Towards a typology of prosody-segment interaction: The case of tone-driven epenthesis

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1 INTRODUCTION

(1) This talk presents on an oft-neglected topic in phonological typology: the interaction between segments and prosody (e.g. pitch/tone/intonation/etc.)

(2) One such interaction is ‘intonation-driven epenthesis’
- The phonological insertion of a vowel in order to host an intonational tune

(3) Take-away point for this talk:
- A parallel and overlooked process of ‘tone-driven epenthesis’ also exists in certain African tonal languages
- Defined as the phonological insertion of a vowel in order to host a tone

(4) Tone-intonation parallelism is predicted under a model where:
- Both types of prosodic systems make use of the same phonological substance (i.e. H/L tonemes) and architecture (e.g. autosegmental representations)
- Both have the same functional pressures to cultivate segmental environments best suited for realizing pitch targets

(5) Roadmap of today’s talk
- §2 Our starting point: Prosodic typology
- §3 Case study: Tone-driven epenthesis in Ghomala’
- §4 Zooming out: Why is tone-driven epenthesis so rare?
- §5 Summary

2 STARTING POINT: PROSODIC TYPOLOGY

2.1 Tone-segment interactions

(6) Although the empirical landscape of tone-segment interactions is not firmly established, there are some things we know
(7) Known to be common: **Depressor effects**
   - Tone lowering with depressor consonants
   - “Broadly, it has been found that voiced segments lower F0, while voiceless segments raise it” (Cibelli 2015; see therein for extensive references)
   - Reflected in tonogenesis, tone distributions and alignment, and sometimes in intonation (e.g. Jun 1998 on Seoul Korean)

   - This, despite “connection between vowel height and fundamental frequency: the higher the vowel, the higher the pitch” (Fox 2002:232, references therein)

(9) **Segments affecting tone** much more common than **tones affecting segments**
   - “There is … little evidence of reciprocation and very little evidence of tone affecting segments” (Wee 2019:208)
   - To date, most common pattern of tones affecting segments involves depression, i.e. **low tone inducing consonant voicing** (Poser 1981, Hansson 2004, Pearce 2007, Sossoukpe 2017, inter alia)

2.2 **Even rarer – Prosody-driven vowel epenthesis**

(10) ‘Text-tune’ relationships in **intonation**
   - When mismatch between the segmental structure (the ‘text’) and the intonational melody (the ‘tune’), usually melody accommodates
   - E.g. via compression, simplification, truncation of tune

(11) However, growing literature shows opposite pattern: manipulating the segments to **accommodate intonation** (Roettger 2017, Grice et al. 2018, Roettger & Grice 2019)

(12) **Tunisian Arabic** [aeb] **intonation** (Hellmuth 2022)
   - Yes-no questions realized with rise-fall complex (i.e. L*+H H-L%) at the right edge of an intonational phrase
   - This intonational complex typically co-occurs with an **epenthetic** vowel [ə]:
     \[
     \text{n kemmil tˤu:l} \rightarrow [\text{n kemmil} \quad \text{L*H H-L%}]
     \]
     \[
     \text{I-continue straight-ahead} \quad \text{‘Should I go straight ahead?’}
     \]
   - Epenthesis never appears when there is only a **simple** rise or **simple** fall, even in the context of a yes/no question

(13) Such prosody-driven epenthesis is a prediction of autosegmental representation

<table>
<thead>
<tr>
<th>Table 1: Autosegmental representational possibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-specified</td>
</tr>
<tr>
<td>H</td>
</tr>
<tr>
<td>[ \text{á} ]</td>
</tr>
</tbody>
</table>
Table 2: Schema of logically possible repairs to deficient representations

<table>
<thead>
<tr>
<th>Spreading</th>
<th>Epenthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Toneless V</td>
<td>H → H H H L</td>
</tr>
<tr>
<td>t =a</td>
<td>ā t ā ā t ā</td>
</tr>
<tr>
<td>b. Floating T</td>
<td>H =L H L H =L H L</td>
</tr>
<tr>
<td>ā t</td>
<td>ā t ā ā t ā</td>
</tr>
</tbody>
</table>

(14) If intonation-driven vowel epenthesis is possible, then what a counterpart **tone-driven epenthesis** in tone languages – is this possible?

