Ternary constituents are a consequence of mora sluicing

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Proposal

- While ternary rhythm exists, ternary feet do not, not even indirectly by means of recursion (pace Martínez-Paricio 2012; Kager & Martínez-Paricio 2013a,b).
- We propose that ternary rhythm arises from mora sluicing, the phenomenon whereby a mora can be excluded from projecting to the syllable level to satisfy an instance of NO-CLASH (pace Elenbaas & Kager 1999).

Outline

- §1 Representational assumptions
- §2 Arguing for mora sluicing: Mohawk and Slovak
- §3 Ternary stress is the consequence of mora sluicing
- §4 Conclusions

1 Representational assumptions

(1) Segments and moras

\[
\begin{array}{c}
\mu \mu
\\
C' V C
\end{array}
\]

- Moras are right-headed (Hyman 1985)

(2) Moras and prominence

\[
\begin{array}{c}
\mu \\
C V C
\end{array} \rightarrow
\begin{array}{c}
\mu \\
C V C
\end{array}
\quad \text{or} \quad
\begin{array}{c}
\mu \\
C V C
\end{array}
\]

- Line1 constituents remotely correspond to syllables.
- Mora sluicing prevents the consonant-headed mora to project to the line1 level.

(3) (Left-headed) feet

\[
\begin{array}{c}
\mu \\
C V C
\end{array}
\quad \begin{array}{c}
\mu \\
C V C
\end{array}
\quad \text{or} \quad \begin{array}{c}
\mu \\
C V C
\end{array}
\quad \begin{array}{c}
\mu \\
C V C
\end{array}
\]

- Feet are located at line2.
- Prominence and constituency are conflated (Hammond 1984; Halle & Vergnaud 1987) and constituents at any level are maximally binary branching.
• In this proposal, even line1 constituents conflate prominence with constituency.

(4) Clash at line1

```
\[ \begin{array}{c}
\text{ } \\
\mu \\
\text{C} \\
\mu \\
\text{V} \\
\text{C}
\end{array} \]
```

(5) No clash at line1 due to mora sluicing

```
\[ \begin{array}{c}
\text{ } \\
\mu \\
\text{C} \\
\mu \\
\text{V} \\
\text{C}
\end{array} \]
```

(6) NO-CLASH(1)
Assign a violation mark for each pair of line1 constituents whose heads are adjacent.

(7) PROJECT\(\mu\)
Assign a violation mark for every mora that does not project as the head of a line1 constituent.

2 Arguing for mora sluicing

2.1 Mohawk

• In Mohawk, stress is penultimate (right-aligned trochee with final-consonant extrametricality).

• Additionally, if the stressed penult is an open syllable, the vowel lengthens.

(8) Penultimate stress in Mohawk (Mellander 2003)
(a) /wak-haratat-u/ wakhara(tatu) ‘I am holding it up’
(b) /wak-haratat-u-hatye-∅/ wakharatatu(hatye) ‘I go along lifting up’
(c) /k-atirut-ha/ kati(rutha) ‘I pull’

• Inflected verb forms are subject to a disyllabic word-minimality requirement. Monovocalic underlying forms are repaired \textit{via} word-initial vowel epenthesis.

• Interestingly, if the newly created syllable is open, the vowel also lengthens.

(9) Word-initial vowel epenthesis
(a) /k-k\text{-}s/ (‘ik.k\text{-}s) ‘I see’
(b) /w-e-\text{-}s/ (‘i:we\text{-}s) ‘She, it is walking around’

• We take this process of \textit{open syllable vowel lengthening} as an argument in favor of the \textit{uneven trochee} (HL) (pace Hayes 1989).

• We interpret open syllable vowel lengthening as a way to satisfy NO-CLASH(1) \textit{via} mora sluicing.

