Cophonologies and upper-lower tone register mapping in Copala Triqui

Jamilläh Rodriguez
University of North Carolina at Chapel Hill

Lee Bickmore
University at Albany & University of the Free State

This paper examines the tone register paradigm in Copala Triqui, an Otomanguean language of Mexico. Past literature on tone register changes has attributed tonal variations to seemingly arbitrary classes. Instead, the synchronic account presented here accounts for these changes through underlying floating tones and phonological processes that occur as the result of two cophonologies tied to an upper and lower tone register.

1. Introduction

In this paper, we examine and analyze the tonal realization of lexical morphemes in Copala Triqui, a Mixtecan language with 5 tone heights. As noted by Hollenbach (1984) and subsequent scholars, the isolation tone of a morpheme will change to a different tone in a number of specific morpho-syntactic environments. The process is sometimes characterized as "lowering", since in isolation lexical morphemes are linked to one of the three higher tones, while in this set of particular contexts they are realized with one of the two lower tones[1]. Past accounts, discussed in §4, essentially characterize this as lexical allomorphy. Instead, we analyze the upper-lower register mapping as a system of cophonologies tied to syntactic environment. Through a cophonology analysis, we propose that the mapping between the upper and lower tone registers is not allomorphy, but rather stems from a single underlying representation in the lexicon.

1.1 Language background

Copala Triqui[2] is a Mixtecan language of the large Otomanguean language family (Longacre, 1957). It is closely related to two other Triqui languages: Chicahuaxtla Triqui and Itunyoso Triqui (see Hernández Mendoza 2017 and Matsukawa 2012 for a discussion on Chicahuaxtla, and DiCanio 2008 for a discussion on Itunyoso). Copala Triqui is also known by speakers as *xna'ánj nu̲'*, and *triqui bajo* 'lower Triqui' for its lower geographical location in comparison to other Triqui communities. Copala Triqui was originally spoken in rural San Juan Copala and the surrounding region on the western border of the state of Oaxaca, Mexico. However, due to continuous political violence and the rapid increase of economic difficulty in the region, speakers have migrated north within Mexico and into the east and west coasts of the U.S. (París Pombo, 2012; Holmes, 2013).

According to an informal 2009 census (Eberhard et al., 2019), Copala Triqui has an estimated

[1]Hollenbach and other Triqui scholars (DiCanio, 2008; Broadwell and Clemens, 2017; Rodriguez and Clemens, 2019) characterize the five individual tones as belonging to one of two tone *registers*—an upper register (comprising tones 3, 4, 5) and a lower one (comprising tones 1 and 2). Throughout the paper, we use the term *register* only in this sense, and not in the way it is sometimes used more formally, as an autosegmental tier in the representation of tone using feature geometry, as found, e.g., in Bao (1999), Snider (1999) and Yip (2002).
[2]There are several alternations in the spelling of 'Triqui', including Triki, Trique, Trike, and Drique. Here we use the spelling preferred by the speakers with whom we have worked.

30,000 speakers, 25,000 living in Mexico. It is likely that since this census was conducted before the rapid increase of migration from the San Juan Copala region more speakers are now living in diaspora. París Pombo (2012) estimates that the population in San Juan Copala has decreased by more than 50%. Furthermore, younger members of the community have a rapid loss of the language in favor of dominating languages, particularly English in the U.S. and Spanish in Mexico.

2. Overview of tones in Copala Triqui

Like many languages in the Otomanguean family, Copala Triqui has a complex tone system, and is one of the rare tonal languages with five distinctive pitch levels (Longacre, 1952; Maddieson, 1978). There are eight lexically contrastive tones. These are 5 level tones: 1, 2, 3, 4, 5 and 3 contour tones: 13, 31, 32.[3]

Tones in Copala Triqui form two registers, based on several phonological processes: an upper register and a lower register. Tones 3, 4, 5, 31, and 32 belong to the upper register, while tones 1, 2, and 13 belong to the lower register (Hollenbach, 1984; Broadwell and Clemens, 2017). Typically, only the tone of the final syllable is contrastive and the tone of all preceding syllables is predictable based on that of the final syllable. If the final syllable has an upper register tone, all preceding syllables are tone 3, as in (1).[4]

(1)	a.	curuvii	[ku^3.ru^3.βiː^3]	‘monkey’
	b.	necó	[ne^3.ko^4]	‘opossum’
	c.	caquíí	[ka^3.kiː^5]	‘earring’
	d.	maree̲	[ma^3.reː^{31}]	‘green’
	e.	tana	[ta^3.na^{32}]	‘goat’

If the final syllable has a lower register tone, all preceding syllables are tone 2, as in (2).

