw is reflected as a bilabial obstruent in at least some environments in all modern Zapotec languages. In most Zapotec languages, only class A verbs have perfective forms beginning in a bilabial consonant. Consider the verb in (41).

- (41) 'be buried; be hidden'
- Proto Core Zapotec: viA *e-kà'ktsi
 Proto Southern Zapotec: viA *gà'ts
 San Agustín Mixtepec (Miahuatec): PFV /mbgà'ts/
 San Baltazar Loxicha (Coatec): PFV /mbga'tʃ/
 Proto Central Zapotec: viA *e-kà'ttsi
 San Pablo Mitla: HAB /rga'ts/ (Stubblefield & Miller 1991)
 Santa María Petapa (Transyautepecan): PFV /be'gà'tʃi/
 Asunción Tlacolulita: PFV /bi'ga'tʃ/

In (41), we see that this intransitive, non-agentive verb has a perfective form beginning in a bilabial consonant in both Southern and Central Zapotec languages, whose last common ancestor was Proto Core Zapotec. By at least this stage, and probably earlier, class A should have included more than just *u-marked agentive verbs.

If class A had non-causative members, the next question is whether it had the irrealis allomorph *ki- reconstructed by Kaufman (2016) for class A. We already saw that causative o-stems show no evidence of *ki-, but, in theory, non-causative class A verbs could take a *CV- prefix if the stem were consonant-initial. There are no Coatec class A transitive verbs without reflexes of *u in the potential form. All class A verbs in Coatec without *u- are intransitive. In Section 2.3, I mentioned the anticausative prefix reconstructed by Kaufman (2016) as *i/*j. If the only class A verbs that have any reflex of pre-tonic *ki are intransitive, and if we already know of an *i prefix that derives intransitive verbs, the vowel in *ki- starts to look a lot like anticausative *i.

Kaufman didn't reconstruct irrealis *ki- only for class A but also for class B. Here we should note that 75% of class B verbs currently reconstructed for Proto-Zapotecan are intransitive, as are 75% of class B verbs recorded in Miahuatec and more than 90% of class B verbs documented in Coatec. Class B is also characterized as typically intransitive in Chatino languages (Campbell 2011: 234; Sullivant 2015: 326). One hypothesis could be that class B started out as only intransitive verbs but that some transitive verbs have acquired identical inflectional morphology due to analogy.

If the *ki- of class B and intransitive C-stems of class A is actually irrealis *k- plus anticausative *i-, this has implications for Zapotecan verb classes. I present an amended version of Tables 2 and 3 below in Table 10.

Table 10. Fourth Amendment to PTZ Verb Classes

	A	B-C	D
Potential	[H]		
Irrealis	*k-		
Perfective	*kwe-	*ku-	*ku-
Replacives	--	--	✓

Note that separating the irrealis prefix from the anticausative prefix eliminates the distinction between classes B and C, formerly distinguished only by the irrealis allomorphs *ki- and *k-. This is not the first time there has been a proposal to combine classes B and C (Smith Stark 2002: 28–29, 2008: 401; Beam de Azcona 2004a: 117; Operstein 2015c: 340). What's novel is the proposal that the irrealis had a single allomorph and that *ki was bimorphemic. The vestiges of the voice prefixes, especially when they fuse with mood and aspect marking, may justify positing new classes or subclasses in modern Zapotec languages, but irrealis allomorphy becomes irrelevant to early Zapotecan verb classification if all verbs took the same allomorph, *k-.

Coatec is bordered by the Chatino languages to the west and by Miahuatec Zapotec to the east and south. All these languages have palatalization of the stem-initial consonant in certain verb forms, which has been attributed to the former existence of *i in a prefix (Beam de Azcona 2009: 60, 2019: 139; Campbell 2011: 226; Sullivant 2015: 317). In the potential form, this palatalization takes place in class B in Chatino, Coatec, and at

least the San Bartolomé Loxicha variety of Miahuatec. In Coatec and Miahuatec it also takes place in Class Ch, which is not found in Chatino, and in *some* class A intransitive C-stems. Beam de Azcona's (2004a, 2009) class Ch is treated by Kaufman as a special type of class D verb in Proto-Zapotec, but this class palatalizes in the potential in Coatec and Miahuatec, suggesting the former existence of a pre-tonic *i. Most class Ch verbs are intransitive, and so we might consider that anticausative *i was present historically and triggered palatalization of the stem-initial consonant.

The relevance of pre-tonic *i to upstep in Coatec is that anticausative verbs which added pre-tonic *i to a consonant-initial base had a pre-tonic vowel. As we saw with the causative prefix, high tone on a pre-tonic vowel could condition upstep on the tonic syllable. Figure 5 shows potential and perfective forms of the anticausative class A verb 'get rolled up.' This verb has palatalization in the potential and perfective, indicating the former presence of pre-tonic, anticausative *i. The falling tone on the lone surviving tonic syllable is more dramatic and starts higher in the potential compared to the perfective, the same pattern of upstep we saw in Figure 3 above.

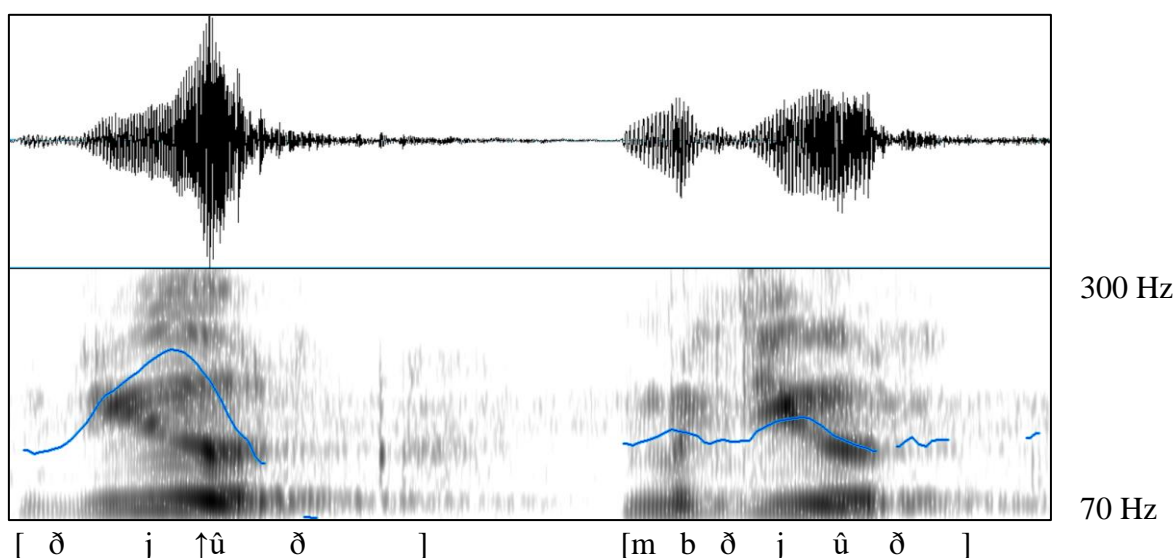


Figure 5. /-d(j)ûd/²¹: IRR.ANTICAUS.POT.get.rolled.up, PFV-ANTICAUS.get.rolled.up