(10) Open syllable vowel lengthening

```
\[ \begin{array}{c}
\text{1} \\
\mu \\
\text{C'} \\
\mu \\
\text{C} \\
\\text{V}
\end{array} \quad \rightarrow \quad \begin{array}{c}
\text{1} \\
\mu \\
\text{C'} \\
\mu \\
\text{C} \\
\\text{V}
\end{array} \quad \begin{array}{c}
\text{2} \\
\mu \\
\text{C'} \\
\mu \\
\text{C} \\
\\text{V}
\end{array} \]
```
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Ternary constituents are a consequence of mora sluicing

- No-CLASH(1) ≫ DEPμ, PROJECTμ
- Open syllable vowel lengthening is phonological, not phonetic.
- Argument: if there is an epenthetic vowel in penultimate position, stress is antepenultimate and the stressed vowel is not lengthened.

(11) Epenthesis in penultimate position and stress retraction
    (a) /k-r-aʔ/  \(\text{akr}_a\)  ‘I will put it into a container’
    (b) /te-k-rik-s/  \(\text{tekeriks}\)  ‘I put them next to each other’
    cf. (c) /wak-ashet-u/  \(\text{wakashe\text{t}u}\)  ‘I have counted it’

(12) Mora sluicing over a whole syllable

[Diagram of syllable structure]

- Word-medial vowel epenthesis: *CC ≫ DEPV, DEPμ
- Antepenultimate stress: No-CLASH(1) ≫ PROJECTμ
- Mora sluicing now affects a whole syllable, the one containing the epenthetic vowel, thus creating a ternary constituent.
- Epenthetic vowels cannot have stress because they do not project a line1 constituent.
- This case of opaque stress-epenthesis interaction is explained as a consequence of satisfying No-CLASH(1), which is needed on independent grounds (cf. Alderete 1999’s Head Dependence).

2.2 Central Slovak

- Central Slovak data also offers evidence in favor of the uneven trochee. Underlying long vowels are shortened after stressed long vowels (/HH/ → (HL)). However, unstressed long vowels faithfully surface as such after stressed light syllables (/LH/ → (LH)).

(13) Post-tonic vowel shortening after long vowels (Mellander 2003)
    (a) /bas-ni:k/  \(\text{bas\text{n}ik}\)  ‘poet’
    (b) /les-ni:k/  \(\text{les\text{n}ik}\)  ‘forester’

- We interpret post-tonic vowel shortening after heavy syllables as a way to satisfy a branchingness condition on line2 dependent constituents.

(14) Conditions on branchingness (at the core of Dresher & van der Hulst 1998):
    (a) The head of constituent C must branch
    (b) The dependent of constituent C must not branch

- The constraint LINE2Dep→|, which states that a line2 constituent must not branch, triggers vowel shortening if ranked above MAXμ.

(15) LINE2Dep→|
    Assign a violation mark for every line2 dependent constituent that branches.
Vowel shortening

- However, vowel shortening in post-tonic position is blocked after stressed light syllables.

Optimal (LH)?

Note that the representation in (17) violates the constraint LINE2Dep→|. In fact, we can posit the representation in (18) instead, where the first line1 constituent branches and takes as its dependent the first mora of the second CV sequence.

Well-formed (LH) with internal mora sluicing

Both the representations in (17) and (18) violate PROJECTµ once, but only (18) satisfies LINE2Dep→|, which is independently needed to explain vowel shortening in /HH/ inputs. This means that (17) is harmonically-bounded by (18).

Corollary

- The process of mora sluicing has been argued to drive two different uneven trochee-creating processes, namely open syllable vowel lengthening in Mohawk and post-tonic vowel shortening in Central Slovak.
- Mora sluicing involves a violation of the constraint PROJECTµ, which demands that every mora is the head of a line1 constituent.
- Mora sluicing is a strategy triggered by different markedness constraints, NO-CLASH(1) in the case of Mohawk and LINE2Dep→| in the case of Central Slovak.
- In both Mohawk and Central Slovak mora sluicing creates ternary constituents at the mora level.
- In the next section, we will argue that the same strategy of mora sluicing is the responsible for ternary stress.
3 Ternary stress is the consequence of mora sluicing

3.1 Ternary non-exhaustive parsing systems: data

(19) Cayuvava (Key 1967) and Tripura Bangla (Das 2001)