(2)	a.	va’tan’	[βaʔ^2.tãʔ^1]	‘six’
	b.	ta’a̲j	[ta^2.ʔah^2]	‘half’
	c.	caniqu̲e	[ka^2.ni^2.ke^{13}]	‘dirty’

There are few exceptions in which a non-final syllable, in addition to the final one, is contrastive. Some examples of these exceptions are given in (3). Due to the predictability of tone in non-final syllables, only the final syllable is marked for tone in the practical orthography unless a lexical item is one of the rare exceptions with non-final contrastive tone.

[3]Tone 5 refers to the highest pitch and tone 1 refers to the lowest pitch. In the practical orthography, tone is represented by a combination of underlines and accents. Throughout this paper, tone is indicated with superscript numbers in addition to the use of the practical orthography developed by Hollenbach and Merino (2009). Other orthographic conventions include /ʧ/ represented with <ch>, /ʃ/ with <x>, /tʂ/ with <chr>, /ʂ/ with <xr>, /ts/ with <tz>, /h/ with <j>, /β/ with <v>, and /ʔ/ with <’>, /k/ is represented as <c> before back vowels and as <qu> before front vowels. Long vowels are written orthographically with two vowels (e.g. /aː/ as <aa>).

[4]All examples presented throughout this paper are from the first author’s field notes unless otherwise indicated.

(3) a. aráxnaa [a^{3}.ra^{5}.ʃnaː^{32}] ‘forgive’
b. chana̲ [ʧa^{3}.na^{1}] ‘woman’
c. xná'anj [ʃna^{5}.ʔãh^{32}] ‘ask’
d. aráya'a̲nj [a^{3}.ra^{5}.ja^{2}.ʔãh^{13}] ‘be amazed; worried’

3. Tone lowering

Lexical items, excluding functional words and adjectives, typically appear in isolation with an upper register tone. The motivation behind the difference in tone between functional words and adjectives and other items in the lexicon is not immediately clear but appears to be a result of the idiosyncratic diachronic development of the language. More on the historical changes of Triqui tone is available in Matsukawa (2012).

The lexical upper register tone on certain items lowers in specific syntactic contexts. We expand upon the table presented by Broadwell and Clemens (2017), which looks at the paradigm in verb inflection.[5] Table 1 shows the paradigm for upper-lower tone mapping across both verbal and nominal domains. As seen below, some upper register tones have two possible lower register outcomes (discussed further in §5). Lexical items are connected arbitrarily to a given class, and the upper-lower variant mapping is unpredictable based on the phonology of an item.

	Class 1	**Class 2**	**Class 3a**	**Class 3b**	**Class 3c**	**Class 4a**	**Class 4b**	**Class 5a**	**Class 5b**
Upper	31	32	3	3	3	4	4	5	5
Lower	1	2	1	2	13	1	2	1	2

Table 1: Upper-lower register paradigm based on descriptions in Hollenbach (1984) and Broadwell and Clemens (2017)

3.1 Tone lowering contexts

Hollenbach (1984) describes contexts in which tone lowering occurs, including aspectual inflection, predicate and nominal negation, certain possessive constructions, appositives, predicate focus, and the derivation of adjectives and adverbs. Examples from these environments are discussed in this section.

In Copala Triqui, ‘stable verbs’ with no inflection for aspect are rare. Some verbs, referred to by Broadwell and Clemens (2017) as ‘strong verbs’, have a binary distinction between the potential and non-potential aspects. The non-potential form maintains the tone it carries in isolation, a high register tone, as shown in (4a). In the potential form, the tone is lowered (4b).