No transitive class A verbs palatalize, and only some intransitive ones do. This makes sense if only some class A intransitive verbs contain anticausative morphology. The potential form of the intransitive class A verb 'heal' is /↑lâ/, but the potential of 'become bitter,' also of class A, is /ljá/. We can surmise that unpalatalized 'heal' did not have pre-tonic *i, whereas palatalized 'become bitter' did.

I assume that verbs like the aforementioned /lâ/ 'heal' and others like /gu?/ 'comb one's hair': 1) never had causative *u because they lack w- in the potential; 2) never had anticausative *i, because they are unpalatalized; and 3) did have some other pre-tonic vowel both because they do not exhibit consonant fortition (something that does happen in class D, due to the historical *kC sequence formed by the concatenation of the irrealis prefix and the stem-initial consonant) and because they do undergo upstep. Thinking

²¹ Class A anticausative C-stems display palatalization in most of the paradigm but lack it in the infinitive, as in the progressive construction 'is being rolled up' /nde+dûd=é/.

about what other vowel could have been present in such verbs, restorative *e, first mentioned in Section 2.3, is a good candidate. This voice prefix is often called “restorative” in the Zapotec literature, because many verbs with this morphology refer to an action that produces a return to an earlier state of affairs, as when healing an injury returns a person to health. Uchihara and Gutiérrez (2020a, 2020b) refer to this as middle voice because of examples like ‘comb one’s hair’ where the subject acts upon herself or himself. Thus, we can surmise that some Coatec C-stems used to have a pre-tonic vowel that was neither *u nor *i, but which was probably restorative *e.

The picture that emerges is that class A, which, after the loss of pre-tonic voice prefixes, contains both consonant- and V-stems in Coatec, used to be a class that consisted entirely of V-stems. Specifically, stems that began in one of the voice prefixes, *u-, *i- or *e-. (42) shows the template for class A verbs in early forms of Zapotecan.

- (42) Class A segmental morphological template for irrealis-marked verbs
- | | | |
|----------|---------------|--|
| IRREALIS | VOICE PREFIX | VERB ROOT |
| [*k- | [{u, i, e} - | [(C)V(CV)] _{ROOT/BASE} STEM]INFLECTEDVERB |

If I am correct in my assertion that the irrealis marker was always *k-, only the voice prefixes could form the nuclei of pre-tonic syllables in potential verb forms. Thus, the only Coatec verbs (other than analogized ones) that have upstep today are those that had pre-tonic voice prefixes historically. Their ability to bear high tone and condition upstep is what makes the voice prefixes relevant to this paper, but working this out has led to a new realization about the origins of class A.

In Core Zapotec languages, class A is characterized by a bilabial consonant in the perfective prefix. As mentioned above, bilabial consonants in Zapotec come from *kw in Proto-Zapotecan. For example, compare ‘corn grains,’ /ntsukwāʔ/ in Zenzontepec Chatino, to /nzõp/ in Coatec. The Popolocan family is thought to be the sister to Zapotecan. Cognate with Proto-Zapotecan *ku-, Popolocan languages have perfective /kú-/ which reduces to /kw’-/ before a vowel (Nakamoto 2017b). Now that we have noted that all class A verbs historically had stems beginning in the non-low vowels /*i, *e, *u/, it makes sense that the perfective prefix *ku- could be realized as *kw- before these vowels.²² In combination with the anticausative and restorative prefixes, this would render the combinations *kwe and *kwi, close to Kaufman’s reconstruction of the class A perfective marker in Proto-Zapotecan as *kwe-, and also to the vowel quality in modern Zapotec languages which variously have *bi-*, *be-*, etc. In fact, a single language may have both, as in Petapa ‘hid (restorative)’ /be’kàʔtʃi/ vs. ‘turned over (anticausative)’ /bi’bi^hza/.

Causative verbs may involve detransitivizing morphology in the perfective. In Teotitlán del Valle, where the reflex of restorative *e- is /a-/, the causative prefix /u-/ is substituted with restorative /a-/ in the perfective, as in the verb ‘make fall’ /u-sa:b/, whose perfective form is /b-á-sa:b/ (Uchihara & Gutiérrez 2020b). Chatino languages have causative u-stems that take a /j-/ prefix in the perfective. Eric Campbell (2017: 118 & p.c.) hypothesizes that this prefix may relate to the Chatino “intransitivizer” (i.e., anticausative) morpheme /j-/ and states that, “the Perfective Aspect prefix y- [...] was a

²² Verb stems beginning in *a belong to class C, in which the stem-initial vowel deletes in the perfective, a topic that merits more attention in the future.

relatively recent Chatino innovation that has no Zapotec cognates.” Whether this is a recent Chatino innovation, though, is in doubt, since I have found this same prefix in the recordings of the Survey of Zapotec and Chatino Languages for Totomachapan Zapotec (Sicoli & Kaufman 2010; Sicoli & Ko 2016). For example, this language has the perfective forms ‘cried’ [j-ŷn:a], ‘drank’ [j-yʔy], and ‘ground’ [j-y:n], where I presume [y] is a fronted reflex of *u following /j/. While this pattern may be due to ancient contact with Chatino, it also could be that both languages here retain something from Proto-Zapotecan, the concatenation of the anticausative and causative prefixes. Thus, in Teotitlán the restorative prefix replaces the causative prefix in the perfective, and in Chatino and Totomachapan the anticausative prefix concatenates with the causative as a way of indicating perfectivity. These patterns are consistent with the tendency for past or perfective forms to relate to lower transitivity (Hopper & Thompson 1980: 293–294).

