Intonational phrase boundaries in BP across speech styles: perception and production

Carolina Serra & Sónia Frota

UFRJ/CAPES (Brazil),
Universidade de Lisboa (Portugal)
Introduction & Background

- It has long been known that the location of intonational boundaries is somehow related to the location of syntactic boundaries.
- **Prosodic hierarchy theory** captures this relation:
  - syntax-phonology mapping principles + phonology proper constraints >> predict preference patterns of intonational phrasing in production and comprehension (Selkirk, 2000; Watson & Gibson, 2005; for Romance languages, Elordieta et al., 2005; Frota et al., 2007).
- Previous descriptions of intonational breaks within Romance (based on read speech isolated sentence *corpora*):
  - the main boundary cues are a H boundary tone and a F0 rise either on the stressed or on the boundary syllable (Frota et al., 2007).
The PhP and the IP in Portuguese

- **Phonological Phrase (PhP) construction:**
  - Lexical head + all elements to the left within the Maximal projection of Lex + following XP *complement* containing just one PW (Frota 2000, Tenani 2002).
  - In BP, unlike EP, the PhP is characterized by the regular occurrence of a *pitch accent* in the most prominent element (Frota & Vigário, 2000; Tenani, 2002).

- **Intonational Phrase (IP) construction:**
  - Strings not structurally attached to the sentence tree / any remaining sequence of adjacent PhPs in a root sentence are mapped onto IPs (Frota 2000). Akin to Selkirk’s (2005) Comma Phrase.
Present Research

Goals
(1) To capture the relation between prosodic breaks as established by prosodic hierarchy theory and perceived prosodic boundaries in read and spontaneous speech;
(2) To test the effects of **syntactic boundary rank** and of **prosodic distance** between boundaries on boundary perception;
(3) To describe the **phonetics and phonology** of intonational breaks, namely the inventory of tones and the way they are realized;
(4) To assess the **most prominent cues** to the perception of prosodic breaks in read speech and spontaneous speech.
Main contributions to the field

* New data: Brazilian Portuguese (BP)

* Contribution to the cross-linguistic knowledge about the placement and shape of prosodic boundaries

* Contribution to the understanding of the way prosodic boundaries are realized and perceived

* Contribution to the knowledge about prosodic differences (prosodic phrasing and the various types of boundary cues) across speech styles (e.g. Blaauw 1994; Jurafsky 2008)
Method

**Corpus:** 5 spontaneous speech (SS) and 5 read speech (RS) passages of about 2 minutes each.

**Speakers:**
1. **Production** - 5 female speakers.
2. **Perception** - 11 listeners.

University students, born in Rio de Janeiro, aged 22-38.

**Procedure:**
1. **Production** – Interviews (SS); Reading of a passage taken from the interview (RS). Passages fully annotated for phonological and intonational phrasing (for Portuguese, Frota 2000, Tenani 2002, Fernandes 2007), to define the placement of predicted prosodic breaks.
Method

Procedure:

(2) Perception

- Listeners had to signal the prosodic breaks they perceived in each passage.
- Breaks should be signaled on a piece of paper containing the orthographic transcription of each passage, without any kind of punctuation marks.
- To assess consistency, listeners repeated the task in 2 sessions (for each session the items were randomized differently).
- The task was preceded by a training phase. Instructions mentioned that *any kind of break* should be marked.
Measurements:

- Location of silent pauses
- **Lengthening** patterns in the nuclear word: duration of stressed and post-stressed syllables relative to the pre-stressed syllable, expressed as percent values
- **F0 variation** in the nuclear word: F0 measurements obtained at the peak of maximum intensity in the syllable (PMI) were the basis for the computation of F0 variation between stressed and pre-stressed syllables, and F0 variation between post-stressed and stressed syllables, both expressed as percent values
- Type & frequency of **nuclear contours** (nuclear PA and boundary tone)
- Type & frequency of **syntactic boundary rank** of (not) perceived boundaries
- **Distance** between (not) perceived boundaries in nº of syllables and prosodic words (PWs)
Comparison: predicted phrasing and perceived phrasing

- **Perceived breaks** = Breaks perceived by at least 8 of the 11 listeners
- Properties of predicted **AND** perceived breaks
- Properties of predicted but **NOT** perceived breaks
- Properties of perceived breaks **NOT** predicted as IPs
Results and Discussion

- **Perceived** prosodic breaks occur at **IP**-boundaries in both styles.

