A focus intonational morpheme
in European Portuguese:
production and perception

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Introduction

• Production studies of the intonational signalling of focus in EP have shown that focus is expressed by a specific pitch accent type, that contrasts with the neutral pitch accent, thus revealing a systematic difference between nuclear accents associated with different meanings (Frota 1997, 2000, 2002a,b, Vigário 1998, Fernandes 2007, Viana & Frota 2007).

• In declaratives, the contrast is essentially realized as an alignment difference: H+L* (neutral accent) and H*+L (focus accent)

• A pilot perceptual study using natural stimuli has shown that subjects are able to distinguish between members of neutral/focus minimal pairs and to match them to the appropriate production context (Frota 2000). However, the perception of the production contrast has not been investigated in detail.
Introduction

• Main goal: To examine whether the two pitch accent categories (production-based) are perceived in a categorical way.
  – Do differences in F0 alignment trigger a perceptual change from one meaning to the other?
  – Do such differences pattern alike in stimuli based on a neutral sentence and a focus sentence?

• Related goal: To contribute to the understanding of the nature of intonational contrasts and to the discussion around the various approaches and methods to define prosodic categories (two issues repeatedly addressed and under debate in much of the recent literature, Niebuhr & Kohler 2004, Gussenhoven 2006, Rietveld & Chen 2006, Schneider et al. 2006, 2009, Gili Fivela 2008, Dilley submitted, Savino & Grice 2009, among many others)
Overview

• Background on the prosody of focus in EP (phrasing and prominence)
• The production contrast (revisited)
• Perception study
  – Context-matching identification task
  – Semantic scaling task
  – Context-matching discrimination task
  – Summary
• Discussion of the findings in the light of the argument for a focus intonational morpheme in EP
Neutral statement vs focus (narrow/contrastive)

What about John and Mary? What happened to them?

John and Mary broke up?
Prosodic focus in EP: NO prosodic boundary (PhP)

- No tonal boundary **after** focus
  - the pitch fall endpoint does not move to the right with the increasing number of posttonic syllables

  [Graph: manhã | angolanas]

  Stress clash data also shows that Focus does not insert a PhP-boundary

- No tonal boundary **before** focus
  - the peak does not move to the left with the increasing number of pretonic syllables

  [Graph: arqueólogo]

  The SC / NSC within PhP is kept under focus

Frota 2000; Frota 2002
Prosodic focus in EP: NO prosodic boundary (IP)

• No IP-level boundary after or before focus
  – Focus was found not to affect the application of any of the sandhi processes observed within IP (unlike topic)

\[
\text{[ A[z] ANGOLANA[z] ofereceram especiaria[z] aos jornalista[\textcolor{red}{\textbullet}] ]I}
\]

\[
\text{[ A[z] angolana[z] ofereceram especiaria[z] AOS JORNALISTA[\textcolor{red}{\textbullet}] ]I}
\]

\[
\text{[ A[z] angolana[z] ofereceram especiaria[\textcolor{red}{\textbullet}] ]I [ aos jornalista[z] ]I}
\]

‘The Angolans gave spices to the journalists’

• No IP-level boundary after or before focus
  – The identity in phrasing between focus and neutral utterances against topic utterances is further supported by intonation

focus – solid line; topic – dashed line

Frota 2000, Frota 2002

The Angolans gave spices to the journalists’
Prosodic focus in EP: prominence and duration

- **Duration** is a cue to **prominence** in EP (Delgado Martins 1977, Andrade & Viana 1988, 1989, Frota 1991)
- In neutral utterances, IP-prominence is final
- In utterances with prosodic focus, the focused word is the IP-head (i.e. Prominence is not positional – EP, Neapolitan / Palermo Italian: D’Imperio 2001, Grice 1995)

- Focus (narrow/contrastive) is signalled by **lengthening** of the stressed syllable of the focused word (may extend into the next syllable, not word-bound)
- There is a **durational difference** between the IP-head in the neutral case and the IP-head in the focus case

Frota 2000, Frota 2002
The production contrast (revisited)

• The two pitch accents: alignment patterns
  – Neutral accent
    \[ H \quad L^* \]
  – Focus accent
    \[ H^* \quad L \]

