Motivating the prosodic hierarchy in Itunyoso Triqui

Christian DiCanio
University at Buffalo
cdicanio@buffalo.edu
Triqui languages

- 3 major language variants with limited mutual intelligibility.
- All complex tone languages within the Mixtecan family.
- Average distance between the major Triqui regions is ~5 km, but it is very mountainous terrain with large elevation differences.
Genetic affiliation (Otomanguean: Eastern)

- Mixtecan-Cuicatecan
  - Mixtecan (3-7 kya)
    - Triqui
    - Copala
    - Itunyoso-Chicahuaxtla
      - Itunyoso
      - Chicahuaxtla
  - Mixtec (1.6-1.8 kya)
    - Cuicatec
      - Cuicatec
      - Tepeuxila
      - Teutila
    - 12 languoids

~60 spoken varieties
Scientific questions

• Prosodic phrasing is often motivated by variable suprasegmental phenomena (pitch, lengthening, phonation type, etc) in different languages (Bennett and Elfner, 2019).

• Given the extremely high functional load of suprasegmental contrasts within words in Otomanguean languages, such variable phenomena are much harder to examine (DiCanio and Bennett, 2020). Though, domains within the *tonal phonology* may be revealing.

• Can we motivate *some sort of* prosodic hierarchy in Triqui?
Status of my scholarship on Itunyoso Triqui

• 2004 – 2008 Dissertation research, focus on phonetics and phonology of tone/phonation/length.
• 2009 – 2014 Post-doctoral research (France, US), focus on perception of tone, phonation; tonal coarticulation
• 2014 – 2019 NSF DLI/DEL documentation grant, focus on text collection, transcription, morphophonology, and prosody
• 2020 – 2022 Continued focus on translation and documentation; UB Humanities institute grant
• 2023 – present Focus on reference grammar; NEH fellowship grant
• 2004 – present The Triqui-Spanish dictionary
Roadmap

1. **Final stress and motivating the iambic foot** with evidence from distributional asymmetries and foot-level phonological processes.

2. Iambic foot with unfooted extrametrical syllables on the left edge that constitute a **prosodic word** (cf. Hernández Mendoza, 2017, in Chicahuaxtla Triqui), with evidence from **tonal distribution**, **tonal morphophonology**, and **speech reduction**.

3. Prosodic word compounds as a domain for the phonological phrase?
Phonetic possibilities are functionally limited

- 9 lexical tones (5 levels, 4 contours) that are also heavily used in the morphology. There is **little space for shifting F0**.

- Half of Triqui morphemes end with open syllables and half end with coda glottal consonants. These are often realized with non-modal phonation. There is **little space for shifting voice quality**.

- Duration is the main cue used by speakers and listeners in distinguishing CV: and CVʔ/CVh syllables (DiCanio, 2012, 2014). There is **little space for shifting duration**.

- There is *stem*-final and utterance-final lengthening, but **no noticeable change to tones in different prosodic positions** and **no declination** (DiCanio and Hatcher, 2018).
II. Final stress

Final syllable lengthening and utterance-final lengthening

(DiCanio and Hatcher 2018)
Tone in monosyllables and disyllables

ββeh(3)⁵ ‘straw mat / petate’
ββe⁴ ‘hair / pelo’
nne³ ‘plough / arado’
nne² ‘to lie / mentir’
nne¹ ‘naked / desnudo’
nne³² ‘water / agua’
nne³¹ ‘meat / carne’
tʃe⁴³ ‘my father / mi padre’
ŋa¹³ ‘when (SUBORD) / cuando’

tʃi³ʔjoh⁵ ‘swamp / ciénaga’
ka³to⁴ ‘shirt / camisa’
a³ra³ ‘refill / rellenar’
a²mẽ² ‘when / cuando’
a¹ka¹ ‘new / nuevo’
a³βi³² ‘leave / salir’
a³nĩ¹ ‘explode / estallar’
a⁴ne⁴³ ‘chew / masticar’
kõ¹ʔõ³ ‘four (N) / cuatro’
Morphological load of tone

- **Sole exponent for verbal aspect**
  - $tʃa^{43}$
  - PERF.eat
  - $tʃa^{2}$
  - POT.eat

- **Exponent for 1s, 1p clitics**
  - $tʃah^{4}$
  - PERF.eat.1s
  - $tʃah^{1}$
  - POT.eat.1s
  - $tʃoʔ^{4}$
  - PERF.eat.1p
  - $tʃoʔ^{2}$
  - POT.eat.1p

- **Exponent of topical and emphatic/optative marking**
  - $tʃah^{3}$
  - PERF.eat.TOP
  - $tʃah^{23}$
  - POT.eat.TOP
  - $tʃaʔ^{4}$
  - PERF.eat.EMPH
  - $tʃaʔ^{24}$
  - POT.eat.OPT
Tonal contrasts by final syllable type