The pre-vocalic *kw- perfective allomorph marked on anticausative and restorative verbs yields the sequences *kwi- and *kwe-. For causative verbs, Chatino and Totomachapan use the anticausative prefix *j- as a de facto perfective prefix that concatenates with the causative prefix. However, by the Core Zapotec period, the causative prefix *u- was omitted in the perfective form. I hypothesize that the perfective forms of causative verbs in Proto-Zapotecan began in a */ku-i-u/ *[kw-j-u] sequence that later reduced in different ways in different languages, as a way of reducing the number of underlying vowels in hiatus or to eliminate morphological redundancy. The Macro-Zapotec grouping in Figure 1 is the set of languages which delete causative *u in the perfective. Table 11 shows an updated verb classification for the Proto-Zapotecan time depth.

Table 11. Fifth Amendment Proto-Zapotecan Verb Classes

	A	B-C	D
Perfective allomorph	*kw-	*ku-	*ku-
Replacives	--	--	✓
Initial segments in the imperfective stem	*i, *e, *u	*i, (*e,) ²³ *a, *C	*a, *k, *kw
Initial segments in the perfective stem	*i, *e	*C (Stem-initial vowels may be present underlyingly but do not surface)	*tʃ, *θ, *n[d]

Above in Table 10, I reanalyzed Kaufman’s class A & B irrealis allomorph *ki- as irrealis *k- plus a voice prefix. Now, in Table 11, I have reanalyzed Kaufman’s class A perfective allomorph *kwe- as *kw- plus a voice prefix. Because Table 11 focuses on the differences between the classes, I omit the floating *H tone of the potential, since it was not restricted to a particular class. Because potential *H is not included here, I labeled the table as “Proto-Zapotecan”, since none of the segments listed changed between Proto-Zapotecan and PTZ.

The new analysis explains the patterns of vowel ablaut found on class A causative verbs in Macro-Zapotec (e.g., ‘kill’ *ukθi with perfective *kwikθi) as resulting from the addition of less transitive voice prefixes to causative bases in the perfective. Kaufman (1989) had proposed a hierarchy which used vowel quality to predict which vowel in a

²³ A single *e-initial verb, ‘drink’, is reconstructed with the class B-C pattern.

sequence would delete. That proposal fails to predict *i surfacing as a glide before *u in Chatino and Tototmachapan, or the deletion of causative *u in perfectives with *i, as in Coatec ‘cry’ /oʔn/ with the perfective /mbiʔn/. The vowel hierarchy also fails to explain why a variety like Petapa has different vowels in the perfectives of class A verbs, as in the aforementioned ‘hid (restorative)’ /beˈkàʔtʃi/ and ‘turned over (anticausative)’ /biˈbiʰza/. To characterize the vowel ablaut as phonologically motivated misses an important morphological generalization, which is that the stem-initial vowel seen in most of the paradigm only ever deletes in the perfective. Synchronically, some languages have pre-tonic /i/ as part of an imperfective allomorph, /ri-/ < *tʰe- (Operstein 2012). The /i/ in this prefix disappears before causative /u/ or /o/, but these same causative verbs omit the back vowel and instead have pre-tonic /i/ in the perfective. If the deletions and substitutions were phonologically motivated, we would expect the concatenation of a Ci- prefix with an *u-initial stem to have the same result, but it doesn’t, because, I argue, vowel ablaut in class A is not phonologically conditioned. Future work can examine more carefully what happens in class B-C, but I propose that in class A these patterns are strictly morphological, with perfective *kw- combining with restorative *e- or anticausative *i- due to a preference for downplaying agentivity in the perfective.

Problems that will need sorting out in future work have to do with why perfective *ku- imposes itself at the expense of the stem-initial vowel of class B-C, rather than reducing to *kw- as in class A. What I propose as anticausative *i-stems of class B(-C) are both phonologically and morphologically similar to class A *i-stems, so it is unclear why the perfective allomorph *kw- is not used in class B(-C). The differences could reflect morphology with different time depths, or be fossilized examples of what was once free variation, and could be analyzed in a Cophonologies framework in future work.

With regards to upstep, the main takeaway from this section is that if the irrealis lacked allomorphy and always presented as *k-, the only source for a pre-tonic vowel in the potential would be one of the voice prefixes /*u-, *i-, *e-/ added to a consonant-initial base. All three voice prefixes are found in class A, and I propose that the anticausative prefix *i also occurred in pre-tonic position in classes B(-C) and Ch. That we find upstep in class A modern C-stems (historical *u-, *i- and *e-stems) and in classes B(-C) and Ch is not surprising then. Likewise, it is not surprising that upstep generally does not occur on modern V-stems, since these verbs never had a pre-tonic syllable.

4.5.2 *The origin of j-stems*

In the last section, I hypothesized that the Proto-Zapotecan perfective prefix *ku- reduced to *kw before at least some vowels. Kaufman (2016) reconstructs the anticausative as having allomorphs *i and *j, with the latter occurring before vowels. Both these cases of allomorphy suggest that early forms of Zapotecan could deal with vowel clusters by turning high vowels into glides.

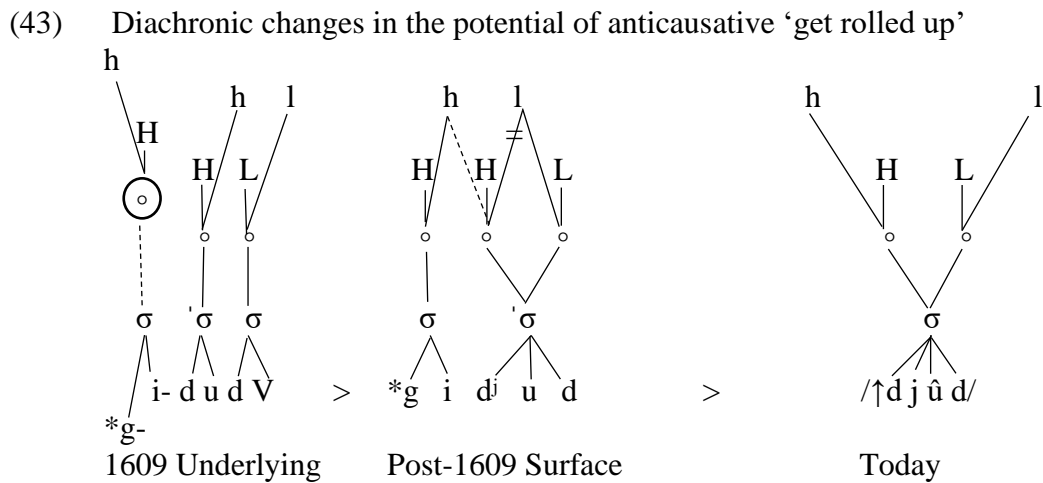
Operstein (2015a: 43) shows that *j is added to vowel-initial roots to derive verbs in several languages. An example from Coatec is the root /òx/ vtC ‘to grind something’, from which is derived /jòx/ viA ‘to get ground.’ As shown in Table 6, j-stems do not undergo upstep. In the last section, we saw that anticausative *i added to a consonant-initial base was pre-tonic and thus could condition upstep. Conversely, anticausative *j added to a vowel-initial base would not even be syllabic and thus could not bear tone.