- Works which do address it: tone-driven epenthesis is **impossible/unattested** (e.g. Blumenfeld 2006, Gleim 2019).

3 CASE STUDY: **TONE-DRIVEN EPENTHESIS IN GHOMALA’**

3.1 Ghomala’ language


- Grassfields Bantoid language of western Cameroon (closely related to Bantu).
- Data largely from previous description (Nissim 1972, 1981; Piron 1997; Eichholzer 2010).
- Supplemented with recordings on YouTube and from 1970s (Hyman p.c., from Nissim).

Table 3: Segmental inventory of Ghomala’

<table>
<thead>
<tr>
<th>LAB.</th>
<th>DENT.</th>
<th>PAL.</th>
<th>VEL.</th>
<th>GLOT.</th>
<th>FRONT</th>
<th>CENTRAL</th>
<th>BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>b</td>
<td>t</td>
<td>d</td>
<td>k</td>
<td>g</td>
<td>ŋ</td>
<td>i</td>
</tr>
<tr>
<td>pf</td>
<td>bv</td>
<td>ts</td>
<td>dz</td>
<td>c</td>
<td>j</td>
<td></td>
<td>e</td>
</tr>
<tr>
<td>f</td>
<td>v</td>
<td>s</td>
<td>ź</td>
<td>ź</td>
<td>y</td>
<td>h</td>
<td>ɛ</td>
</tr>
<tr>
<td>m</td>
<td>n</td>
<td>ɲ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a</td>
</tr>
<tr>
<td>l</td>
<td>y</td>
<td>ʉ</td>
<td>̆</td>
<td>w</td>
<td>̆</td>
<td>w</td>
<td></td>
</tr>
</tbody>
</table>

(16) Possible codas are in bold (will become important later): **p k ŋ m ŋ**

3.2 **Tone-driven epenthesis**

(17) **The tone system**

- Basic **H vs. L** tonal distinction, at an abstract level.
- On surface, lexical **six-way contrast** on roots.

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1 More marginal phones include z, aspirated stops (e.g. tʰ <th>), pre-nasalized stops, as well as various consonant + glide sequences.
Table 4: Six-way tone contrast on open syllables (Nissim 1981:150,153)

<table>
<thead>
<tr>
<th>Tone</th>
<th>Syllable</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>H ță [ță]</td>
<td>‘you saw the parent’</td>
</tr>
<tr>
<td>Downstep</td>
<td>*H *dą [dą]</td>
<td>‘you saw the spouse’</td>
</tr>
<tr>
<td>Level-low</td>
<td>L° țo [țo]</td>
<td>‘you saw the cola nut’</td>
</tr>
<tr>
<td>Low</td>
<td>L tă [tă]</td>
<td>‘you saw the pot’</td>
</tr>
<tr>
<td>Falling</td>
<td>HL bų [bų]</td>
<td>‘you saw the madman’</td>
</tr>
<tr>
<td>Rising</td>
<td>LH bů [bů]</td>
<td>‘you saw the dog’</td>
</tr>
</tbody>
</table>

(18) For our purposes we shall leave aside the lexical downstep (row b. from Table 4)

Table 5: Same set of tone contrasts with syllables closed with a sonorant (i.e. m ŋ)

<table>
<thead>
<tr>
<th>Tone</th>
<th>Syllable</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>kóm [kóm]</td>
<td>‘crab’ (Nissim 1981: 216)</td>
</tr>
<tr>
<td>Level-low</td>
<td>L lūm [lūm]</td>
<td>‘dry season’ (Nissim 1981: 72)</td>
</tr>
<tr>
<td>Low</td>
<td>HL fům [fům]</td>
<td>‘plantation’ (Eichholzer 2010: 16; from English farm)</td>
</tr>
<tr>
<td>Rising</td>
<td>LH bům [bům]</td>
<td>‘destiny’ (Nissim 1981: 74)</td>
</tr>
</tbody>
</table>

(19) The star of the show today: **Tone-driven epenthesis**
- Seen with an open sonorant when they co-occur with a rising tone
- A /c̥k̥/ sequence variably becomes [c̥k̥v̥], with a final epenthetic vowel