Table 5: Tonal patterns on disyllabic words

<table>
<thead>
<tr>
<th></th>
<th>Open σ</th>
<th>Coda /f/i/</th>
<th>Coda /ʔ/</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4</td>
<td>a⁴tf[i:⁴³] 'to pass'</td>
<td>tfa⁴tf[iH] 'tarantula'</td>
<td>a⁴tf[i:⁴³] 'we pass'</td>
</tr>
<tr>
<td>4.43</td>
<td>a⁴tf[i:⁴³] 'to ask for'</td>
<td>a⁴tf[iH] 'to ask for'</td>
<td>a⁴tf[iH] 'we ask'</td>
</tr>
<tr>
<td>3.45</td>
<td>ti³ti:⁴ 'to roast'</td>
<td>ti³kif[i] 'to roast'</td>
<td>ti³kif[i] 'we ask'</td>
</tr>
<tr>
<td>3.4</td>
<td>ti³kif[i] 'to grow'</td>
<td>ti³kif[i] 'to grow'</td>
<td>ti³kif[i] 'we grow'</td>
</tr>
<tr>
<td>3.3</td>
<td>a³t[i:³] 'to lack'</td>
<td>a³t[iH] 'to lack'</td>
<td>a³t[iH] 'we lack'</td>
</tr>
<tr>
<td>3.2</td>
<td>a³t[iH] 'to bury'</td>
<td>a³t[iH] 'to bury'</td>
<td>a³t[iH] 'we bury'</td>
</tr>
<tr>
<td>3.1</td>
<td>ka³ti:¹ 'hip'</td>
<td>kw³nifi¹ 'hip'</td>
<td>kw³nifi¹ 'hip'</td>
</tr>
<tr>
<td>3.43</td>
<td>kw³nifi¹ 'Wednesday'</td>
<td>kw³nifi¹ 'Wednesday'</td>
<td>kw³nifi¹ 'Wednesday'</td>
</tr>
<tr>
<td>3.32</td>
<td>ti³n[i:³²] 'nopal cactus'</td>
<td>ti³n[iH] 'nopal cactus'</td>
<td>ti³n[iH] 'nopal cactus'</td>
</tr>
<tr>
<td>2.3</td>
<td>nu²m[i:³] 'tied'</td>
<td>ru²m[iH] 'tied'</td>
<td>ru²m[iH] 'tied'</td>
</tr>
<tr>
<td>2.2</td>
<td>ku²ra:² 'clear'</td>
<td>tf[i]²ko[i] 'clear'</td>
<td>tf[i]²ko[i] 'clear'</td>
</tr>
<tr>
<td>2.32</td>
<td>ku²ra:² 'wide'</td>
<td>ku²ra:² 'wide'</td>
<td>ku²ra:² 'wide'</td>
</tr>
<tr>
<td>1.3</td>
<td>ja¹ko:³ 'poor'</td>
<td>nu¹k[w]af[i] 'poor'</td>
<td>nu¹k[w]af[i] 'poor'</td>
</tr>
<tr>
<td>1.1</td>
<td>ka¹si:¹ 'white'</td>
<td>ni¹t[iH] 'white'</td>
<td>ni¹t[iH] 'white'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>na¹t[iH] 'white'</td>
<td>na¹t[iH] 'white'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>si³si:¹ 'sweet (N)'</td>
<td>si³si:¹ 'sweet (N)'</td>
</tr>
</tbody>
</table>

DiCanio et al 2020
Moraic structure and leftward tonal association

• Final syllables are bimoraic.

• In most morphemes, the penultimate syllable tone is predictable based on the final tone. Tones associate to penultimate syllables.

• This is argued for all Triqui languages (DiCanio 2008, DiCanio et al 2020, Hernández Mendoza 2017, Hollenbach 1984).

---

<table>
<thead>
<tr>
<th>Tone Feature</th>
<th>Level T</th>
<th>Falling T</th>
<th>Rising T</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>one</td>
<td>one</td>
<td>one</td>
</tr>
<tr>
<td>+</td>
<td>&lt;3/&gt;</td>
<td>&lt;3/&gt;</td>
<td>&lt;3/&gt;</td>
</tr>
<tr>
<td>−</td>
<td>&lt;3/&gt;</td>
<td>&lt;3/&gt;</td>
<td>&lt;3/&gt;</td>
</tr>
<tr>
<td>+</td>
<td>&lt;2/&gt;</td>
<td>&lt;3/&gt;</td>
<td>&lt;3/&gt;</td>
</tr>
<tr>
<td>−</td>
<td>&lt;2/&gt;</td>
<td>&lt;3/&gt;</td>
<td>&lt;3/&gt;</td>
</tr>
</tbody>
</table>

Two types of tones surface in non-final (unstressed) syllables in Itunyoso Triqui: (1) level tones which result from a process of leftward tonal association (DiCanio 2008, 2016) and (2) level tones which are underlyingly specified on non-final syllables. The latter category includes only tones /2/ and /3/.