• Neutral accent is the nucleus of broad focus declaratives: standard declarative contour: \((H^*) H+L^* L\%

• Focus accent is the nucleus of narrow/contrastive focus declaratives irrespective of focus position (early or late)

Peak height does **not** differentiate the two accents
The production contrast (revisited): phonetic detail

- Alignment relative to segmental landmarks

The intervals HtoS0 and LtoV1 for the neutral fall (‘N’eutral and ‘T’opic) and the focus fall (‘F’ocus): jornalistas

Frota 2002a
The production contrast (revisited)

- The contrast is present in child language, very early on, and its use is appropriate according to context (Frota & Vigário 2008)

```
ta´ta ta´ta ‘Tata. Tata’ (child’s name) 1;09
```
What about perception?

- Clear and robust contrast in production. But is the distinction perceived? Do native listeners distinguish between intended neutral utterances (=with a broad focus interpretation) and intended focus utterances (=with a narrow/contrastive focus interpretation)?

- Pilot perception study (natural stimuli): given context C, choose the felicitous utterance from a pair (AX)

- Ex: As angolanas ofereceram especiarias aos jornalistas focus on ANGOLANAS/neutral utterance
  Context: Quem ofereceu especiarias aos jornalistas? [Early focus] ‘Who gave spices to the journalists?’
What about perception?

- Results

  - The distinction is perceived. Early and late focus are equally well distinguished from neutral.
  - But how is the distinction implemented (late focus)?
  - Is it gradual or categorical?
  - Are differences in F0 alignment enough to trigger a perceptual change from one meaning to the other?
Perception study

• Several studies have examined alignment contrasts associated with intonational meaning distinctions in different languages and have provided mixed results (e.g. Pierrehumbert & Steele 1989, Chen 2003, Dilley submitted, D’Imperio 2000, Niebuhr & Kohler 2004)

• Their findings (together with findings on scaling contrasts) have led authors to argue for the key importance of using semantically motivated tasks, and to question the suitability of the traditional CP concept to investigate intonational meaning (Chen 2003, Niebuhr & Kohler 2004, Schneider et al. 2009, Prieto et al. submitted, a.o.)

• Three experiments (all semantically motivated) test the H+L* (neutral accent), H*+L (focus accent) contrast in EP (late focus)
Perception study

- **Stimuli**

  4 stimulus series were constructed based on natural productions (source utts)
  2 series have a focus accent base (CF,JF)
  2 series have a neutral accent base (CN,JN)
  The distance between the peaks in the CN/CF and JN/JF natural productions was divided in equal steps of 30ms (6 steps for CN/CF, 7 steps for JN/JF)
  CN, JN: peak and valley alignment were shifted forward in steps of 30ms
  CJ, JF: peak and valley alignment were shifted backwards in steps of 30ms

  - **CN/CF**: A Maria ofereceu-me **caramelos**
  - **JN/JF**: As angolanas ofereceram especiarias aos **jornalistas**
Perception study

- Participants
Students and staff at colleges in Lisbon, native speakers of EP (Lisbon variety), normal hearing, 18 years of age or older
25 subjects participated in the study.
Each task had a training section with natural stimuli (not used in the task itself). Participants that performed at chance level or below in the training are excluded.
3 Experiments > 1 session (c.70 minutes)

- Experiment 1
Context-matching identification task
Two contexts (A and B) are presented on screen (8000ms), followed by the stimulus. Participants choose the appropriate context (A or B, forced choice). [+RTs] Trials randomized across participants. SuperLabpro4.5
Training: 8 trials with feedback for correctness and item repetition if incorrect response
4 stimuli series (26 items)x 3 repetitions x 20 subjects=1560 responses

A: Ouvi dizer: ‘I heard that...’
B: Foi aos estudantes que as angolanas ofereceram especiarias?
‘Was it to the students that the Angolans gave species?’
Exp.1: Context-matching identification

One-way ANOVAs show a significant effect of stimulus number, p<0.001

P-value of statistical comparisons of identification rates (expressed as proportion of F-responses) for adjacent pairs of stimuli (Tukey HSD).
Exp. 1: Context-matching identification

One-way ANOVAs show a significant effect of stimulus number, \( p < 0.001 \)