(a) Cayuvava

\[
\begin{align*}
2 \sigma & (\sigma\sigma) \\
3 \sigma & (\sigma\sigma)\sigma \\
4 \sigma & (\sigma\sigma)(\sigma\sigma) \\
5 \sigma & (\sigma\sigma)(\sigma\sigma)\sigma \\
6 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma) \\
7 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)\sigma \\
8 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)(\sigma\sigma) \\
9 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)(\sigma\sigma)\sigma
\end{align*}
\]

(b) Tripura Bangla

\[
\begin{align*}
2 \sigma & (\sigma\sigma) \\
3 \sigma & (\sigma\sigma)\sigma \\
4 \sigma & (\sigma\sigma)(\sigma\sigma) \\
5 \sigma & (\sigma\sigma)(\sigma\sigma)\sigma \\
6 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma) \\
7 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)\sigma \\
8 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)(\sigma\sigma) \\
9 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)(\sigma\sigma)\sigma
\end{align*}
\]

Descriptive generalizations:

- Cayuvava: stress on every third syllable counting from the right edge of the word (right-to-left trochees with final extrametricality)
- Tripura Bangla: primary stress on the first syllable and secondary stress on every third syllable afterwards except when this would create final stress (left-to-right trochees)

3.2 Ternary exhaustive parsing systems: data

(20) Estonian and Chugach Alutiiq (Elenbaas & Kager 1999)

(a) Estonian

\[
\begin{align*}
2 \sigma & (\sigma\sigma) \\
3 \sigma & (\sigma\sigma)\sigma \\
4 \sigma & (\sigma\sigma)(\sigma\sigma) \\
5 \sigma & (\sigma\sigma)(\sigma\sigma)\sigma \\
6 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma) \\
7 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)\sigma \\
8 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)(\sigma\sigma) \\
9 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)(\sigma\sigma)\sigma
\end{align*}
\]

(b) Chugach Alutiiq

\[
\begin{align*}
2 \sigma & (\sigma\sigma) \\
3 \sigma & (\sigma\sigma)\sigma \\
4 \sigma & (\sigma\sigma)(\sigma\sigma) \\
5 \sigma & (\sigma\sigma)(\sigma\sigma)\sigma \\
6 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma) \\
7 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)\sigma \\
8 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)(\sigma\sigma) \\
9 \sigma & (\sigma\sigma)(\sigma\sigma)(\sigma\sigma)(\sigma\sigma)\sigma
\end{align*}
\]

Descriptive generalizations:

- Estonian: primary stress on the first syllable and secondary stress on every third syllable afterwards except when this would create final stress (left-to-right trochees). In this case, the last secondary stress is one syllable away from the previous secondary stress, thus mixing binary and ternary rhythm in 3n+1-syllable words.
- Chugach Alutiiq: like Estonian but assigning iambs.

3.3 Analysis

More on representations

- Main stress is a constituent (as in the early days, Liberman & Prince 1977), represented here as the line3 constituent.
- Everything is maximally binary.

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1 In this presentation we consider words containing only light syllables. Therefore, weight effects will not be discussed.
Ternary constituents are a consequence of mora sluicing.

(21) A schematic representation

\[ \begin{array}{ccc}
& 3 & \\
2 & & \\
1 & 1 & \\
\mu & \mu & \mu \\
C & V & C & V & C & V & C & V \\
\end{array} \]

3.3.1 **Binary vs. ternary rhythm**

- Binary rhythm results from the projection of every mora as the head of a line 1 constituent at the expense of clashes at level 1.

(22) Binary rhythm ranking

\[ \text{PROJECT}_\mu \gg \text{NO-CLASH}(1) \]

(23) Binary rhythm²

<table>
<thead>
<tr>
<th>/σσσσσ/</th>
<th>PROJECT(_\mu)</th>
<th>NO-CLASH(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="" alt="Diagram" /></td>
<td>****</td>
<td></td>
</tr>
</tbody>
</table>

- Ternary rhythm obtains with the opposite ranking, whereby clashes at level 1 are avoided at the expense of not projecting all moras as the head of a line 1 constituent.