More predicted IPs are perceived as breaks in **RS** than in **SS**.

---

data:

<table>
<thead>
<tr>
<th></th>
<th>PhP-edges perceived</th>
<th>PhP-edges not perceived</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RS</td>
<td>SS</td>
<td>Total</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>12 (1.4%)</td>
<td>10 (2.3%)</td>
<td>22</td>
</tr>
<tr>
<td><strong>Remote</strong></td>
<td>2 (0.5%)</td>
<td>10 (2.3%)</td>
<td>12</td>
</tr>
<tr>
<td><strong>Spontaneous</strong></td>
<td>10 (2.3%)</td>
<td>428 (97.7%)</td>
<td>438</td>
</tr>
</tbody>
</table>

**Distribution of PhP-edges**:

- **Remote**:
  - PhP-edges perceived: 2 (0.5%)
  - PhP-edges not perceived: 436 (99.5%)

- **Spontaneous**:
  - PhP-edges perceived: 10 (2.3%)
  - PhP-edges not perceived: 428 (97.7%)

**Percentage of IP-edges perceived**:

- **Remote**:
  - PhP-edges perceived: 64%
  - PhP-edges not perceived: 36%

- **Spontaneous**:
  - PhP-edges perceived: 37%
  - PhP-edges not perceived: 63%
Results and Discussion

Phonetic and Phonological Properties of predicted & perceived / non-perceived breaks

- The main cue to the perception of a break is the presence of a pause, across speakers and for both styles.
Results and Discussion

*Phonetic and Phonological Properties of predicted & perceived / non-perceived breaks*

- Pauses are longer next to perceived IP-edges, across speakers and for both styles. Perceived PhP-edges behave as IP-edges (> they were realized as IPs)
Results and Discussion

*Phonetic and Phonological Properties of predicted & perceived / non-perceived breaks*

- **Lengthening patterns** and **F0 properties** at the IP-edge: Speaker-dependent strategies

- The bulk of *lengthening* goes on the stressed syllable (as previously reported for EP in Frota 2000). It **may** be a cue to perception, dependent on the speaker (e.g. Sp1, SS). Overall, *bigger* lengthening contrasts in SS. Perceived PhP-edges in SS behave as IP-edges (> they were realized as IPs)
Phonetic and Phonological Properties of predicted & perceived / non-perceived breaks: lengthening

READ SPEECH: (A) Stressed syllable and (B) post-stressed-syllable lengthening relative to pre-stressed syllable (B)

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>133%</td>
<td>169%</td>
<td>28%</td>
<td>17%</td>
<td>80%</td>
<td>70%</td>
<td>43%</td>
<td>127%</td>
</tr>
<tr>
<td>182%</td>
<td>194%</td>
<td>10%</td>
<td>1%</td>
<td>23%</td>
<td>20%</td>
<td>11%</td>
<td>98%</td>
</tr>
</tbody>
</table>

IP-edges perceived as breaks
IP-edges not perceived as breaks

SPONTANEOUS SPEECH: (A) Stressed syllable and (B) post-stressed-syllable lengthening relative to pre-stressed syllable (B)

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sp 1</td>
<td>Sp 2</td>
<td>Sp 3</td>
<td>Sp 4</td>
<td>Sp 5</td>
<td></td>
</tr>
<tr>
<td>210%</td>
<td>1%</td>
<td>111%</td>
<td>94%</td>
<td>170%</td>
<td>127%</td>
</tr>
<tr>
<td>84%</td>
<td>71%</td>
<td>45%</td>
<td>7%</td>
<td>95%</td>
<td>38%</td>
</tr>
</tbody>
</table>

IP-edges perceived as breaks
IP-edges not perceived as breaks

* only two cases
Phonetic and Phonological Properties of predicted & perceived / non-perceived breaks: F0 properties

- F0 variation may be a cue to perception, but also dependent on the speaker (e.g. Sp2, RS). Speaker’s strategies seem to either favour lengthening or F0 variation (e.g. Sp1 vs. Sp2). Overall, larger F0 variation (on the stressed syllable) in RS.