<table>
<thead>
<tr>
<th></th>
<th>1-2</th>
<th>2-3</th>
<th>3-4</th>
<th>4-5</th>
<th>5-6</th>
<th>6-7</th>
</tr>
</thead>
<tbody>
<tr>
<td>JF</td>
<td>0.6441</td>
<td>1.000</td>
<td>0.0007*</td>
<td>0.9996</td>
<td>0.0995</td>
<td>0.9999</td>
</tr>
<tr>
<td>JN</td>
<td>1.000</td>
<td>0.4849</td>
<td>0.9806</td>
<td>0.0002*</td>
<td>0.4849</td>
<td>0.9958</td>
</tr>
</tbody>
</table>

P-value of statistical comparisons of identification rates (expressed as proportion of F-responses) for adjacent pairs of stimuli (Tukey HSD).
Exp.1: Context-matching identification

Mean RTs for the within-category stimuli vs. the across category stimuli

<table>
<thead>
<tr>
<th>Mean RTs</th>
<th>Within</th>
<th>Across</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF</td>
<td>3180</td>
<td>3562</td>
<td>0.546</td>
</tr>
<tr>
<td>CN</td>
<td>2552</td>
<td>3301</td>
<td>0.224</td>
</tr>
<tr>
<td>JF</td>
<td>3366</td>
<td>3556</td>
<td>0.797</td>
</tr>
<tr>
<td>JN</td>
<td>3231</td>
<td>4573</td>
<td>0.239</td>
</tr>
</tbody>
</table>

N>F: within category, RTs are faster in the N continua and the diff. relative to across category is larger

Base stimulus effects are higher in the F continua: longer duration of the stressed syllable under focus (19ms) - They are also larger in the J series than in the C series (subjects said J series ‘was more difficult’)

Conclusion: listeners perceive the H+L*, H*+L contrast in a discrete manner, as identification boundaries emerge in the 4 series.
Exp. 2: Semantic scaling

• Experiment 2

Semantic scaling task
Participants hear the context plus the stimulus (like in natural conversation), and rate appropriateness of stimulus to context in an scale of 7 points (1 to 7, 1=NOT appropriate, 7=appropriate)

Half of stimuli have context N; the other half context F

They were instructed to answer as quickly as possible

Training: 8 trials without feedback

4 stimuli series (26 items)x 3 repetitions x 15 subjects=1170

• Results

Context type: One-way ANOVA shows a significant effect of context (p<0.001), with F-context triggering more appropriate responses (mean for F=5.08, for N=4.18)

The analysis was run by context, showing that in the F-context ambiguous items (items near the identification boundary in Exp. 1) tend to be perceived as focus. This effect is not found in the N-context where the rating curves are generally similar to the identification curves in Exp 1.
Exp.2: Semantic scaling

CF: Tukey HSD shows a significant N/F difference for CF1 and CF2, (p<0.05)
The ambiguous item in Exp.1 is perceived as Focus in the F-context (CF3)
The right-hand side of the CF continuum shows the base stimulus effect

CN: Tukey HSD shows a significant N/F differences for all steps, expect CN3 and CN4 (p<0.01)
The ambiguous items in Exp.1 are perceived as Focus in the F-context (CN3, CN4)
Exp.2: Semantic scaling

JF: Tukey HSD shows a significant N/F difference for all steps, except JF6 (p<0.05)
The ambiguous items in Exp.1 are perceived as Focus in the F-context (JF4, JF5)
The right-hand side of the JF continuum shows the base stimulus effect, stronger than in CF (like in Exp.1)

JN: Tukey HSD shows significant N/F differences for JN1, JN6, JN7 (p<0.05)
The ambiguous items in Exp.1 are perceived as Focus in the F-context (JN4, JN5), consistent with previous results for the other series. However, no discreteness in the rating for JN.
Overall, the results for the two J series are less clear than those for the C series.
Exp.2: Semantic scaling