(4) a. chá [ʧa^{4}] ‘eats; ate’ (non-potential)
b. cha̲ [ʧa^{2}] ‘will eat’ (potential) (Broadwell and Clemens, 2017)

In contrast, ‘weak verbs’ have a ternary distinction between the continuative (5a), completive (5b), and potential (5c) aspects. Tone lowering is only present in the potential aspect of both strong and weak verbs.

[5]The class with an upper register tone 3 and lower register tone 2 is not included in Broadwell and Clemens (2017) as it has previously not been attested in aspectual inflection. We include it here as Class 3b to account for all upper-lower register mappings, including those not attested in the verbal domain.

(5)	a.	unánj	[u.n˜ah^{5}]	‘runs’ (continuative)
	b.	cunánj	[ku.n˜ah^{5}]	‘ran’ (completive)
	c.	cuna̲nj	[ku.n˜ah^{1}]	‘will run’ (potential)

Predicate negation introduces a toggling effect in the completive and potential aspects, a phenomenon also reported in Itunyoso Triqui (DiCanio, 2016). Affirmative examples are shown in (6)[6] and negative examples of the same sentence in every aspect are shown in (7).

(6)	a.	**Chá**	xnii	ne	a.
		[ʧa^{4}	ʃni:^{3}	ne^{31}	a^{32}]
		eat	boy	meat	DECL
		‘The boy eats meat.’, ‘The boy ate meat.’			
	b.	**Cha̲**	xnii	ne	a.
		[ʧa^{2}	ʃni:^{3}	ne^{31}	a^{32}]
		eat	boy	meat	DECL
		‘The boy will eat meat.’(Hollenbach, 1984, 210)			

With the addition of the negative *ne*^{3} in the continuative form in (7a), the verb maintains its lexical tone. In (7b), the verb tone is lowered, and in the potential form with the potential negative marker *se̲*^{2}, the tone is a high register tone. In other words, the tone register of the verb in the completive (6a and 7b) and potential (6b and 7c) aspects is flipped.

(7)	a.	Ne	**chá**	xnii	ne	a.
		ne^{3}	ʧa^{4}	ʃni:^{3}	ne^{31}	a^{32}
		NEG	eat	boy	meat	DECL
		‘The boy doesn’t eat meat.’				
	b.	Ne	**cha̲**	xnii	ne	a.
		ne^{3}	ʧa^{2}	ʃni:^{3}	ne^{31}	a^{32}
		NEG	eat	boy	meat	DECL
		‘The boy didn’t eat meat.’				
	c.	Se̲	**chá**	xnii	ne	a.
		se^{2}	ʧa^{4}	ʃni:^{3}	ne^{31}	a^{32}
		‘The boy won’t eat meat.’ (Hollenbach, 1984, 210)				

In nominal negation, the tone of nouns following the negative *nuwe’* [nuβeʔ] is lowered to a lower register tone. Although this negative construction is documented in Hollenbach (1984), speakers with whom we work, both in New York and Oaxaca, claim this construction is no longer used.

[6] The following abbreviations are used in the glosses of this paper: 1 = first person, 2 = second person, 3 = third person, DECL = declarative, FEM = feminine, MASC = masculine, NEG = negation, NP = non-potential, OT = Optimality Theory, PL = plural, POT = potential, REL = relative pronoun, SG = singular, TBU = tone bearing unit, UR = underlying representation.

(8)	nuwe’	**xnii**	(Cf. xnii /ʃniː³/ ‘boy’)
	[nuβeʔ³	ʃniː¹³]	
	NEG	boy	
	‘not a boy’ (Hollenbach, 1984, 240)		

There are several possessive constructions in Copala Triqui. When a noun is preceded by the possessive marker *se* /se³²/, its tone is lowered (9a). This is not true of all possessive constructions, such as the one in (9b), where the possessive marker *si’yaj* /siʔyah³/ precedes the possessor and the upper register tone is maintained.