The tonal morphology of the potential in Coatec Zapotec (Di'zhke')

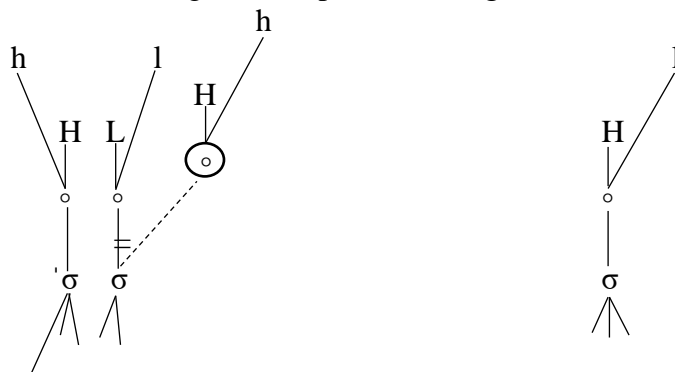
(43) and (44) show potential forms for two anticausative verbs with an underlying HL melody. For the earliest stages I show an underlying representation, because I assume that at that time the surface forms could be derived via straightforward, cognitive processes. However, for the most recent forms I show only surface forms because modern speakers must memorize paradigmatic forms which arose historically via processes which have now become opaque due to the loss of unstressed vowels.

In (43), the floating high tone of the potential docked onto the pre-tonic syllable in antiquity, leaving the underlying tones of the root in situ. Post-tonic vowel loss led to the creation of a falling composite contour tone which could be realized on a single syllable. I propose that whereas the H tone was previously associated with the high register, both portions of the falling tone became associated with the low register through a process of anticipatory assimilation when this contour tone was created. However, the first portion of the falling tone could be affected by upstep when following a high tone in the pre-tonic syllable, as shown in the intermediate stage in (43). The deletion of the pre-tonic syllable means that today speakers must memorize upstepped surface forms in the potential of this and similar verbs.

In (44), there is no pre-tonic syllable because the anticausative allomorph *j serves as onset to the tonic syllable. The floating high tone of the potential instead docked onto the post-tonic syllable, causing delinking of the underlying L tone. This meant that a verb with an HL melody throughout most of the paradigm would have H on both syllables in the potential. This process must have been transparent as long as post-tonic vowels were retained but became opaque once the post-tonic vowels were lost.



(44) Diachronic changes in the potential of 'get burnt'



j-o l o *g- Pre-1609	>	/j ó l/ Today
----------------------------	---	----------------------

The dates in (43–44) come from philological evidence. The *Relación del pueblo de Coatlán* (Gutiérrez 1905 [1609]) is a report made to the king of Spain about the Coatec-speaking region in 1609. In it, the founder of Coatlán is named as *Meneyadela*. *Mene*, today /mɛn/, is a class term meaning ‘respected person’, and *ya-dela* is a name from the Mesoamerican ritual calendar meaning ‘1-Dog’ (Oudijk 2021: 94, 96), where Córdova (1578) supplies the Colonial Valley Zapotec cognates *quia* (/kja/ or /gja/) and *tella*. The name *Mene Yadela* in Colonial Coatec shows that as of 1609, earlier *g (Proto-Zapotecan *k) had been lost preceding /j/ <y>, but post-tonic vowels still survived. Thus, the early form *gjólò in (44) must predate 1609, and the intermediate form *gidjûd in (43) must be later. I hypothesize that post-tonic vowels were lost before pre-tonic vowels were, because several Zapotec languages, including the Southern Zapotec variety of Coatecas Altas, retain pre-tonic vowels despite having lost post-tonic vowels, whereas I know of no Zapotec variety where the reverse is true. I therefore infer that post-tonic vowels and, subsequently, pretonic vowels were lost in Coatec sometime after 1609 and before 1886, when Antonio Peñafiel sent a lexical survey to Santa María Coatlán, whose mayor recorded no post-tonic vowels in native vocabulary (Peñafiel 1886). The tonal morphology of the potential in Coatec was thus phonologically predictable during the first century of New Spain but likely transformed into a word-and-paradigm system of tone ablaut during the second half of the Colonial period.

The lack of upstep on *j-stems is support for my proposal that class A had a vowel-less irrealis prefix *k-, as opposed to Kaufman’s (2016) *ki-. If the irrealis prefix in class A were *ki-, we would expect it to be able to concatenate with j-stems, but the lack of upstep on these verbs in Coatec suggests otherwise. On the other hand, if the *i in *ki was the anticausative prefix, it makes sense that it would be pre-tonic before a consonant but be pronounced as a glide before a vowel.

4.5.3 *The special status of causative *u-*

All verbs that had pre-tonic voice prefixes display upstep in Coatec if the root tone is falling or glottal. However, causative verbs with low tone have upstep, while restorative and anticausative verbs with low tone have tone ablaut. The reasons why anticausative and restorative verbs with low tone don’t exhibit upstep will be explained in 4.6. In this section, I explain that causative verbs don’t have tone ablaut because, at some stage in prehistory, causative *u did not have the same status as the other voice prefixes but was an auxiliary verb and itself constituted the root being marked for the potential.