Incidentally, each of these tones also contrast aspect prefixes in the language, i.e. /ki/-n˜ı:P˜ı: /`perf-know’ vs. /ki/-n˜ı:P˜ı: /`pot-know’. DiCanio (2016, 234) describes the process of leftward tonal association below in (4). The autosegmental representation of this process is shown in Figure 1 for words [ʧu ku:] ‘animal’, [ʧi ko yo:] ‘tadpole’, [ɾu ne:] ‘bean’, and [ɾu ne:] ‘avocado’.

(4) Leftward association convention: Assign a tone or tone contour, right to left, starting on the rightmost mora (TBU) of the word and then associate the leftmost tone in the word to all preceding moras within the word.

---

Both phonetic evidence (lengthening) and the distribution of contour tones in Itunyoso Triqui suggest that final syllables are heavy and bimoraic, while non-final syllables are monomoraic (DiCanio 2008). One consequence of this structure is that individual tone levels are associated with single moras. DiCanio (2016, 235) also argues that each mora may be associated with only a single tone and that tonal stranding is not possible. This is captured via principles (5) and (6) below.

(5) Moraic tonal specification: A mora may be associated with only a single tone.

(6) No floating tones: Every tone must be associated with a mora.

---

McPherson (2017) and Yip (1993), and an additional counter-example to recent arguments that tonal features are unnecessary, i.e. Clements, Michaud & Patin (2011); Hyman (2011); Odden (2011).
**Leftward association convention:**

Assign a tone or tone contour, right to left, starting on the rightmost mora (tone-bearing unit) of the word and then associate the leftmost tone in the word to all preceding moras within the word.

(DiCanio et al 2020)
Final stress – lots of evidence (but not just phonetic)

- **Phonetic evidence**: stem-final syllables are longer than preceding syllables within the morpheme (DiCanio 2010, DiCanio and Hatcher 2018).

- **Phonological evidence**:  
  1. Nasal vowels only occur in final syllables.  
  2. Glottal consonants only occur in final syllables.  
  3. Prenasalized stops only occur in final syllables.  
  4. **Full tonal contrasts (all 9 tones) only occur in final syllables.**  
  5. **Final syllables license contrasts in pre-final (non-final) syllables.**

- Virtually identical properties are found throughout Triqui languages (DiCanio, 2008, 2010, 2016; DiCanio et al., 2020; Elliott et al., 2016; Hollenbach, 1984; Hernández Mendoza, 2017).
What about other units?
III. Foot structure

• What type of foot parsing might be possible?

• Evidence comes from three sources:
  a) high tone /4/ is restricted to the foot
  b) Spanish loanword adaptation
  c) variable deletion or shortening of extrametrical vowels

• Possible analyses:

1) No feet
   \[ \sigma_{\mu}, \sigma_{\mu}\sigma_{\mu}, \sigma_{\mu}\sigma_{\mu}\sigma_{\mu}, \sigma_{\mu}\sigma_{\mu}\sigma_{\mu}\sigma_{\mu} \]

2) Iterative Iambic feet
   \[ (\sigma_{\mu\mu}), (\sigma_{\mu}\sigma_{\mu\mu}), (\sigma_{\mu})(\sigma_{\mu}\sigma_{\mu\mu}), (\sigma_{\mu}\sigma_{\mu})(\sigma_{\mu}\sigma_{\mu\mu}) \]

3) Non-iterative Iambic feet
   \[ (\sigma_{\mu\mu}), (\sigma_{\mu}\sigma_{\mu\mu}), \sigma_{\mu}(\sigma_{\mu}\sigma_{\mu\mu}), \sigma_{\mu}\sigma_{\mu}(\sigma_{\mu}\sigma_{\mu\mu}) \]
(a) The distribution of high tones is limited to the foot

- Tones on most pre-tonic syllables mostly result from leftward association from the final stressed syllable.

- This predicts high tone /4/ will spread leftward across the word, but it does not. Instead, we get tone /3/ as a default here.