* only two cases
Phonetic and Phonological Properties of predicted & perceived / non-perceived breaks: Nuclear contours

- H+L* L% is the most common contour in both styles, but with different frequencies (RS > SS)

IP-edge with perceived break, Sp 3 – RS [a gente podia ter ficado mais um pouquinho] IP
we could have stayed longer
Phonetic and Phonological Properties of predicted & perceived / non-perceived breaks: Nuclear contours

- Falling/low nuclei & Low boundary are dominant in RS (against previous results for read isolated sentences – Frota et al. 2007); in SS the distribution of falling/low and rising/high nuclei, as well as low/high boundaries is about even.

IP-edge with perceived break, Sp 1 – RS / SS [foi um período muito ruim pra mim] IP
It was a very bad time | for me |

RS

SS
Phonetic and Phonological Properties of predicted & perceived / non-perceived breaks:

Nuclear contours

Boundary tones

- **RS**
  - READ SPEECH: Distribution (% of falling/low (L) and rising/high (H) pitch accents
  - IP-edges perceived as breaks
  - IP-edges not perceived as breaks

- **SS**
  - SPONTANEOUS SPEECH: Distribution (% of falling/low (L) and rising/high (H) pitch accents
  - IP-edges perceived as breaks
  - IP-edges not perceived as breaks
Results and Discussion

**Phonetic and Phonological Properties of predicted & perceived / non-perceived breaks: IP size**

- Perceived IPs are **longer** than non perceived IPs, across speakers and styles (both in nº syll and nº PWs) >>

Nº syll already shown to be relevant to IP formation as a size condition: >8 (>60%); >12 (>90%) Elordieta et al 2005
Results and Discussion

Phonetic and Phonological Properties of predicted & perceived / non-perceived breaks: IP size

- n° PWs

Size affects perception
Results and Discussion

*Phonetic and Phonological Properties of predicted & perceived / non-perceived breaks: distance*

- Distance between **Perceived breaks** is **longer** than between perceived and non-perceived breaks, across speakers and styles (both in nº syll and nº PWs)

![Graphs showing distance effects on perception]

---

**Distance affects perception**
Results and Discussion

**Syntactic boundary rank**

- Perceived IP-edges are mostly matrix sentences edges, across styles >> Par, DE, XP >> Top, IS >> C

- S boundary is more robustly perceived as a major prosodic boundary (e.g. Collier & ‘t Hart 1975, Cole 2008)

- But no neat gradual effect of syntactic rank, suggesting that *mapping predictability* (Edge S>Edge IP) has a role to play (phrasing of Par, DE, Top is affected by length effects/prosodic subordination)
Summary

- Perceived breaks occur at IP-edges, regardless of style
- More predicted IPs NOT perceived in SS (63% vs. 36%)
- Properties of predicted & perceived IPs / not perceived:
  1. A pause is the strongest cue, across speech styles
  2. Lengthening (stressed syll.) is speaker-dependent and characterises especially SS
  3. F0 variation (stressed syll.) is speaker-dependent and characterises especially RS
  4. Nuclear contours: more falling contours in RS; more contour variation (token, not type) in SS
  5. Longer IPs are more robustly perceived, across styles
  6. Distance between IPs promotes the perception of a break, across speech styles
  7. Syntactic rank shows a main effect of S (mapping predictability), across speech styles
Conclusion

• SS shows more variability in the relation between predicted, perceived and produced phrasing (as expected). The variability emerges from a more even distribution of the same types of cues, that seem to play similar roles in both styles. This even distribution may be an important factor behind the lower perception of predicted breaks in SS.
• Unlike in previous reports (e.g. Howell & Kadi-Hanifi 1991, Blauuw 1994), BP data does not show marked differences in type between styles (such as pauses mainly in SS or at different locations, or a tendency to produce much more phrases in one of the styles relative to the other).
• In BP, predicted IP-phrasing is fairly robust across styles: 87% all predicted IPs were realized as such (94% in RS; 81% in SS); only 0.8% of predicted PhPs were perceived as breaks and uttered as IPs (0.3% in RS; 1.3 in SS).
THANK YOU!
References