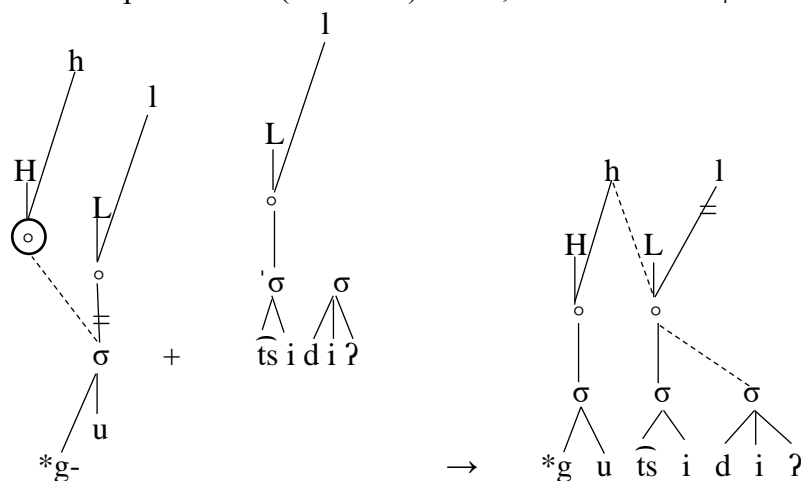
Beam de Azcona and Cruz Santiago (2022) discuss compound verbs as well as verbal complexes consisting of bound strings of auxiliary verbs with other verbs in a single phonological word in Miahuatec Zapotec. In both cases, the final root is prosodically more prominent, but only the first verb root can be inflected for aspect. It is common in Zapotec languages for syntactic constructions to become phonologically bound and verbs are a frequent source of new verbal prefixes (Smith Stark 2003; Broadwell 2015b; Beam de Azcona 2023, Forthcoming). Causative *u could have begun as a reduced form of Proto-Zapotecan *unĩ ‘do.’ Some, but not all, causative verbs are derived with *k following the *u (or even instead of the *u), suggesting that the less valent verb was marked as irrealis in an ancient causative construction (Operstein 2014; Foreman &

Dooley 2015: 273). In Zapotecan languages, certain verbs require verbal complements with irrealis marking (Black 1994; López Nicolás 2016: 534–537; Gutiérrez Lorenzo 2021: 222–225). Thus, many causative verbs look like they have *u in the auxiliary slot in an INFLECTION-AUX-IRREALIS-VERB template. While anticausative *i- and restorative *e- could have a similar historical trajectory, their lack of the fossilized *k- prefix suggests that causative *u- was a verb more recently than *i- and *e-.

I reconstruct the ‘do’ verb root as *unĩ in Proto-Zapotecan, reflected as /ũn/ in Coatec, with a simplex L melody. If the auxiliary verb *u was a reduced form of ‘do’, it may have had the same low tone as the fuller root. In Coatec, causative vowel-stems have low tone if not glottalized, as in ‘find out’ /õn/, ‘open one’s mouth’ /õts/, and ‘kill’ /ùθ/. The intransitive verb ‘die’ /âθ/ has falling tone, suggesting earlier *ákθi with an HL melody. Whether /â/ was a separate derivational morpheme or part of the intransitive root deserves further consideration in the future, but there is no trace of either /a/ or its high tone in the causative verb, which would have been *ùkθi with an L melody. Bickmore and Broadwell (1998) report that a low tone is part of the process that derives transitive verbs from intransitive ones in Sierra Juárez Zapotec, perhaps due to *ù-.

If *ù was the inflected verb in a bound verbal complex, it would have been the target for the floating high tone, while also being pre-tonic. As mentioned earlier, the floating high tone to mark potential was a PTZ innovation, so the patterns I am positing here indicate that *ù had the status of an auxiliary verb through at least the PTZ time depth. Coatec tone ablaut reflects tone changes on the tonic or post-tonic syllables in pre-history, but *ù’s status as head verb would have attracted the floating high to the pre-tonic syllable, as in (45).

(45) Pre-Coatec potential of (causative) ‘learn,’ cf. modern /w-↑tsid/



In (45), only the verb root *ù is inflected as potential. After tier conflation there would have been surface phonetic effects, including upstep on the second root following the high tone on the pre-tonic root, and probably tone spreading from the tonic syllable onto the post-tonic syllable, as happens in modern varieties with underlyingly toneless post-tonic syllables. The regularity of upstep on causative C-stems is explained by *ù’s status as an inflectable verb root combined with its prosodic realization as pre-tonic when preceding a consonant-initial root within the same phonological word. The anticausative and restorative prefixes were also pre-tonic, and could acquire a high tone,

but the verb roots to which they attached would also undergo tonal changes if they had an underlying simplex L melody, for reasons discussed in the following section.

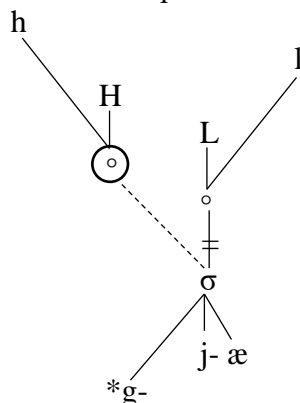
4.6 Ranked constraints that motivated the behavior of potential *[H]

Anticausative and restorative verbs undergo upstep in the potential if they have glottal or falling tone, but instead have tone ablaut if they are low-toned. This incongruency appears to be conditioned by the verb's underlying tonal melody. In this section, I compare patterns of tone ablaut and upstep and make inferences about the ranked constraints which characterize the behavior of the floating H tone in an ancestor of Coatec. A number of ranked constraints can be inferred from the examples seen so far.

All contour tones have been explained as resulting either from the loss of weak intervocalic consonants /*k, *ʔ, *w, *j/ or later from the loss of post-tonic vowels after 1609. Internal reconstruction suggests that there were no contour tones prior to these changes. The NOCONTOUR constraint was thus highly ranked in an earlier ancestor.

In (43), we saw that the floating tone would dock onto an underlyingly toneless pre-tonic syllable if one were available, leaving the underlying HL melody of the verb root in situ. This behavior satisfies three additional constraints: *FLOAT, which seeks to have every tone associated with a TBU; SPECIFYT, which prescribes that every TBU be associated with a tone; and MAX-T, which prohibits the deletion of underlying tones (Yip 2002: 83). The fact that the floating H would dock onto a root syllable and cause its underlying tone to delete if there were no toneless syllables available, as in (44) and (46), indicates that in Pre-Coatec *FLOAT and NOCONTOUR outranked MAX-T.