Table 6: Tone-driven vowel epenthesis with syllables closed by an obstruent

<table>
<thead>
<tr>
<th>Tone</th>
<th>Syllable</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>/kâp/ [kâp]</td>
<td>‘pipe’ (Eichholzer 2010: 23)</td>
</tr>
<tr>
<td>Downstep</td>
<td>/bâp°/ [bâp°]</td>
<td>‘animal’ (Eichholzer 2010: 3)</td>
</tr>
<tr>
<td>Level-low</td>
<td>/pâp/ [pâp]</td>
<td>‘wing’ (Nissim 1981: 218)</td>
</tr>
<tr>
<td>Low</td>
<td>/lâp/ [lâp]</td>
<td>‘elegance’ (Eichholzer 2010: 31)</td>
</tr>
<tr>
<td>Rising</td>
<td>/lâp/ [lâp]</td>
<td>‘pool of water’ (Eichholzer 2010: 31)</td>
</tr>
</tbody>
</table>

(20) This variation is found consistently across Ghomala’ literature/recordings
- Same word, different transcription: vōpá ‘dust’ (Nissim 1981:198) VS. vōpà (Moguo 2021:141) – **No contrast** between such forms

(21) Tone-driven epenthesis happens with all coda obstruents (i.e. p k ʔ)

Table 7: Tone-driven epenthesis with all coda obstruents (Nissim 1981)

<table>
<thead>
<tr>
<th>Tone</th>
<th>Syllable</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>/gɔp/ [gɔp]</td>
<td>‘hen’ (p. 63)</td>
</tr>
<tr>
<td>/ŋkâp/ [ŋkâp]</td>
<td>‘money’ (p. 300)</td>
<td>[AUDIO]</td>
</tr>
<tr>
<td>Downstep</td>
<td>/mɔk/ [mɔk]</td>
<td>‘fire’ (p. 48)</td>
</tr>
<tr>
<td>Level-low</td>
<td>/s̥k/ [s̥k]</td>
<td>‘wall’ (p. 65)</td>
</tr>
<tr>
<td>Low</td>
<td>/gwɔʔ/ [gwɔʔ]</td>
<td>‘termite’ (p. 146)</td>
</tr>
<tr>
<td>/lɔʔ/ [lɔʔ]</td>
<td>‘village’ (p. 74)</td>
<td></td>
</tr>
<tr>
<td>Rising</td>
<td>/pûʔ/ [pûʔ]</td>
<td>‘package’ (p. 146)</td>
</tr>
<tr>
<td>/gûʔ/ [gûʔ]</td>
<td>‘strength’ (p. 90)</td>
<td></td>
</tr>
</tbody>
</table>

(22) Nissim is explicit in treating this final vowel as epenthesis, stating that its only function is to support a tone (Nissim 1981:65,90)
(23) No epenthesis with other tonal contrasts (i.e. rows a-d from Table 6)
   • ɓàp° ‘animal’ → only [ɓàp°]  Cf. *[ɓàpə°]  [AUDIO]
   • làp ‘elegance’ → only [làp]  Cf. *[lápə°]
   • lòʔ° ‘yam’ → only [lòʔ°]  Cf. *[lòʔə°]  [AUDIO]

(24) Demonstrates epenthesis not due purely to markedness of obstruent codas

(25) Against a deletion alternative – I.e. */cvcv/ → [cvc]
   • The analytic indeterminacy of epenthesis is notoriously difficult (Morley 2015)

(26) Evidence from root phonotactics
   • Vast majority of roots in language are monosyllabic (e.g. CV/CVC shapes)
   • Major exception to this generalization are exactly these [cùc̣á] forms

(27) Evidence from closed syllable restrictions – Applies to [cùc̣á] too
   • Recall the vowel inventory /i e e u ø a u o ə/ (where ø is IPA [e])
   • Before coda p and k only the low vowels ø and a are allowed
   • If this were underlying /cvcə/, we would expect full range of vowels, I.e. expect non-existent roots */bùpə/ or */gèkə/
   • In other words, cùk patterns as a closed syllable underlyingly

3.3 Morphon-phonological alternations

(28) Further evidence comes from morpho-phonological alternations
   • Reveal complete co-variation between rising tones and epenthetic vowels