(9)	a.	se	**ratziin**	so’	(Cf. ratziin /ratsĩː³/ ‘tomato’)
		[se³²	ratsĩː¹³	soʔ³]	
		POSS	tomato	3.SG.M	
		‘his tomato’ (Hollenbach, 2008, 26)			
	b.	si’yaj	no’	**ratziin**	
		[siʔjah³	noʔ³	ratsĩː³]	
		POSS	3.SG.FEM	tomato	
		‘her tomato’			

Rodriguez and Clemens (2019) look at the derivation of adjectives as nominal compounds with lowering. Examples of nominal compounds with tone lowering on the second root are given in (10).

(10)	a.	tacaan	**yu’ve’**	(Cf. yu’ve’ /juʔβeʔ³/ ‘snow’)
		[takãː³	juʔβeʔ¹]	
		mountain	snow	
		‘snowy mountain’		
	b.	mesá	**aga’**	(Cf. aga’ /aɣaʔ³/ ‘metal’
		[mesa⁴	aɣaʔ¹³]	
		table	metal	
		‘iron table’ (Rodriguez and Clemens, 2019)		

When a pronoun is followed by an appositive phrase, both the pronoun and the non- phrase-final pronoun *síí* /siː⁵/ are lowered. This only applies when the pronoun is first or second person. The relative pronoun has a lower register tone 1 in (11a) where the preceding pronoun is the second person pronoun. In contrast, the lexical tone 5 is maintained on the relative pronoun in (11b) where the preceding pronoun is the third person masculine form.

(11)	a.	so’	**sij**	cu’naj	Gwá	(Cf. síí /siː⁵/ REL)
		[zoʔ¹	sih¹	kuʔnah¹	gwa⁴]	
		2.SG	REL	call	Juan	
		‘you, the one who is called Juan’				

b.	so’	**síí**	cunaj^{1}	Gwá^{4}
	[zoʔ^{3}	siː^{5}	kuʔnah^{1}	ɡwa^{4}]
	3.MASC.SG	REL	call	Juan

‘he, the one who is called Juan’(Hollenbach, 1984, 245)

Copala Triqui is a VSO language, although SVO is also commonly elicited as a word order. In an unfocused phrase in the continuative aspect, the verb maintains an upper register tone, as in (12a). When the predicate is focused the tone is lowered to the lower register tone, as in (12b).

(12)	a.	**achrá**	so’	a.
		[atʂa^{5}	soʔ^{3}	a^{32}]
		sing	3.SG.MASC	PART

‘He is singing.’

b.	**achraj**	so’	a.
	[atʂah^{1}	soʔ^{3}	a^{32}]
	Sing	3.SG.MASC	PART

‘He IS SINGING.’ (Hollenbach, 1984, 247)

4. Previous analysis of tone lowering

Previous accounts of tone lowering point to upper-lower register tone mapping as a lexical process. In Copala Triqui, Hollenbach (1984) divides the tone lowering processes between two formatives: F1 and F2. The F1 formative applies to aspectual tone lowering only, while the F2 formative applies to all other tone lowering environments. The tone lowering rules in these formatives are “…morphological rules that realize particular formatives, and they take place within the lexicon” (Hollenbach, 1984, 213). The synchronic account we present here moves towards an analysis that unifies both formatives.

Lexical items belong to one of nine classes, as given in the paradigm repeated here in Table 2.

	Class 1	**Class 2**	**Class 3a**	**Class 3b**	**Class 3c**	**Class 4a**	**Class 4b**	**Class 5a**	**Class 5b**
Upper	31	32	3	3	3	4	4	5	5
Lower	1	2	1	2	13	1	2	1	2

Table 2: Upper-lower register mapping in the tone lowering paradigm

The lowered form is consistent for a lexical item across all lowering contexts and never changes. For example, *aga’* /aɣaʔ^{3}/ ‘metal’ is tone 3 in isolation and only ever lowers to tone 13 (13a), regardless of tone lowering context. In contrast, *yu’ve’* /juʔβeʔ^{3}/ ‘snow’ is tone 3 in isolation and only ever lowers to tone 1, regardless of tone lowering context (13b).