**Table:** Absence of tone /4/ on antepenults

<table>
<thead>
<tr>
<th>Underlying tone</th>
<th>Surface tonal melody</th>
<th>Predicted tonal melody</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>atʃini\textsuperscript{43}</td>
<td>a\textsuperscript{3}tʃi\textsuperscript{4}ni\textsuperscript{43}</td>
<td>*a\textsuperscript{4}tʃi\textsuperscript{4}ni\textsuperscript{43}</td>
<td>‘to get drunk’</td>
</tr>
<tr>
<td>tjukuti\textsuperscript{43}</td>
<td>tsu\textsuperscript{3}ku\textsuperscript{4}ti\textsuperscript{43}</td>
<td>*tsu\textsuperscript{4}ku\textsuperscript{4}ti\textsuperscript{43}</td>
<td>‘basket (canasta)’</td>
</tr>
<tr>
<td>tuk\textsuperscript{kw}á\̥\text{ʔ}áh\textsuperscript{4}</td>
<td>tu\textsuperscript{3}k\textsuperscript{w}á\textsuperscript{4}ʔáh\textsuperscript{4}</td>
<td>*tu\textsuperscript{4}k\textsuperscript{w}á\textsuperscript{4}ʔáh\textsuperscript{4}</td>
<td>‘pitchfork’</td>
</tr>
<tr>
<td>k:oh\textsuperscript{32} tukutah\textsuperscript{4}</td>
<td>k:oh\textsuperscript{32} tu\textsuperscript{3}ku\textsuperscript{4}tah\textsuperscript{4}</td>
<td>*k:oh\textsuperscript{4}tu\textsuperscript{4}ku\textsuperscript{4}tah\textsuperscript{4}</td>
<td>‘fern’ (plant + fern)</td>
</tr>
<tr>
<td>kasiti\textsuperscript{43}</td>
<td>ka\textsuperscript{3}si\textsuperscript{4}ti\textsuperscript{43}</td>
<td>*ka\textsuperscript{4}si\textsuperscript{4}ti\textsuperscript{43}</td>
<td>‘oil’ &lt; Sp. aceite</td>
</tr>
<tr>
<td>skaleta\textsuperscript{43}</td>
<td>ska\textsuperscript{3}le\textsuperscript{4}ta\textsuperscript{43}</td>
<td>*ska\textsuperscript{4}le\textsuperscript{4}ta\textsuperscript{43}</td>
<td>‘bicycle’ &lt; Sp. bicicleta</td>
</tr>
</tbody>
</table>
(b) Spanish loanwords

• Words from Spanish with penultimate stress are almost always borrowed with tone /43/ on the final syllable and tone /4/ on the penult.

<table>
<thead>
<tr>
<th>Spanish</th>
<th>Triqui</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>pera</td>
<td>pe⁴ra⁴³</td>
<td>‘pear’</td>
</tr>
<tr>
<td>queso</td>
<td>ke⁴su⁴³</td>
<td>‘cheese’</td>
</tr>
</tbody>
</table>
• Words from Spanish with final stress are borrowed with tone /43/ on the final syllable but tone /3/ on the penult.

<table>
<thead>
<tr>
<th>Spanish</th>
<th>Triqui</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>cartón</td>
<td>ka³rtũ⁴³</td>
<td>‘cardboard’</td>
</tr>
<tr>
<td>camión</td>
<td>ka³mjũ⁴³</td>
<td>‘truck’</td>
</tr>
</tbody>
</table>

• But there is a strong preference for loanwords to be disyllabic.
What about words with more than 2 syllables?

<table>
<thead>
<tr>
<th>Spanish name</th>
<th>Triqui loanword</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>[fer'nando]</td>
<td>na⁴ndo:⁴³</td>
<td>Fernando</td>
</tr>
<tr>
<td>[flo'rensja]</td>
<td>le⁴ntʃa:⁴³</td>
<td>Florencia</td>
</tr>
<tr>
<td>[te'resa]</td>
<td>re⁴sa:⁴³</td>
<td>Teresa</td>
</tr>
<tr>
<td>[apo'lonjo]</td>
<td>lo⁴ni:⁴³</td>
<td>Apolonio</td>
</tr>
<tr>
<td>[mar'tin]</td>
<td>βa³ti:⁴³</td>
<td>Martín</td>
</tr>
<tr>
<td>[isa'βel]</td>
<td>sa³βe:⁴³</td>
<td>Isabél</td>
</tr>
<tr>
<td>[natiβi'ðad]</td>
<td>ti³ta:⁴³</td>
<td>Natividad</td>
</tr>
</tbody>
</table>

- Longer words are shortened to a two syllable-sized unit.
What about words with one syllable?

Table: Spanish loanwords with final epenthesis or lengthening

<table>
<thead>
<tr>
<th>Spanish word</th>
<th>Triqui loanword</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>par [par]</td>
<td>pa³ri:¹</td>
<td>‘pair’</td>
</tr>
<tr>
<td>dios [djos]</td>
<td>tjo³si:¹~tjo⁴si:⁴³</td>
<td>‘god, deity’</td>
</tr>
<tr>
<td>arroz [a'ros]</td>
<td>ro³si:¹</td>
<td>‘rice’</td>
</tr>
<tr>
<td>rey [rej]</td>
<td>re⁴.i:⁴³</td>
<td>‘king’</td>
</tr>
</tbody>
</table>

• Shorter words are **lengthened** to two syllables.
An iambic template for loanwords

• There is a strong tendency for loanwords to satisfy a 2 syllable, iambic template.

• Similar templatic structure is suggestive of foot-based units in languages like Japanese (Poser 1990).
(c) Variable deletion and reduction of extrametrical (pre-penultimate) vowels

- In many Triqui varieties, there is a general pattern whereby pre-tonic vowels are lost.