(29) Deverbal nominalization mirrors the distribution of the monomorphemic lexicon
   • Lexical tone of root overwritten with LH tone
   • If this involves a coda obstruent, an epenthetic vowel must be added

(30) Deverbal nominalization (Nissim 1981: 288-289)
   • túù ‘be strong’ → túù ‘iron’
   • sù ‘(to) weed’ → sù ‘hoe’
   • tòŋ ‘(to) weed’ → nütʊŋ ‘throat’
   • tóŋ ‘push’ → tóŋ ‘fruit’
   • tsùʔ ‘twist’ → dzùʔʊ ‘liana (vine)’
   • fók ‘blow (cold)’ → fók ‘cold’

(31) Morpho-phonological alternation in [N of N] constructions
   • Used for possession, compounds, and other meanings of association

(32) Like most Bantoid/Bantu languages, Ghomala’ has a noun class system, albeit relatively reduced with only 6 classes (SG-PL pairings 1-2, 3-4, and 5-6)
   • Evidence for these classes comes from distinct concord patterns
   • Class 2 plural mṣə̀ŋ ‘birds’ mṣə̀ŋ pạ-puə ‘two birds’
   • Class 4 plural mkwə̣ ‘feet’ mkwə́ ṃụ-ḅuə́ ‘two feet’
   • Class 6 plural dẓ ‘goats’ dẓ tṣ-puə ‘two goats’
(33) Class 1 nouns such as mú ‘child’ versus Class 3 nouns such as thó ‘head’
- Different concord patterns in [N of N] constructions
- mú L bvű → [mû bvű]
- thó H bvű → [thó ‘bvű]

Class 1: dog ‘the child of the dog’ (Nissim 1981: 264)
Class 3: dog ‘the head of the dog’ (Nissim 1981: 153)

(34) [N of N] constructions and tone-segment co-variation (Nissim 1981: 157-158, 250-252)
- mú L göp → [mû göpá] ‘the child of the hen’ [AUDIO]
- kòʔo L göp → [kôʔ göpá] ‘the rooster of the hen’
- gi L göp → [gi göpá] ‘the voice of the hen’
- dyǎ L göp → [dyâ göpá] ‘the house of the hen’
- thó H göp → [thó göp] ‘the head of the hen’ [AUDIO]
- mkòʔo H göp → [mkôʔ göp] ‘the roosters of the hen’
- kwè H göp → [kwè göp] ‘the foot of the hen’
- tǎŋ H göp → [tǎŋ göp] ‘the ear of the hen’

(35) Complete tone/segment co-variation
- If you add rising tone to [cvk], then you feed epenthesis (i.e. [cvka])
- If you eliminate rising tone from [cvk], then you bleed epenthesis (i.e. [cvk])

4 ZOOMING OUT: WHY IS TONE-DRIVEN EPENTHESES SO RARE?

4.1 A common constraint

(36) Let us refer to this constraint in Ghomala’ as ‘the *[cvk] constraint’
- Sonorous segments such as vowels and sonorants possess richer harmonic structures than obstruents → make for better tone-bearing units
- It is well-known that rising pitch takes longer to execute than a falling pitch and consequently has greater duration on average (e.g. Sundberg 1973, etc.)
- Taking together, [cvk] structures may not provide enough sonorous material to adequately realize the rising tone within its allotted duration

(37) Two common repair families:
- Reduce the contour tone (effect the ‘tune’)
- Expand the vowel duration (effect the ‘text’)

(38) Reduce the ‘contourness’ of tone – Compression, simplification, or flattening
- May result in complete neutralization
- In Xhosa [xho], HL contours are merged with H tones when a vowel is shortened in unstressed (i.e. pre-penultimate) environment (Lanham 1958, Zhang 2013)

(39) Expand the vowel duration
- Non-neutralizing lengthening in Mitla Zapotec [zaw] for syllables with rising but not falling contours (Briggs 1961, cited in Zhang 2013)
4.2 Epenthesis as a rare repair

(40) A common constraint but a rare repair:
- The motivation is very common, i.e. avoiding rising tone on suboptimal host
- However, tone-driven epenthesis as a repair is extremely rare
- E.g. no such repair in aforementioned typological surveys (Gordon 2001, Zhang 2013)