(13)	a.	mesa	aga’
		[mesa^{4}	aɣaʔ^{13}]
		table	metal

‘iron table’

b. tacaan yu'v<u>e</u>'
[takã:^{3} juʔβeʔ^{1}]
mountain snow
'snowy mountain' (Rodriguez and Clemens, 2019, 7)

These differences in lowering cannot be attributed to the phonology or a tone sandhi pattern as tone lowering is not influenced by the tone of the preceding root. This is shown in (14), where *rmii* /ʂmi:^{32}/ 'ball' lowers to tone 2 regardless of the difference in tone of the preceding noun in a nominal compound construction.

(14) a. manzana rm<u>ii</u>
[mansana^{4} ʂmi:^{2}]
apple ball
'round apple'

b. ra'vii rm<u>ii</u>
[raʔβi:^{32} ʂmi:^{2}]
apple ball
'round apple'. (Rodriguez and Clemens, 2019, 7)

Given the seeming arbitrariness of Copala Triqui's tone lowering paradigm and that the sub-classes are not phonologically predictable, Hollenbach (1984, 213) concluded "there is simply no way to assign an underlying form to F1 or F2, short of a completely unmotivated abstract analysis." In addition, we note that there is not a clear default class or mapping that is preferred by speakers.[7]

It should be noted that certain classes in the paradigm are sensitive to coda type and vowel length, a sensitivity that is shared by processes in Itunyoso Triqui as well (DiCanio, 2012). For example, glottal stops only occur with non-contour tones (Hollenbach, 1984). DiCanio (2016) analyzes glottal consonants as tone-bearing units that can affect tonal processes. However, vowel length and coda do not affect the analysis we present here.

Below we summarize the morpho-syntactic contexts where tone lowering occurs.

(15) Morpho-syntactic contexts with tone lowering
a. 'Strong' and 'weak' verbs in the potential aspect
b. Verbs in predicate negation
c. Nouns in nominal negation
d. Nouns in possessive *se*^{32} constructions
e. Relative marker in appositives
f. Predicate focus
g. Nominal compounds

[7]Investigation into whether there is a preference by speakers for a lowered form given an upper form through a nonce test is ongoing by the first author.

5. A synchronic analysis of tone lowering

Rather than maintain that the relationship between the surface tones of a form in upper register contexts versus lower register ones is lexical—where both variants would be found in the lexicon as allomorphs, with one form (e.g. the lower register one) being inserted in one set of morphosyntactic contexts, and the other one elsewhere—we propose an analysis in which each lexical morpheme has a single underlying representation. The surface tonal realization, of course, is still determined in part by the morpho-syntactic environment in which it is found. We account for this within an Optimality Theory framework using cophonologies (Orgun, 1996; Inkelas et al., 1997; Anttila, 2002; Inkelas and Zoll, 2007), where one set of OT constraint rankings is triggered in one set of contexts and a different set of ranking is triggered in the others. We believe this is a more parsimonious analysis.

In examining Table 1 the following generalizations emerge concerning the relationship between the upper and lower register realizations of a morpheme's tone:

1. If the upper register is a contour tone, always a fall from T_1 to T_2, the corresponding lower register realization is always T_2.

2. If the upper register is a tone 4 or 5, then for each of these, the corresponding lower register tone can be either a tone 1 or 2.

3. If the upper register is a tone 3, then the lower register tone could be either a tone 1, 2, or 13, the latter being the only attested rising tone in the language.

To account for this we propose the 9 distinct underlying tonal representations given in Table 3. As shown, each UR has two tones. In the case of Class 1 and Class 2, the two tones are linked, exactly as they are realized in the upper register outputs. In Classes 3-5, one of the two tones is linked in the UR, and the other one is floating. In almost all cases it is the second of the two tones which is floating, the sole exception being Class 3c where it is the first tone that is underlyingly floating.