(46) Pre-Coatec potential of (anticausative) ‘disintegrate, melt’ /jǎ/



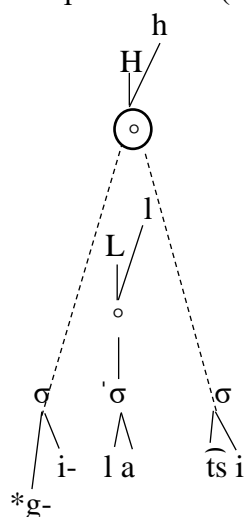
In (46), the floating H docks onto the tonic syllable because it is the only syllable in the inflected verb. The verb in (44) likewise lacked a pre-tonic syllable but had a disyllabic root with an HL melody and the floating tone there docked onto the post-tonic syllable. Modern Coatec verbs with rising tone, e.g., ‘get covered’ /jǎ/ (< Proto-Zapotecan *j-akūʔ), undergo no tonal changes in the potential. Assuming this verb had a Pre-Coatec form *j-àgúʔ, if the floating high of the potential docked onto the post-tonic syllable, there would be no change in the surface form, since this syllable was already high. Docking onto the tonic syllable would have created a rising/high pattern of tone ablaut, unattested in modern Coatec. It seems it was preferable for the potential form to have no discernible marking rather than to mark it on the tonic syllable, though marking it on the tonic syllable was an option when inflecting monosyllabic roots without syllabic prefixes, as in (45–46). The privileged position of the tonic syllable can be captured

with the HEAD-MAX-T constraint (Yip 2002: 182), which dictates that tones of head syllables should be preserved. In Pre-Coatec this positional faithfulness constraint outranked unconditioned MAX-T, because the underlying tones of post-tonic syllables were more likely to be replaced than the tones of tonic syllables. In turn, HEAD-MAX-T was outranked by *FLOAT and NOCONTOUR because the tone of the tonic syllable would delete if it were the only possible docking site for the floating high tone, as in (45–46).

Other Zapotec languages rank constraints differently. Bickmore and Broadwell (1998: 51) report that in Sierra Juárez Zapotec “the stressed syllable attracts the floating high.” This seems to also be the case in Lachixío, in verbs like ‘get tied,’ whose stem is /rátʃi/ but whose potential form is /tʃátʃi/ (Sicoli 2007: 98), or ‘eat,’ shown earlier in (28), where the floating high tone replaces the underlying low of the tonic syllable while leaving the post-tonic syllable toneless. Considering that the last common ancestor of Lachixío and Sierra Juárez was Proto Macro-Zapotec, it seems that HEAD-MAX-T was not as highly ranked in that language as it was in a more recent ancestor of Coatec.

(47) shows a disyllabic root with a simplex L melody. I assume that only the tonic syllable was underlyingly specified for low tone. Both (43) and (47) had underlyingly toneless pretonic syllables. That the floating high docked onto the pre-tonic syllable in (43) is evident by the modern upstep. That the floating H docked onto the post-tonic syllable in (47) is evident by modern low/rising tone ablaut. There is no modern reflex of pre-tonic high tone in (47), but as I stated in Section 3.2, high and rising tones are not affected by morphological upstep synchronically. The alternatives are to propose that floating high only docked onto one syllable and preferred a toneless post-tonic syllable over the pre-tonic syllable, or to propose that the floating tone docked onto any and all toneless syllables. Bickmore and Broadwell (1998) propose that a floating high tone in Sierra Juárez Zapotec can simultaneously dock onto more than one toneless syllable, and this proposal would apply SPECIFYT more consistently, so I prefer this analysis.

(47) Pre-Coatec potential of (anticausative) ‘become thin,’ cf. modern /ljäts/



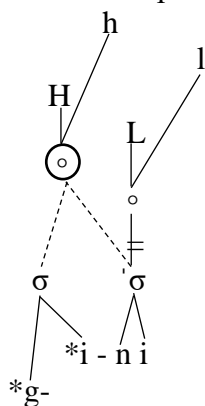
This example prompts the question of why high and rising tones do not undergo morphological upstep. When the floating high docked anywhere on an unglottalized root, the modern root always has either high or rising, precisely the two tones that don't show the effects of morphological upstep. Since surface high and rising tones are ways of marking the potential in Coatec, it may be that at some point, perhaps after pre-tonic

vowel loss, speakers deemed it unnecessary to upstep a verb that already had high or rising, since this would have amounted to double marking of the same category.

Note that, strictly speaking, upstep is not always absent on verbs that historically docked the floating H onto both pre- and post-tonic toneless syllables. In Section 4.4.1, we saw that the tones of post-tonic syllables did not survive on glottalized verbs. Surely some of the post-tonic syllables onto which the floating high tone would have docked were in words with glottalized tonic syllables. That all glottalized verbs undergo upstep where there was a pre-tonic voice prefix historically is evidence that indeed the floating tone docked onto all toneless syllables, and not just the post-tonic one.

(46) showed a low-toned monosyllable without a pre-tonic prefix, and (47) showed a low-toned disyllable that had both pre- and post-tonic toneless syllables. One remaining problem concerns low-toned monosyllabic roots that had an underlyingly toneless pre-tonic prefix. (48) shows the internal reconstruction for one such verb from Table 5.

(48) Pre-Coatec potential of (anticausative) ‘end,’ cf. modern /ní/



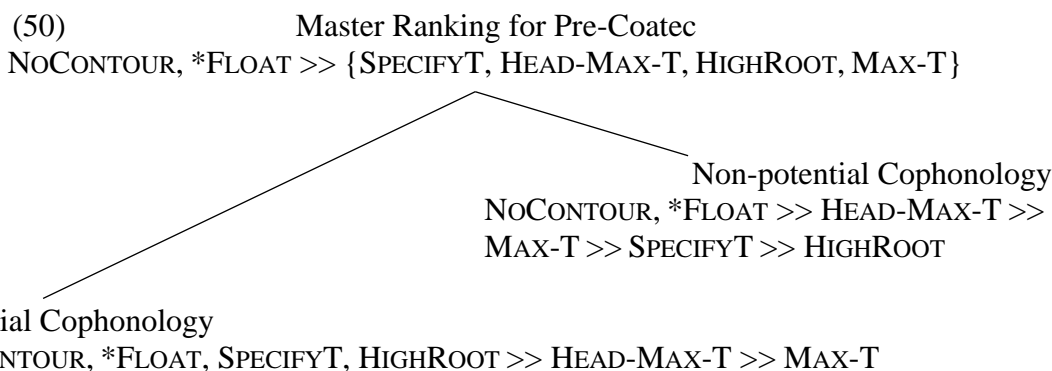
I explained the upstep in example (43) by saying that the floating H of the potential would have docked onto the pre-tonic syllable because it was toneless (SPECIFYT and *FLOAT), while leaving the HL melody of the root intact (MAX-T). This explanation does not suffice for examples like (48), because if docking onto a pre-tonic syllable alone met the demands of associating *[H] and marking the potential, it wouldn't be necessary to delink the low tone of the verb root in (48) (in violation of HEAD-MAX-T).