<table>
<thead>
<tr>
<th>Itunyoso</th>
<th>Chicahuaxtla</th>
<th>Copala</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>tʃu³kwah⁵</td>
<td>fua³kwua⁵³</td>
<td>fkwu⁵</td>
<td>‘snake’</td>
</tr>
<tr>
<td>tʃa³ Disorder</td>
<td>a³ Disorder</td>
<td>Disorder⁵</td>
<td>‘mosquito’</td>
</tr>
<tr>
<td>ru¹mĩ¹</td>
<td>ru¹mĩ³</td>
<td>mĩ³</td>
<td>‘lazy’</td>
</tr>
<tr>
<td>៬eh⁵</td>
<td>we⁵³</td>
<td>jue⁵</td>
<td>‘petate’</td>
</tr>
<tr>
<td>t:uh⁵</td>
<td>tu⁵³</td>
<td>i³tu⁵</td>
<td>‘knot’</td>
</tr>
<tr>
<td>?βi¹</td>
<td>?wi³²</td>
<td>ju³βe¹</td>
<td>‘raw’</td>
</tr>
</tbody>
</table>
Causative prefix /tu³-/ in an antepenult before /k-α³βʔ³/ ‘to die.’

Extrametrical vowels (in antepenults) are variably deleted and reduced more than penults are.

The vowel in /tu³-/ is almost gone here.
This type of pattern is typical for trisyllabic words with a causative prefix, but it does not occur with the same causative prefix when it appears attached to a monosyllabic verb root, as we see in Figure 3. In this example, we see the word /tu³-tʃa⁴³=neh³/ 'they fed' from the longer clause /tu³-tʃa⁴³=neh³ le⁴³/ 'they fed (the) little ones.' While this example is indeed from a different recording and from a different speaker with a different age (Elena is middle-aged here, while Rosa, above, is in her early 30’s), the difference in the production of the causative prefix is notable. Whereas the vowel is devoiced and virtually absent in the antepenultimate syllable, it is 71 ms long in the penult and has complete voicing. Moreover, in the antepenult, the sample is utterance-initial, where we might anticipate finding speech reduction overall. In Figure 3, the sample is utterance-medial and comes from a recording where the speaker is listing her childcare responsibilities. We might expect more reduction of the penult as a result of this, but there is none.

Figure 3: Causative prefix /tu³-/ in a penult; from Line 35 of Cómo se cuidó a sus niños trabajando en Sinaloa, 6/14/15, by Elena Eugenia Martínez and Nieves López González.

The same prefix is not reduced in /tu³-tʃa⁴³ = neh³/ CAUS-eat = 3P ‘They made (her) eat...’

This is now a disyllabic stem.
Antepenults are shorter than penults in 1 hr spontaneous speech (just about 200 trisyllabic words) \((p < .05)\).
All these pieces of evidence converge

- The evidence here converges on a two syllable unit being important in Triqui prosody
  - An iambic foot is the domain of high tone /4/
  - Spanish loanwords are preferably borrowed as single iambic feet.
  - Antepenults are reduced or deleted more than penults are.
- In addition to suggesting that Triqui words are mostly iambic feet, it seems like antepenults are extrametrical.
IV. Evidence for the prosodic word

• Prefixation can generate words with up to four syllables in Itunyoso Triqui. How are such syllables parsed on the left edge of the foot?

• The prosodic word is the domain of three types of tonal processes related to Triqui morphology.
  a) The prosodic word is the domain of possessed stems and two stem-level tonal changes associated with nominal stem formation.
  b) The prosodic word is the domain of aspect-marked verbs and tonal changes associated with aspectual prefixation.
a. Nominal possession

(4) si³-ka³tofi⁵
   POSS’D-shirt.1s
   ‘my shirt.’

(5) si³-ka³to⁴=ūh³
   POSS’D-shirt=3F
   ‘her shirt.’

(6) si³-ka³to⁴ si⁵ʔ³
   POSS’D-shirt child
   ‘the child’s shirt.’

• Alienably-possessed nouns require a possessed prefix /si³-/. 

• This prefix is required regardless of whether the possessor is an endoclitic (4), an enclitic (5), or a separate noun phrase (6).
Prefix-conditioned tone changes

<table>
<thead>
<tr>
<th>Root</th>
<th>Possessed stem</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>ka³si³?³</td>
<td>si³-ka²si³?³</td>
<td>‘honey’</td>
</tr>
<tr>
<td>ku³ruh³</td>
<td>si³-ku²ruh³</td>
<td>‘large pot’</td>
</tr>
<tr>
<td>na³si³</td>
<td>si³-na²si³</td>
<td>‘tomato’</td>
</tr>
<tr>
<td>rā³?ā³</td>
<td>si³-rā²?ā³</td>
<td>‘mushroom’</td>
</tr>
<tr>
<td>tʃo³2</td>
<td>si³-tʃo²</td>
<td>‘comal/griddle’</td>
</tr>
<tr>
<td>kw⁴eh³2</td>
<td>si³-kw⁴eh²</td>
<td>‘quelite/edible green’</td>
</tr>
<tr>
<td>ti³ni³2</td>
<td>si³-ti²ni²</td>
<td>‘nopal/edible cactus’</td>
</tr>
<tr>
<td>ru³ne³2</td>
<td>si³-ru²ne²</td>
<td>‘beans’</td>
</tr>
<tr>
<td>se³?eh²</td>
<td>si³-se²?eh²</td>
<td>‘ring’</td>
</tr>
</tbody>
</table>