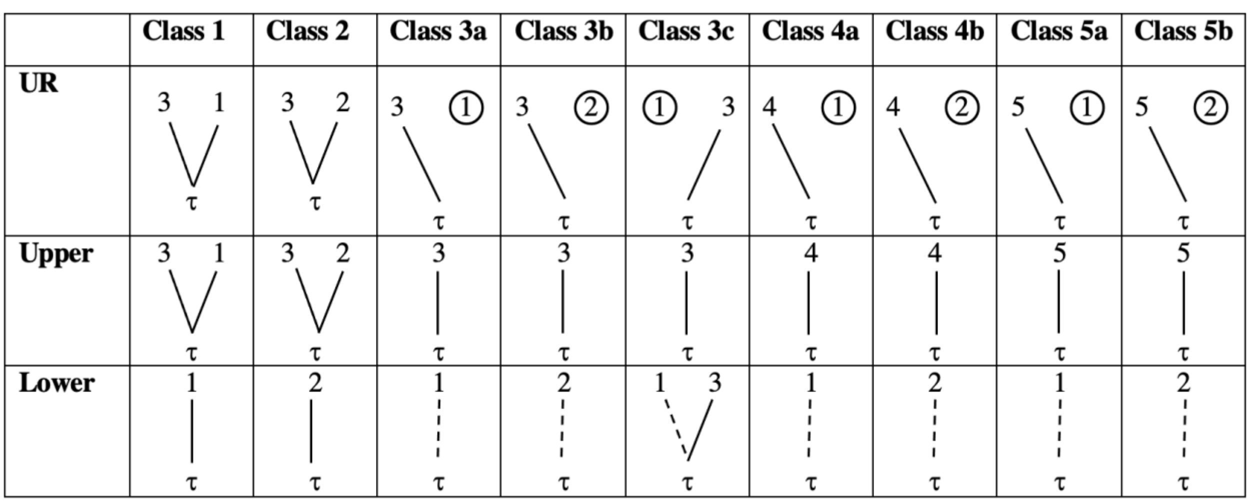

Table 3: A visual representation of the underlying representation and surface forms resulting from upper and lower cophonologies

Given these URs, the upper and lower registers are derived as follows. In the upper register all the underlying linkages are preserved in the output, with the floating tones not being realized. In the lower register, the generalization is that upper register tones (3- 5) are not realized. This is overridden in a single case (3b) where the rightmost tone is underlyingly linked.

In the analysis that follows we employ the following constraints, defined below.

(16) Constraints for analysis

a. NODELINK: mora-tone associations in the input must be maintained by corresponding elements in the output

b. NODELINK-FINAL: mora-tone associations involving the rightmost tone in the input mu be maintained by corresponding elements in the output

c. MAX-T: assign a penalty for each tone in the input not present in the output

d. *FALL: assign a penalty if τ is linked to two tones where the first is higher than the secc

e. *RISE: assign a penalty if τ is linked to two tones where the first is lower than the secor

f. *H: assign a penalty for each 3, 4 or 5 tone realized in the ouput

The constraints in (16c-e) are straightforward and require no further comment here. The constraint in (16b) is a type of positional faithfulness constraint, in this case targeting only the rightmost tone in the input (see, inter alia, Beckman 1998 and Lombardi 1999).[8] With regard to (16f), while markedness constraints penalizing individual tones from occurring on the surface (e.g. *H, *L, *M) are well known, we assume subsets of tones in languages with multiple tone height contrasts can also be targeted. One way to do this would be to reference the presence of a node within the feature geometry (see the references in fn. 1), which in this case would represent the grouping of tones 3, 4, and 5 as opposed to the grouping of tones 1 and 2.

In order to illustrate our OT account of these tonal correspondences, we will derive the upper and lower register forms for Class 1, 3a and 3c. Class 2 behaves parallel to Class 1, and Class 3b; Class 4a,b; and 5a,b are exactly parallel to Class 3a.

5.1 Upper register

We begin with the Class 1 form. The input has two linked tones constituting a fall. The grammatical output form is the maximally faithful one. We account for this by an undominated ranking of NODELINK.

[8]The constraints listed in (16) are those that play a crucial role in the OT analysis. Of course, one could identify other constraints that could conceivably be added to the tableaux, but for purposes of clarity we do not include those that do not further distinguish between the candidates. (A couple are mentioned in the text below). The counterpart to NODELINK would be NOSPREAD (penalizing the addition of association lines). This constraint does not help to further distinguish candidates, as it could be ranked anywhere in the Upper Register Cophonology (as the optimal forms never violate it), and would be ranked very lowly in the Lower Register Cophonology.