I have internally reconstructed four possible melodies on verb roots: H, L, HL, and LH. The simplex L melody differs from all the other melodies by lacking an H. Perhaps part of the salience of potential marking is having an H somewhere on the verb root itself, because root syllables are the canonical locus of tonal contrasts. Under this hypothesis, in an example like (43), for the floating H to dock onto the pre-tonic syllable satisfies *FLOAT and for the verb root to keep its HL melody satisfies the requirement that verb roots have an H somewhere in their potential form, which makes it possible to avoid violating MAX-T. In an example like (48), however, there is no H underlyingly associated with the verb root, and HEAD-MAX-T must be violated to satisfy the higher ranked constraint that requires the presence of H on the verb root.

If this hypothesis is correct, it suggests a morphological motivation or conditioning. Different ways of treating “morphological differentiation of phonological patterns” are examined by Inkelas and Zoll (2007), who advocate for the Cophonology approach that

I will use here. In (49), I introduce a constraint that requires an H tone on every root. If this constraint were being applied to the modern language, glottalized verbs with upstep would need to be addressed somehow, either by positing that the glottal tone has underlying H, or by wording this constraint such that an h feature on the register tier was sufficient. However, since the proposal is for a language spoken centuries ago, I assume that glottalized roots had potential forms with at least one H syllable, the same as modal roots. (50) locates this constraint relative to the other ranked constraints mentioned in this section for two cophonologies that I propose for the internally reconstructed ancestor of Coatec. If potential forms prioritize having a high tone somewhere on the root over preserving the underlying tone of even the tonic syllable, then the HIGHROOT constraint is ranked above the HEAD-MAX-T constraint in the cophonology relevant to the potential construction. However, the HIGHROOT constraint would have been ignored as a low priority for other verb forms. For example, the anticausative verb ‘get washed’ (Proto-Zapotecan *j-aʔt̪ē) has the modern Coatec forms potential /jät/, imperfective /ndjät/, and perfective /mbjät/, where the HIGHROOT constraint seems to have not been in play historically for the latter two forms. For this paper, it suffices to simply contrast potential forms with everything else, but the labels could be refined in the future if the same constraint ranking here characterized as “potential” were to be found in other morphological constructions, such as nouns possessed with the first person singular, or agentive verbs with first person singular subjects, which also involve a floating high tone.

(49) HIGHROOT: Each root must have at least one TBU associated with H tone



Future work can look more closely at the difference between post-tonic root syllables and pre-tonic prefix syllables in Zapotec languages, and refine how they are characterized prosodically and in the lexicon and morphosyntax. For the ancestor of Coatec, I have ranked SPECIFYT higher in the potential cophonology than in the non-potential because there is no upstep in other paradigmatic forms, suggesting that other pre-tonic syllables may have remained toneless, as they do in several other Zapotec languages that preserve pre-tonic syllables. I have personally observed this in Tanetze, Petapa, Tlacolulita, and Coatecas Altas. Tanetze and Petapa also preserve post-tonic syllables, which surface with a copy of the tone from the tonic syllable. Thus, SPECIFYT seems to treat pre-tonic and post-tonic syllables differently, a fact likely related to the generalization about potential forms in Pre-Coatec needing an H somewhere on the root and not merely on a pre-tonic prefix.

One could posit additional constraints, but those discussed in this section are the most important for understanding why today we see a given pattern of ablaut or else upstep depending on the original number of syllables and underlying tones per verb stem.

5. Conclusions

Using internal reconstruction of potential-marked verbs in Coatec, I have proposed that in some earlier form of Zapotec: 1) the syllable was the TBU; 2) each syllable could only bear one tone; 3) tonic syllables were underlyingly specified as low or high; 4) pre-tonic prefixes were usually toneless but could serve as host to floating tones; 5) the association of the floating high tone with the pre-tonic, tonic, and/or post-tonic syllable was determined by a set of ranked constraints; and 6) *ʔ was a consonantal segment.

As to what ancestor(s) of Coatec these generalizations applied to, a comparison with other Zapotecan languages holds some clues. In Proto-Chatino and in some Zapotec languages, tonal melodies found on disyllabic roots contain a maximum of two tones, suggesting that in all the early Zapotecan proto-languages each TBU could bear a maximum of one tone. According to Campbell and Woodbury (2010) and Sicoli (2007), Both Proto-Chatino and Lachixío can have complex tonal melodies on monosyllables with long vowels. This is evidence that in the earliest forms of Zapotec(an), the TBU was the mora rather than the syllable. Thus, the ancestor of Coatec that had the syllable as the TBU should be Core Zapotec or later. The inventory of possible tones that could occur underlyingly on each TBU is reconstructed by Campbell and Woodbury as /H, L, Ø/ for Proto-Chatino, and Sicoli (2007: 92–94) reports the same inventory for both Lachixío and Asunción Mixtepec, though he reports tonelessness in unstressed syllables and in grammatical words only. The internal reconstruction of Pre-Coatec indicates this same inventory, though the tonic syllable must be specified for L or H, and the same holds for the Tanetze variety of Rincón Zapotec. A comparison of these languages suggests that early forms of Zapotecan had this same inventory, but the requirement that the tonic syllable be underlyingly specified for tone may be a Zapotec innovation. Since we have no tonal data from Soltec, we can't determine whether this innovation dates from as early as Proto-Zapotec or if it only occurred by the Trochaic Zapotec stage, but the Trochaic Zapotec stress shift may be relevant here. The requirement that the tonic syllable be underlyingly specified for tone is tied to stress, and Trochaic Zapotec languages all reflect a shift in which any disyllabic roots with stress on the ultima shifted it to the penult (Beam de Azcona In Preparation). If the constraint that the tonic syllable be specified for tone is related to the reconfiguration of the stress system, it may not have applied until the Trochaic Zapotec stage. *ʔ must have been a consonant from Proto-Zapotecan until after Proto Core Zapotec times, since it has this status in Chatino languages, Pre-Coatec, and Rincón Zapotec (Doroteo Velasco In Preparation). These hypotheses are summarized in Table 12.

Table 12. Preliminary Hypotheses about Early Zapotecan Tonal Systems

	Proto-Zapotecan	Proto-Zapotec	Proto Trochaic Zapotec	Proto Core Zapotec
1 tone per TBU	✓	✓	✓	✓
TBU	μ	μ	μ	σ?
Tonal Inventory	H, L, Ø	H, L, Ø	H, L, Ø	H, L, Ø

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Tones on tonic syllable of content words	H, L, Ø	H, L, Ø?	H, L	H, L
Tonal contrasts possible on all syllables	✓	✓	✓	✓
Status of *?	Segment	Segment	Segment	Segment

In exploring possible pre-tonic environments conducive to upstep, I proposed that Kaufman's *ki- was bimorphemic and that class A was originally composed of morphologically complex V-stems that began in one of the voice prefixes. Southern Zapotec was not previously known to have a restorative category, but the presence of upstep in verbs which lack causative *w-* and anticausative palatalization was resolved by positing a high-tone-bearing restorative prefix *e in an ancestor of Coatec.