(41) In fact, works which posit a maximally restrictive theory of epenthesis assume tone-driven epenthesis to be impossible/unattested (Blumenfeld 2006; Gleim 2019)
- “Tone conditions cannot affect string structure” and therefore tone “cannot force epenthesis/syncope” (Blumenfeld 2006:41)
- Epenthesis is “used exclusively as a response to pressures of syllable structure, sonority sequencing, syllable contact, and word minimality” (Blumenfeld 2006:5)

(42) Outside of Ghomala’, tone-driven epenthesis entertained only in:
- Barain [bva] Chadic: Chad (Loverstrand 2012)

(43) Only in Wamey is there good evidence for bona fide epenthesis (Rolle & Merrill to appear)
- Out soon in Phonology – Draft: https://ling.auf.net/lingbuzz/006624
- Arguments parallel to those developed for Ghomala’ showing that rising tones on closed syllables trigger epenthesis

| Table 8: Wamey – Complementary distribution of cvc and cvcə roots based on tone |
|---------------------------------|---------------------------------|
| Tone   | CVC shape  | CVÇø shape |
|        |            |            |
| a.     | -cæw   | ‘urinating’ | *cvcó |
| b.     | -cæw   | ‘hiding’   | *cvcò |
| c.     | -cæw   | ‘domestic animal’ | *cvcè |
| d.     | *cvć    | -nkæwó | ‘dance’ (n.) |

4.3 Why so rare? – The functional load of tone

(44) Despite its occurrence in Wamey and Ghomala’, it is incredibly rare – But why?
- Towards an explanation: the relatively low functional load of tone

(45) Functional load (Hockett 1955, 1966; Wedel et al. 2013; inter alia)
- “Functional load (FL) quantifies the contributions by phonological contrasts to distinctions made across the lexicon” (Round et al. 2022)
- English contrast t vs. d has a high functional load (e.g. many minimal pairs – tie/die, tall/doll, tune/dune, sat/sad, etc.)
- Cf. θ vs. ð with much lower functional load (e.g. ether/either) (Hall et al. 2019)

(46) The number of tonal minimal pairs is often very low in tonal languages
Hausa [hau] (Chadic: Nigeria)
- “Although tone does not have a functional load comparable to that of many West African languages like Igbo or Yoruba, it does serve to distinguish a number of lexical items” (Newman 2000:599)
- ràiná: LH ‘look after a baby’
ráiná: HL ‘despise, have contempt for’

Relative functional load (FL) and entropy measures
- How much information is lost if you merge all values of a category?
  - No vowel contrasts: r̃ṼñV: vs. r̃ṼñV:
  - No tone contrasts: raina: vs. raina:
- Chinese tonal languages Mandarin and Cantonese – FL of vowels is largely equivalent to that of tone, demonstrating equal lexical importance (Surendran & Niyogi 2003, 2006; Surendran & Levow 2004; Oh et al. 2015)
- In contrast in Hausa, FL of vowels is 3.5 times as important as tone (Rolle 2020)
- What is more typical? Cross-linguistic quantitative study still required

If functional load is low, little reason to excessively maintain tone contrast
- In tonal languages, most morphemes bearing tone are expressed jointly by tonal and segmental material together, and more rarely by tone alone
- If there is enough segmental material to differentiate the morpheme from other paradigmatically-related morphemes (e.g. all nominal roots, or all TAM suffixes), then adding more segmental material via epenthesis may be costlier than being faithful to the underlying tone pattern

In short, in most tonal languages if the H portion of a [c̩v̩k] sequence were simply deleted, little information would be lost to correctly identify the intended meaning

5 Summary

To summarize:
- We demonstrated one rare process termed ‘tone-driven epenthesis’, defined as the phonological insertion of a vowel to host a tone
- We provided evidence for this process from the Cameroonian language Ghomala’, with evidence from root phonotactics and morpho-phonological alternations (both derivation and inflection)
- Finally, we hypothesized that the reason tone-driven epenthesis is so rare is due to the low functional load of tone in many tone languages

These findings support tone-intonation parallelism:
- Both types of prosodic systems make use of the same phonological substance (i.e. H/L tonemes) and representation (e.g. autosegmental architecture)
- Both have the same functional pressures to cultivate segmental environments best suited for realizing pitch targets

For references: [rtf] [bib] (or see my website)