- This prefix conditions tone changes on roots with tone /3/ or /32/.
- Tone /3/ > 2.3
- Tone /32/ > 2
Under another analysis, the possessed prefix has two allomorphs: /si\(^3\)-(2)/ and /si\(^3\)-(/2)/. The former applies in virtually all contexts while the latter only applies to roots with tone /3/ or /32/. For roots with tone /3/, the tonal spreading applies only one syllable to the right. For roots with tone /32/, it applies to the entire root. This analysis assumes phonologically-conditioned allomorphy is encoded in the morphology. Regardless of the phonological analysis that one prefers for the possessed prefix, the domain of the tonal changes associated with the nominal stem morphology is the prosodic word. For a word like /Ru\(^3\)ne\(^32\)/ 'bean', the tonal alternations and prosodic structure are given in Figure 5.

Note that the underlying roots do not show the output of the leftward tonal association rule. Thus, non-final syllables in roots are tonally-unspecified.

There is another tonal process in Itunyoso Triqui that applies within the domain of the prosodic word – low tone spreading. As discussed in the chapter on tonal phonology, contour tones first associate with the final syllable of the root and then a process of leftward tonal association spreads the leftmost tone on the final syllable to the left. This results in many words having predictable non-final tones, e.g. /3.32, 4.43, 4.4, 3.3, 2.2, 1.1/. In the case of tonal melody /31/ though, tone /1/ spreads leftward on all polysyllabic words, e.g. /3.1, 3.1.1/. This process is iterative and it gives the impression that the melody is left-aligned instead of right-aligned like the other contour tones. In autosegmental terms, tone /1/ delinks a preceding tone /3/, which then associates leftward. While tone /3/ may be reassociated, it is never deleted. This process produces the left-aligned tonal melody.

As it so happens, low tone spreading not only applies to uninflected roots, but also to roots with the possessed prefix. Figure 6 provides a representation of this tonal reassociation in a prosodic word for the root /tSi\(^3\)Pi\(^1\)/ 'illness.' Note that this representation is identical to the tonal patterns we observe in trisyllabic roots like /a\(^3\)tSi\(^1\)Pi\(^1\)/ 'to begin.' In both cases, the domain of the leftward spreading process is the prosodic word. The only crucial difference between the derived and non-derived processes of tonal reassociation here is that the antepenult in the non-derived context has no underlying tone – it receives its tone via leftward reassociation and low tone spreading. In the derived context with the possessed prefix, the root tone /3/ is lost via tonal absorption with the prefixal tone.

Representation of possessed stems as prosodic words with stem tonal alternations. The underlying roots do not show the output of the leftward tonal association rule. Thus, non-final syllables in roots are tonally-unspecified.
Prefixed stems as the domain of low tone spreading

Low tone spreading applies across not just morphemes, but prefixed nouns where tone /3/ is absorbed (DiCanio, 2008; DiCanio et al., 2020).
What is the domain here?

• It could be the *nominal stem*, but that’s a morphological domain and not strictly-speaking a phonological one.

• It could also be a phonological domain like the *prosodic word*. 
b. Verbal aspect marking as a prosodic domain

- Vowel-initial verbs take a /k-/ prefix for aspect marking and consonant-initial verbs take a /kV-/ prefix. Note the **potential aspect tone**.

<table>
<thead>
<tr>
<th>Class</th>
<th>Root</th>
<th>Gloss</th>
<th>Potential form</th>
<th>Perfective form</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-initial</td>
<td>a³ni³</td>
<td>‘to expel’</td>
<td>ka²ni³</td>
<td>ka³ni³</td>
</tr>
<tr>
<td>V-initial</td>
<td>a³tʃi³</td>
<td>‘to peel’</td>
<td>ka²tʃi³</td>
<td>ka³tʃi³</td>
</tr>
<tr>
<td>V-initial</td>
<td>u³tā³</td>
<td>‘to suck’</td>
<td>ku²tā³</td>
<td>ku³tā³</td>
</tr>
<tr>
<td>C-initial</td>
<td>tʃi³ʔi⁴</td>
<td>‘to defecate’</td>
<td>ka²-tʃi³ʔi⁴</td>
<td>ka³-tʃi³ʔi⁴</td>
</tr>
<tr>
<td>C-initial</td>
<td>ni³kah²</td>
<td>‘to carry’</td>
<td>ki²-ni³kah²</td>
<td>ki³-ni³kah²</td>
</tr>
<tr>
<td>C-initial</td>
<td>ta³βi³²</td>
<td>‘to ascend’</td>
<td>ki²-ta³βi³²</td>
<td>ki³-ta³βi³²</td>
</tr>
</tbody>
</table>

Perfective aspect prefixes do not involve any tonal replacement of the verb stem’s tone and carry a default tone /3/ when they occur in /kV-/ allomorphs before consonant-initial verbs. The domain of leftward tonal association in Itunyoso Triqui verbs is the prosodic word, but it may never delink a prefixal/morphological tone. Figure 8 demonstrates this process of leftward tonal association for a perfective-marked verb. For the same verb marked with potential aspect, it appears that the potential prefix tone dominates the entire prosodic word and, unlike the default leftward tonal association process in the language, we have what appears to be rightward tonal association from the prefix. This is phonologically-marked since leftward tonal association is argued to occur in all Triqui...
Overwrite with the potential aspect tone