It was mentioned that in both Tanetze and Petapa, post-tonic syllables do not bear their own contrastive tones separate from those of tonic syllables. According to Table 12, this is innovatory. Whereas Coatec deleted post-tonic vowels but kept their tones, varieties like Petapa and Tanetze kept post-tonic vowels but neutralized their tonal contrasts. This explains the lack of contour tones or melodies in some languages for cognate sets like 'thorn', which has a rising tone in Southern Zapotec, including Coatec /jítʃ/ and a reported MH melody in Sierra Juárez Zapotec /jettséʔ/ (Nellis & Goodner de Nellis 1983), but where Petapa has simplified the melody to low /gə̀h̄tsæ/ [gə̀h̄tsə̀], and Tlacolulita, thought to have shared an earlier migration with Petapa (Beam de Azcona 2018), has a monosyllable with low tone /ciètʃ/. Both Coatec and Tlacolulita have lost the post-tonic syllable in this word, but where Coatec has a contour tone, Tlacolulita has a level one. This can be explained if post-tonic vowels were lost in pre-Coatec at a time when both syllables could have separate tonal contrasts, as in Sierra Juárez Zapotec, whereas when pre-Tlacolulita lost its post-tonic vowels, the language had already undergone the tonal reduction seen in Petapa, an important observation for comparative reconstruction of Zapotec tone going forward.

Though the hypotheses above in Table 12 are preliminary, to my knowledge no study yet published has made hypotheses about the tonal inventory of Proto-Zapotecan, Proto Trochaic Zapotec, or Proto Core Zapotec, and there has been no new work published on Proto-Zapotec tone since Swadesh (1947). This study has relied most heavily on internal reconstruction of patterns of tonal morphology used to mark the potential in Coatec Zapotec, a highly endangered language. To date, the phenomenon of morphological upstep has not been found in other Zapotec languages beyond Coatec. Though the restorative prefix exists in other Zapotec languages, it has never been documented in the Southern Zapotec subgroup, and the existence of upstep on verbs with neither palatalization nor a *w-* prefix in Coatec here allowed me to infer the presence of the restorative prefix in earlier forms of Southern Zapotec, which in turn led to insights about the origins of class A in the Zapotecan family. The linguistic knowledge of a small number of elderly Coatec speakers has thus proven crucial to untangling several complexities of historical Zapotec verbal morphology as well as tone change, highlighting the importance of documenting endangered languages for historical linguistics.

While these advances are of value to those interested in Zapotecan languages, a wider audience of linguists can find here a case study of historical tone change in a family that has contrasted tone for thousands of years. Such studies are necessary because, as observed by Campbell (2022: 15), “our understanding of tone change in already tonal languages trails behind our understanding of tonogenesis.” The development of contour tones in Coatec can be added to the existing literature on how these tones are formed through vowel loss (Newman 1995: 764; Yip 2002: 47). As anticipated by Hyman (2018), when tonal contrasts are of considerable time depth, pitch becomes a significant conditioning factor in the development of allotones, which themselves become contrastive when one of the original TBU’s is lost. This is the case with morphological upstep in Coatec, where subphonemic alternations (high register allotones) are emerging as new tonal contrasts due to the loss of one conditioning environment, pre-tonic syllables with high pitch. Thus far, I have not documented upstepped tones on non-verbal lexical items in isolation, but one can imagine that such a development is possible. Writing about Chatino tonal patterns, Eric Campbell observes, “Perhaps new tonal melodies created in verbal inflection propagate to other parts of the lexicon via analogy, creating new *lexical* tone melodies in some varieties” (Campbell 2022: 31).

Another key finding of this paper concerns the status of *ʔ. Phonation has long been recognized as intertwined with tone or as a precursor to tone (Haudricort 1961; Matisoff 1973; Yip 2002; Hyman 2018). Among Zapotec languages, the greatest number of phonation contrasts is found in a contiguous group of Central Zapotec varieties that borders the Mixe region (Stubblefield & Miller de Stubblefield 1991; Munro et al. 1999; Adam 2003; Benn 2021; Galván Salazar In Preparation). These Central Zapotec languages diverged from each other only recently, suggesting that a complex system of phonation contrasts is not original to Zapotec or Zapotecan, but is a much later development. In these languages, there are distributional restrictions such that tone and phonation are partially predictable by one another. For example, among Petapa disyllables checked vowels /Vʔ/ are always low, whereas rearticulated vowels /VʔV/ are always high, though these phonation categories contrast on monosyllables with high tone (Beam de Azcona 2018). In this paper, I argued that *ʔ was a consonant until after the Core Zapotec period, meaning that Zapotec suprasegmental phonation contrasts post-date the emergence of tone by several millennia. The tonally conditioned restrictions on phonation suggest that tone has been a conditioning factor in the development of phonation contrasts. One such case, the development of breathy vowels in San Lucas Quiaviní, has already been argued to have been conditioned tonally (Uchihara 2016). Thus, while tones have arisen out of phonation contrasts in Southeast Asia (Matisoff 1973), phonation contrasts have arisen out of tonal contrasts in Zapotec languages of Mesoamerica. The internal reconstruction of Pre-Coatec has implications for the whole family, by revealing the earlier status of *ʔ as a consonant.

The reconstruction of *ʔ as a consonant that later turned into a suprasegmental contrast raises metrical questions that should be explored further. In Proto-Zapotecan, *k was moraic when in coda position and there is reason to believe that *ʔ was as well. For example, in most Zapotec languages vowels are short in CVʔ monosyllables but long in their unglottalized counterparts. Zapotec phonation has been treated as analogous to tone, with laryngeal features represented on their own tier and associating with moras that are in turn associated with segments (Hernández Luna 2021). However, length differences on glottalized vs. modal vowels in the same environments suggest that glottal closure is timed similarly to moraic coda consonants. Furthermore, while /CVʔV/

forms are often analyzed as monosyllables with a suprasegmental laryngeal feature in Zapotec languages (Chávez Peón 2010; Covarrubias Acosta 2020), Rincón Zapotec treats such forms as disyllabic (Doroteo Velasco In Preparation), just as I argued above for Pre-Coatec. Future research should consider the structural changes involved in the transition from a consonant to a suprasegmental contrast, and whether there are intermediate stages or vestiges of such contrasts' segmental origin.

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