Phrasing and Focus in Bengali

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Some of the most basic aspects of Bengali prosody are not agreed upon in the literature.

The current study examines an extensive set of new data, addressing two questions:

1. **Phrasing**: How many tonally-marked levels of phrasing are there in the prosodic structure?
2. **Focus**: How is focus realized in the prosody?
Previous studies agree that there are **two tonally-marked prosodic phrases** in Bengali, roughly corresponding to the **sentence** and the **content word**:

- Jun (2005): Intonation Phrase (IP), Accentual Phrase (AP)
- Selkirk (2006): Intonation Phrase (IP), Major Phrase (MaP)
Previous studies: Focus realization in Bengali

- Focused constituents bear a **rising pitch contour**.
- Three studies describe this contour as a **low pitch accent** (L*) followed by a **high tone** associated to the focus domain R-edge:
  - Selkirk (2006): L*…[H]_{FOC} high tone morpheme
- Michaels & Nelson (2004) attributes this rising pitch to a **rising pitch accent** (L*+H) on the focused constituent.
Current study: Overview

- The current study examines an extensive set of newly-recorded data.
- Utterances are annotated and analyzed using the preliminary B-ToBI model of Bengali prosody.¹
- B-ToBI is based on the general ToBI (Tones and Break Indices) guidelines for prosodic transcription,² adopting the Autosegmental-Metrical model of intonational phonology.³

¹ The preliminary B-ToBI model is described in Khan (2006, 2007).
² Beckman & Ayers (1997); Beckman & Hirschberg (1994)
³ Pierrehumbert (1980); Beckman & Pierrehumbert (1986); Pierrehumbert & Beckman (1988)
Current study: Data collection and analysis

- **Subjects**: 25 adult speakers of Standard Bengali.
- **Stimuli**: 57 sentences controlled to elicit different tones, phrasings, and focus realizations.
- Subjects’ recordings were judged for fluency by a native speaker consultant.
- A total of 1,255 utterances were annotated and analyzed following the B-ToBI transcription system.
Current study: Outline of B-ToBI model

- **Pitch accents (PA)**
  - Associate to the prominent syllable of a content word
  - 3 pitch accent types:
    - \( L^* \) default
    - \( H^* \) ironic or surprising info
    - \( L^*+H \) focused elements

- **Accentual phrase (AP)**
  - Roughly a content word and surrounding function words
  - Domain of exactly 1 PA
  - 1 boundary tone type: \( Ha \)

- **Intermediate phrase (ip)**
  - Marks small syntactic constituents
  - 3 boundary tone types:
    - \( H^- \) marks small phrases
    - \( L^- \) & \( LH^- \) mark full clauses

- **Intonation phrase (IP)**
  - Roughly a sentence
  - 4 boundary tone types:
    - \( L\% \) declaratives
    - \( LH\% \) default wh-questions
    - \( HL\% \) yes/no questions
    - \( H\% \) other interrogatives (echo questions, requests, etc.)

\textit{NB:} Boundary tones are overridden when co-occuring with the boundary tone of a higher domain.
Current study: Overview of results

- **Phrasing:** Despite previous proposals of two tonally-marked prosodic phrases, data from the current study suggest there are three tonally-marked phrases.

- **Focus:** Counter the analyses of most previous studies, data from the current study support Michaels & Nelson’s (2004) *rising pitch accent* analysis.

- In the following slides, evidence in support of the current analysis (*i.e.* B-ToBI) is presented.
Phrasing: Justification for 3-phrase structure

- When previous studies agree on two tonally-marked phrases, what is the justification for three?

1. **Final syllable duration:** The final syllable of an IP is longer than that of an ip, which is longer than that of an AP.¹

2. **Pitch height:** The pitch of an IP tone is more extreme (higher H, lower L) than that of the equivalent ip tone, which is more extreme than that of the equivalent AP tone.²

¹ Only the AP vs. ip duration contrast is illustrated here, as the number of tokens of ip-final and IP-final syllables matched on both segmental and tonal properties in the current data set did not add up to reach statistical significance. See fn. 2 for additional evidence supporting the IP vs. ip distinction.

² See Khan (2006, 2007, forthcoming) for distributional and additional phonetic evidence supporting the current study’s three-phrase analysis.
Phrasing: Duration differences

- One acoustic difference between APs and ips is final syllable duration.

- Measurement: duration of the final syllables of ten pairs of identical\(^1\) APs and ips (as % of total word duration).

<table>
<thead>
<tr>
<th></th>
<th>AP-final</th>
<th>ip-final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ha</td>
<td>L*</td>
<td>Ha</td>
</tr>
<tr>
<td>Ninake</td>
<td></td>
<td>Ninake</td>
</tr>
</tbody>
</table>

Total duration = 403ms
Final $\sigma = 120$ms (29.8%)

Total duration = 540ms
Final $\sigma = 238$ms (44.1%)

\(^{1}\) Here, “identical” = same word, same speaker, same syntactic position
Phrasing: Duration differences

- **ip-final syllables are longer than identical**\(^1\) AP-final syllables
  [paired \(t(8) = 3.05, p = .02\)].

\(^1\) Here, “identical” = same word, same speaker, same syntactic position
Phrasing:
Pitch height differences

- APs and ips are also distinguished in pitch height.
- In identical\(^1\) words, the pitch of the high ip boundary tone (H-) is higher than that of the high AP boundary tone (Ha) \([\text{paired } t(4) = 3.76, p = 0.02]\).

\(^{1}\) Here, “identical” = same word, same speaker, same position in sentence
Phrasing: Pitch height differences

- Similarly, the pitch of a high IP boundary tone (H%) is higher than that of an equivalent\(^1\) high ip boundary tone (H-) [paired \(t(4) = 4.57, p = 0.01\)].