(24) Ternary rhythm ranking

\[ \text{NO-CLASH}(1) \gg \text{PROJECT}_\mu \]

² We abstract away from directionality in this analysis, which is the result of the alignment constraints HEADFOOT-Right/Left, which refers to line 3, the main stress constituent, and ALLFEET-Right/Left, as well as from the foot type constraints TROCHEE and IAMB.
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(25) Ternary rhythm

<table>
<thead>
<tr>
<th></th>
<th>NO-CLASH(1)</th>
<th>PROJECTµ</th>
</tr>
</thead>
<tbody>
<tr>
<td>/σσσσσ/</td>
<td>3 2 1</td>
<td>***</td>
</tr>
<tr>
<td>a.</td>
<td>C V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C V</td>
<td>C V C V C V C V</td>
</tr>
<tr>
<td></td>
<td>1 1 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>μ μ μ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 1 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>μ μ μ</td>
<td></td>
</tr>
</tbody>
</table>

3.3.2 Exhaustive vs. non-exhaustive ternary rhythm

- Exhaustive ternary rhythm (where ternarity is disrupted in 3n+1-syllable words in favor of binarity at the opposite edge of footing) results from parsing all moras into line2 constituents (feet) at the expense of creating clashes at level 2.

(26) Parseµ(2)

Assign a violation mark for every mora that is not parsed into a line2 constituent.

(27) No-Clash(2)

Assign a violation mark for each pair of line2 constituents whose heads are adjacent.

(28) Exhaustive ternary rhythm ranking (Estonian, Chugach Alutiiq)

Parseµ(2) ∫ No-Clash(2)

(29) Exhaustive ternary rhythm

<table>
<thead>
<tr>
<th></th>
<th>Parseµ(2)</th>
<th>No-Clash(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/σσσσσσ/</td>
<td>3 2 2</td>
<td>*</td>
</tr>
<tr>
<td>a.</td>
<td>C V C V C V C V C V C V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 1 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>μ μ μ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 1 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>μ μ μ</td>
<td></td>
</tr>
</tbody>
</table>

- Non-exhaustive ternary rhythm, however, obtains with the opposite ranking, whereby avoiding clashes at level 2 takes precedence over parsing all moras into line2 constituents (feet).

(30) Non-exhaustive ternary rhythm ranking (Cayuvava, Tripura Bangla)

No-Clash(2) ∫ Parseµ(2)
Ternary constituents are a consequence of mora sluicing

4 Conclusions

- Ternarity is a consequence of mora sluicing.

- Mora sluicing has high explanatory power: it has been proved to be necessary on independent grounds to explain otherwise unrelated phenomena such as uneven trochee-creating processes in Mohawk and Central Slovak and opaque stress-epenthesis interactions in Mohawk (but also final-consonant extrametricality and three-syllable window systems, see Hermans 2013).

- The relation between what we call line1 constituents (i.e., phonological syllables or foot-bearing units) and phonetic syllables (i.e., CV or CVC sequences) is not one-to-one:
  - 2 phonetic syllables or 1 heavy phonetic syllable in 1 line1 constituent (ternary stress, uneven trochee):

\[
\begin{align*}
\text{a. } & \overline{C}V \overline{C}V \overline{C}V \overline{C}V \\
& \mu \mu \mu \mu
\end{align*}
\]

- 1 phonetic syllable in 1 line1 constituent (syllabic trochee):

\[
\begin{align*}
\text{b. } & \overline{C}V \overline{C}V \\
& \mu \mu
\end{align*}
\]
1 phonetic syllable in 2 line1 constituents (moraic trochee):

```
  2
  1
  C  C
```

- Our position is that prosodic constituents below the phonological word are not recursive. The only recursive prosodic constituents are those above the phonological word, which are relevant for the phonology-syntax interface (Elfner 2012, pace Martínez-Paricio 2012; Kager & Martínez-Paricio 2013a,b).

References