Certain verbs undergo complete tonal overwrite with potential aspect tone /2/ (DiCanio 2023)

<table>
<thead>
<tr>
<th>Root</th>
<th>Gloss</th>
<th>Potential form</th>
<th>Perfective form</th>
</tr>
</thead>
<tbody>
<tr>
<td>a₃tʃih³</td>
<td>‘to grow’</td>
<td>ka²tʃih²</td>
<td>ka³tʃih³</td>
</tr>
<tr>
<td>a⁴tʃi⁴³</td>
<td>‘to pass by’</td>
<td>ka²tʃi²</td>
<td>ka⁴tʃi⁴³</td>
</tr>
<tr>
<td>u⁴tʃu⁴h⁴</td>
<td>‘to smell’</td>
<td>ku²tʃu²h²</td>
<td>ku⁴tʃu⁴h⁴</td>
</tr>
<tr>
<td>tʃu⁴mã⁴³</td>
<td>‘to help’</td>
<td>ku²-tʃu²mã²</td>
<td>ku³-tʃu⁴mã⁴³</td>
</tr>
<tr>
<td>na³ri³yũ³</td>
<td>‘to measure’</td>
<td>ki²-na²ri²yũ²</td>
<td>ki³-na³ri³yũ³</td>
</tr>
<tr>
<td>?naʔ³</td>
<td>‘to come’</td>
<td>ka²-ʔnaʔ²</td>
<td>ka³-ʔnaʔ³</td>
</tr>
<tr>
<td>nãh⁵</td>
<td>‘to wash’</td>
<td>ki²-nãh²</td>
<td>ki³-nãh⁵</td>
</tr>
</tbody>
</table>

Perfective aspect prefixes do not involve any tonal replacement of the verb stem’s tone and carry a default tone /3/ when they occur in /kV-/ allomorphs before consonant-initial verbs. The domain of leftward tonal association in Itunyoso Triqui verbs is the prosodic word, but it may never delink a prefixal/morphological tone. Figure 8 demonstrates this process of leftward tonal association for a perfective-marked verb. For the same verb marked with potential aspect, it appears that the potential prefix tone dominates the entire prosodic word and, unlike the default leftward tonal association process in the language, we have what appears to be rightward tonal association from the prefix. This is phonologically-marked since leftward tonal association is argued to occur in all Triqui.
Prosodic representation of /na₄tuh⁴/ ‘to fall’ with potential aspect prefixation. Note that there is no underlying tone on the penult of the verb stem here, as the penult receives its tonal assignment via leftward tonal association when no potential prefix is present.
Parallelism across prefixed words

- Note the parallelism here between (a) nominal prefixation and tonal changes on stems and (b) verbal prefixation and tonal changes on stems.

- Both involves processes which overwrite roots with a low tone.

- The domain here could be disyllabic, trisyllabic, or quadrisyllabic.

- This appears to be a prosodic domain like the prosodic word.
In a trisyllabic root like /tsu\(^3\)tsu\(^4\)ba\(^{43}\)/ ‘peanut’, there would be two extrametrical syllables.

Figure: Prosodic representation of possessed trisyllabic word – /tsu\(^3\)tsu\(^4\)ba\(^{43}\)/ ‘peanut’. 
Summary of evidence for prosodic structure

<table>
<thead>
<tr>
<th>Domain</th>
<th>Phonetics</th>
<th>Segmental phonology</th>
<th>Tonal phonology</th>
<th>Structural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress</td>
<td>Lengthening</td>
<td>Maximal contrast</td>
<td>Maximal contrast and tonal licensing</td>
<td></td>
</tr>
<tr>
<td>Iambic foot</td>
<td>No reduction</td>
<td>Minimal contrast</td>
<td>Tone /4/ licensed</td>
<td>Frequent template</td>
</tr>
<tr>
<td>Prosodic word</td>
<td>Extrametrical</td>
<td>Minimal contrast</td>
<td>Domain of prefixal morphophonology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>reduction</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Returning to our hypotheses

- Possible analyses:
  1) No feet
     \( \sigma_{\mu\mu} \), \( \sigma_{\mu\mu} \), \( \sigma_{\mu\mu} \), \( \sigma_{\mu\mu} \), \( \sigma_{\mu\mu} \)
  2) Iterative Iambic feet
     \( (\sigma_{\mu\mu}) \), \( (\sigma_{\mu\mu}) \), \( (\sigma_{\mu\mu}) \), \( (\sigma_{\mu\mu}) \)
  3) Non-iterative iambic feet
     \( (\sigma_{\mu\mu}) \), \( (\sigma_{\mu\mu}) \), \( (\sigma_{\mu\mu}) \), \( (\sigma_{\mu\mu}) \)

- Itunyoso Triqui has final iambic feet, but stem formation processes occur on prosodic words which may be longer.
V. Discussion

• What about phonological words? Are there higher levels still?
  • Yes, “compounds” fall into this group, but they have a quirk in Triqui/Mixtecan – they must be two prosodic words.