/3 1/ τ	NoDelink	*Fall	*Rise	Max-T	*H	NoDel-F
☞ a. 3 1 τ		*			*	
b. 3 τ	*!			*	*	*
c. 1 τ	*!			*		

Table 4: Upper register Tone 31

Candidate (a) is successful as it is the only one not to incur a penalty by top-ranked NoDelink. In both (b) and (c) one of the two underlying associations is no longer present. The only constraint candidate (a) violates is the more lowly-ranked *Fall, and *H. Max-T is violated once by (b) and (c) as only one of the two underlying tones is present in the output. We do not consider candidates here or below where a floating tone is found in candidate output forms. This, of course, can be accomplished by simply positing a highly ranked constraint which penalizes floating tones in the output.

We now examine the Class 3a form. The underlying form has two tones, where only the first one is linked. The grammatical output form is the one where the first tone remains linked and the second one is not realized. The high ranking of NoDelink will insure the first tone remains linked, and the *Fall constraint will penalize the linking of the underlyingly floating tone.

/3 1/ τ	NoDelink	*Fall	*Rise	Max-T	*H	NoDel-F
☞ a. 3 τ				*	*	
b. 1 τ	*!			*		
c. 3 1 τ		*!			*	

Table 5: Upper register Tone 3

Candidate (b) violates NoDelink as the output does not have a link from tone 3 to the TBU. Candidate (c) is disqualified by violating *Fall. We do not consider any candidates where an additional TBU is added (to which the input Tone 1 could link), something that can be straightforwardly accounted for by an undominated Dep-τ constraint.

Finally, we turn to Class 3c forms. Similar to the Class 3a forms, the underlying representation has one linked and one floating tone, where the linked tone survives in the grammatical output form. The only difference is that in the Class 3c forms the floating tone precedes rather than follows the linked tone. In these cases, a high ranking of NoDelink and *Rise predicts the correct output.

/1 3/ τ	NoDelink	*Fall	*Rise	Max-T	Max-Fin-T
☞ a. 3 τ				*	
b. 1 τ	*!			*	*
c. 1 3 τ			*!		

Table 6: Upper register Tone 3

Candidate (b) violates NoDelink as the output does not contain a link from tone 3 to the TBU. Candidate (a) wins out over candidate (c), as the latter violates *Rise.

Let us now consider how the constraints must be ranked to achieve the desired outcomes noted above. The tableau in (4) shows that either NoDelink or Max-T must be ranked above *Fall. In tableau (5), candidate (b) shows that NoDelink must be ranked above *H. Candidate (c) shows that *Fall must be ranked above Max-T. The tableau in (6) shows that *Rise must be ranked above Max-T. Given this, the overall rankings of the constraints for the upper register forms is that given in Figure 1.

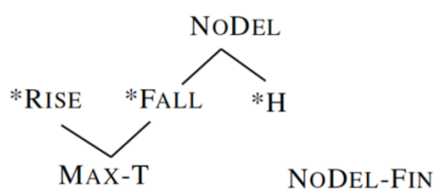

Figure 1: Overall ranking of OT constraints for the upper register cophonology

5.2 Lower register

We now turn to the tonal realizations in the lower register. We begin with the Class 1 forms. In the UR, the first (leftmost) tone is linked to the TBU and the second is floating. The optimal output in the lower register is the form where the TBU is linked to the lower register tone rather than the higher register one. This is accomplished by a high ranking of
*H, as illustrated below.

/3 1/ τ	NoDel-Fin	*H	*Fall	NoDelink	Max-T	*Rise
☞a. 1 τ				*	*	
b. 3 τ		*!			*	
c. 3 1 τ		*!	*			

Table 7: Lower register Tone 1

Candidates (b) and (c) are ruled out due to violations of *H, as each is linked to a tone 3 in the output. While optimal candidate (a) violates both NoDelink as well as Max-T, as the input tone 3 and its association to the TBU are not attested in the output, these constraints are both ranked below *H.

Let us now consider a Class 3a form, where the UR has a TBU linked to two tones (a falling tone), and the grammatical output form has the TBU linked only to the lower register tone. We will see that the optimal output is derived in much the same way as it was in (7).