\(^1\) Here, “equivalent” = same or structurally-similar word, same speaker
The current study proposes three layers of tonally-marked prosodic structure: AP, ip, and IP.

Support:
- **Duration distinction** in the final syllables of APs vs. ips
- **Three-way height distinction** in the high boundary tones of each phrase type (i.e. H% vs. H- vs. Ha)

We now move on to **focus realization**, described in the current study as involving a **rising pitch accent**.  

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1 The rising pitch accent is realized as a low pitch on the prominent syllable and rising/high pitch on the following 1-2 syllables.
When we already have a low pitch accent and high boundary tones in the inventory (below, left), what is the justification for proposing a rising pitch accent (below, right)?

- **4 syllables, non-focused**
  - Default L* pitch accent
  - Default Ha boundary tone

- **4 syllables, focused**
  - Focus L*+H pitch accent
  - No local boundary tone
Focus:
Theoretical justification for L*+H

- The rising pitch accent analysis avoids problematic stipulations found in previous studies:
  - Bengali is not a lexical tone language, but Lahiri & Fitzpatrick-Cole’s (1999) underlying H* for focus particles runs counter to this fact.
  - Focus Prominence Theory\(^1\) states that prosodic boundaries of focus must align with prominence; a focus-R boundary tone (e.g. H\(_P\)), however, would not be prominence-adjacent.\(^2\)
  - Positing a boundary at the focus-R edge leaves deaccented post-focal material prosodically unparsed, thus violating the Strict Layer Hypothesis.\(^3\)

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2 See Selkirk (2006)
3 Selkirk (1984), (1986); Nespor & Vogel (1986)
Focus:
Empirical justification for L*+H

- The L*+H analysis is supported by **two durational observations:**

  1. **F₀ rise:** The rise in pitch in a focused word occurs within a fixed distance of the pitch accented syllable.
     - Not expected, unless the H tone is associated with the PA.
  2. **F₀ fall:** As the focused word increases in length, its F₀ max occurs farther from the R-edge. Unlike non-focused constituents, *pitch starts to fall* well before the R-edge.
     - Not expected if the H tone is associated to the word-R-edge.

- By controlling the length of the focused word, the boundary tone analysis and L*+H analysis make **different predictions,** illustrated on the following slide.
Focus:
Varying focus domain length

Predictions of boundary-aligned H tone analyses

\[ \text{L*} + \text{H} \]

[Short constituent]

F\textsubscript{0} rise: shorter
F\textsubscript{0} fall: same (negligible)
% F\textsubscript{0} rise: same (~100%)
% F\textsubscript{0} fall: same (negligible)

\[ \text{L*} + \text{H} \]

[Significantly longer constituent]

F\textsubscript{0} rise: longer
F\textsubscript{0} fall: same (negligible)
% F\textsubscript{0} rise: same (~100%)
% F\textsubscript{0} fall: same (negligible)

Predictions of bitonal pitch accent analyses (Michaels & Nelson 2004, current study)

\[ \text{L*} + \text{H} \]

[Short constituent]

F\textsubscript{0} rise: same
F\textsubscript{0} fall: shorter
% F\textsubscript{0} rise: larger %
% F\textsubscript{0} fall: smaller %

\[ \text{L*} + \text{H} \]

[Significantly longer constituent]

F\textsubscript{0} rise: same
F\textsubscript{0} fall: longer
% F\textsubscript{0} rise: smaller %
% F\textsubscript{0} fall: larger %
Focus: Varying focus domain length

Duration of pitch rise and fall in focused constituents of varying length

Duration (as % of total word)

Number of syllables in focused word
Focus: Varying focus domain length

- As the length of the **focused word increases**, the duration of % $F_0$ **rise decreases**, and the duration of % $F_0$ **fall increases**.
- This supports analyses that attribute the rising pitch on focused words to a **rising pitch accent**, and **not to a tone associated to a boundary**.

<table>
<thead>
<tr>
<th>2 syllables, focused</th>
<th>4 syllables, focused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larger % rise than [Romilake]</td>
<td>Smaller % rise than [make]</td>
</tr>
<tr>
<td>Smaller % fall than [Romilake]</td>
<td>Larger % fall than [make]</td>
</tr>
</tbody>
</table>

![Graph showing pitch changes for 2 and 4 syllable words, with % rise and fall annotations.]
By not positing a prosodic boundary at the right edge of the focus domain, the rising pitch accent analysis also effectively avoids violating the Strict Layer Hypothesis.

Post-focal material is prosodically parsed in the same AP as the focus domain; the resulting AP is boxed in orange above.
Focus: Summary of new findings

- Focused constituents bear rising pitch due to a **rising pitch accent** \((L^*+H)\), and not to a boundary-marking tone.
- The rising pitch accent analysis is supported by empirical evidence involving the **timing of the \(F_0\) maximum** in focused constituents.
- The current analysis also avoids the theoretical difficulties of the boundary-marking tone analyses.
Conclusions

- Durational and pitch height data suggest that Bengali is among the few languages, including Kiche, Basque, and Farsi, that tonally mark three prosodic phrases.

- Furthermore, by attributing the rising pitch on focused constituents to a rising pitch accent, the current analysis explains the timing of $F_0$ maxima and effectively avoids:
  - Positing lexical tones in a non-lexical-tone language,
  - Violating the Focus-Prominence Theory, and
  - Violating the Strict Layer Hypothesis.

1 Nielsen (2005)
2 Hualde (1988, 1999); Jun (2005)
3 Jun (2005); Esposito & Barjam (2007); Scarborough (2007)
References