• What about pronominal clitics?
  • Endoclitics fall within the domain of the prosodic word, but enclitics may comprise an intermediate domain higher than the prosodic word.

Aside from these categories, there does not seem to be much phonological or phonetic evidence for higher level prosodic parsing.
The cliticized word

PrWd

Cl.Wd

F

σ

σ

σ

σ

μ

μ

μ

μ

ki₃

na₄

tufi₄

=sifi₃

Figure: The cliticized word in Itunyoso Triqui. Example is /ki₃-na₄-tufi₄=sifi₃/ PERF-fall=3M ‘he fell.’
Figure 12: The prosodic structure of sentence (4).

### 3.1 Methods

#### 3.1.1 Design and Stimuli

Given the careful nature of the task and the lack of widespread Triqui literacy, a repetition task was used to test the influence of phrasal position on the production of different lexical tones. Two Triqui consultants read target sentences to participants who then repeated the sentence three to four times. In order to attenuate any potential effect of phonetic imitation on the production of tonal sequences, participants were instructed to produce a distractor sequence prior to repetition. Participants spoke the numbers “1, 2, 3”, in Triqui [NgoH13, B:i13, Ba1Pni3], prior to repeating the target sentence.

We anticipate sensory memory traces containing detailed phonetic information to decay within 300 ms and analyzed sensory

---

\[ (7) \quad ki^3-na^3-ri^3=tʃuh^3 \quad \eta^2\text{go}^2 \quad tu^3-k^w^4 \quad tʃu^3-ta^3 \quad ni^3-ko^1 \quad tʃa^31 \quad tʃːu^3 \]

PERF-look.for=ANIM one house.of bee hang head tree

‘The animal looked for a beehive hanging from the tree branch.’
Conclusions

• Most arguments for a prosodic hierarchy lean heavily on variable processes found in non-tonal languages, e.g. relative prominence. That’s just not available in complex tone languages.

• The hierarchy here is not modulated by variable processes involving pitch given its high functional load in the language.

• The prosodic hierarchy in Itunyoso Triqui is best motivated by examining the locus of phonological contrast (cf. Harris, 1997), phonetic domains of reduction, and the relation between phonological and morphophonological processes related to tone.
Acknowledgements

• Basileo Martínez Cruz and Benigno Cruz Martínez

• Funding support from the National Endowment for the Humanities Grant FN-291125-23 A reference grammar of Itunyoso Triqui [ISO 639-3 trq].
References


Appendix 1: How big can words get?

• Most roots (~65%) are disyllabic in the language. About 8-10% are trisyllabic.

• Up to two prefixes (each a CV syllable) may occur on verbs – an aspect marker preceding the verb root; and an iterative or causative prefix before this.

• Only one prefix may precede nouns – that marking POSSESSED status.

• With enclitics, words can be up to 6 syllables, but this is rare in actual speech.
(1) \( ku^3-tu^3-t\text{ju}^3?\betai^3 = sih^3 = \text{uh}^3 \)
PERF-CAUS-be.afraid = 3M = 3F
‘He scared her.’

(2) \( na^3-r\text{u}^3\text{n}\text{u}^4 = \text{uh}^3 \betae^3 \)
ITER-paint = 3F house
‘She repainted the house.’

(3) \( (ki^2)-na^2-r\text{u}^3\text{n}\text{u}^4 = \text{uh}^3 \betae^3 \)
(POT)-ITER-paint = 3F house
‘She will repaint the house.’
Compounds involve two prosodic words. They are always head-initial and often the modifier undergoes tonal replacement to tone /2/.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Gloss</th>
<th>Tone-changing compound</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>tʃa³¹ ti³si³</td>
<td>‘nipple’</td>
<td>tʃa³kaf³ k:ih²</td>
<td>‘wild boar’</td>
</tr>
<tr>
<td>tʃa³¹ + ti³si³</td>
<td>‘head/point’ + ‘breast’</td>
<td>tʃa³kaf³ + k:ih³</td>
<td>‘pig’ + ‘mountainside’</td>
</tr>
<tr>
<td>tʃu³kwaf³ stu³ku³²</td>
<td>‘coral snake’</td>
<td>tʃu³kwaf³ tʃi²ri³²</td>
<td>‘gray beetle’</td>
</tr>
<tr>
<td>tʃu³kwaf³ + stu³ku³²</td>
<td>‘snake/critter’ + ‘jewelry’</td>
<td>tʃu³kwaf³ + tʃi³ri³³</td>
<td>w/red stripes’</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure: A nominal syntactic compound with tone lowering (to /2/) in Itunyoso Triqui – an example of a phonological word. Here, the word /tʃu³kʷaʃi⁵ tʃi²ri²/ ‘gray beetle w/red stripes’ is given.