/3 1/ τ	NoDel-Fin	*H	*Fall	NoDelink	Max-T	*Rise
☞a. 1 τ				*	*	
b. 3 τ	*!	*		*	*	
c. 3 1 τ		*!	*			

Table 8: Upper register Tone 31 with an output tone 1 in the lower register

Both candidates (b) and (c) violate *H, ranked above NoDelink and Max-T. In addition, candidate (b) violates NoDel-Final, as the input association between the TBU and Tone 1 is not present.

Finally, we turn to Class 3c, where the UR has a floating tone followed by a linked tone, and the grammatical output form is a rising tone linked to both input tones.

/1 3/ τ	NoDel-Fin	*H	*Fall	NoDelink	Max-T	*Rise
☞ a. 1 3 τ		*				*
b. 1 τ	*!			*	*	
c. 3 τ		*!			*	

Table 9: Upper register Tone 3 with an output tone 13 in the lower register

This is the only surface realization within the Lower Register forms which contains a tone greater than tone 2. As shown in the tableau, this results in a violation of *H, something not true of candidate (b), where the tone 1 surfaces. Candidate (a) is judged to be superior to candidate (b) in that it satisfies NoDel-Final which insists that any association between the rightmost tone in the input and the TBU must be maintained in the output. While this is true for candidate (a), it is not for (b) as the latter does not include the input association between the TBU and tone 3. Candidate (a) fares better than candidate (c) as the latter incurs a violation of Max-T, ranked above *Rise.

With regard to constraint ranking, in tableau (7), candidate (b) establishes that *H must be ranked above NoDelink. Candidate (c) shows that either *H or *Fall must be ranked above both NoDelink and Max-T. Tableau (8) shows that either *H or *Fall must be ranked above both NoDelink and Max-T. Finally, in tableau (9), we see that NoDel-Final must be ranked above *H, and that Max-T must be ranked above *Rise. Thus, the overall constraint ranking for the lower register is that given in Figure 2.

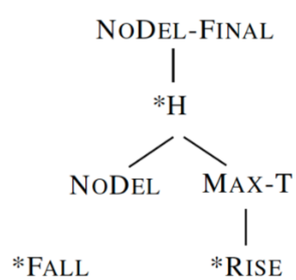

Figure 2: Overall ranking of OT constraints for the lower register cophonology

6. Conclusion

Syntactically-conditioned tone lowering is prevalent across all three Triqui languages. We have shown that in Copala Triqui a given morpheme will always lower to a specific tone in the lower register context, but for many morphemes, this tone cannot be predicted by the surface isolation (upper register) tone, or the phonological environment in which it appears in the lower register. Previous accounts have assumed this was a case of lexical allomorphy. In Itunyoso Triqui, tonal processes in personal clitics “lie somewhere between these two extremes: not arbitrarily affiliated with stems within a particular paradigm, but also not easily phonologically predictable" (DiCanio, 2016). The same is true of Chicahuaxtla Triqui, where the mapping between upper register tones and lower register tones is not phonologically predictable (Matsukawa, 2012). We have presented an analysis for Copala Triqui that does not involve lexical allomorphy, but instead maintains that each morpheme has a unique underlying representation. Its realization in the upper and lower register environments is determined through two co-phonologies, each tied to a register, where the applicable OT constraints are ranked differently in each co-phonology. Whether this approach can be extended to the other Triqui languages is a matter for further research. Lexical allomorphy is common in the Otomanguean language family (Baerman et al., 2019). The primary advantage of the cophonology analysis we presented here is the removal of the arbitrary nature of a lexical class assignment for each lexical item in the language. Instead, we have successfully demonstrated that it is possible to analyze the complex tone variation in Copala Triqui with a single underlying representation for each lexical item.

In the beginning of §5, we presented three generalizations of the relationship between the upper and lower register variants. With the exception of Class 3c, the upper register classes have floating tones to the right of a linked tone. An account of lowering that utilizes cophonology theory provides a unifying characteristic of this generalization that is not possible with the account of lexical allomorphy. It also provides insight for why falling tones are restricted to upper cophonology contexts and the rising tone is restricted to lower cophonology contexts. Such a treatment of these generalizations removes the arbitrary rule listing required by lexical allomorphy.

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