Mean RTs for stimuli in Exp. 2

<table>
<thead>
<tr>
<th>Mean RTs</th>
<th>Appropriate</th>
<th>Not approp.</th>
<th>IB (Exp.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF - F</td>
<td>1405</td>
<td>1882</td>
<td>1391</td>
</tr>
<tr>
<td>CF - N</td>
<td>1527</td>
<td>2023</td>
<td>1805</td>
</tr>
<tr>
<td>CN - F</td>
<td>1055</td>
<td>1557</td>
<td>1298</td>
</tr>
<tr>
<td>CN - N</td>
<td>1086</td>
<td>1355</td>
<td>1630</td>
</tr>
<tr>
<td>JF - F</td>
<td>1014</td>
<td>1573</td>
<td>1116</td>
</tr>
<tr>
<td>JF - N</td>
<td>1498</td>
<td>1344</td>
<td>1863</td>
</tr>
<tr>
<td>JN - F</td>
<td>1365</td>
<td>1619</td>
<td>1327</td>
</tr>
<tr>
<td>JN – N</td>
<td>1184</td>
<td>1627</td>
<td>1767</td>
</tr>
</tbody>
</table>

The largest RT measures are for the stimuli that are NOT appropriate to the context (with the exception of JF-N); Stimuli around the identification boundary (Exp. 1) show larger RTs only if the context is neutral.

Conclusion: results are consistent with those from Exp. 1, if the effect of context is taken into account.
Exp. 3: Context matching discrimination

- Experiment 3

**Context matching discrimination**

A context (F or N) is presented on screen (3000 ms) followed by a pair of stimuli (with a ISI of 200 ms). Subjects have to decide which of the stimuli is appropriate to the context, by answering A, B, or I don’t know (the latter was to be used only if they could not decide between A, B).

Stimuli within each pair are two steps apart: 1/3, 2/4, 3/5, 4/6, 5/7

Half of stimuli have context N; the other half context F; Half have early/late peak order, half late/early

Subjects were instructed to answer as quickly as possible

Different pairs: C(4+4)+J(5+5); Same pairs C(3)+J(3); 2 Extreme pairs.

Total 26 x 3 repetitions x 17 subjects =1326 responses

Training: 5 trials with feedback for correctness and item repetition if incorrect response

- Results

Extreme pairs: 0.94 (N,F)=pilot exp.

*No significant effect of context* on the proportion of Different answers (p=0.187), although overall F triggers more different answers than N (means are 0.74 and 0.68)
Exp. 3: Context matching discrimination

- Results
  
  Discrimination results are presented as $d'$ for each stimulus pair: the DIFFERENT responses to the different pairs were used as hit rate and the DIFFERENT responses to the same pairs as false alarms (Kaplan et al. 1978)

  Wilcoxon Matched Pairs Test carried out on $d'$ for each of the CF, CN, JF, JN shows NO significant effect of context, confirming the 1st general result.

  Effect of order of presentation: tendency for better discrimination in pairs of stimuli with early-late order. Wilcoxon Matched Pairs Test showed a significant effect for JF ($p<0.05$) and a borderline result for CN. (effect similar to that reported for low-high order in many studies)
Exp. 3: Context matching discrimination

CF3 is ambiguous in Exp.1 & 2. Discrimination peak for CF is across CF3, that is CF2-CF4, followed by the pairs involving the ambiguous stimulus, and lowest discrimination is reached at the end of the continuum, between two stimuli within the same category, according to Exp. 1 & 2.

CN3 and CN4 are ambiguous (Exp.1&2). Discrimination peak region for CN for pairs involving the beginning of the continuum and the ambiguous pairs. Lowest discrimination is reached to the end of the continuum. The lower Peak values are consistent with the fact that all pairs tested involve one of the ambiguous items as defined in the previous exps.
In Exp. 1 the crucial distinction is between F4 and F5. The discrimination peak is across that boundary, followed by pairs involving ambiguous stimuli and lowest discrimination is reached at the beginning of the continuum, between two stimuli within the same category (Exps. 1 & 2). 

Boundary between N4 and N5 (Exp. 1). Discrimination peak region across that boundary (N3-N5 & N4-N6), and lower discrimination at the beginning and end of continuum, matching Exp. 1 results. On the other hand sensitivity is lower in line with the less clear results for the J series previously reported. 

[right-end: effect of the focus base in JF

false alarm rate same pairs J>N: 0.43/0.29]
Summary and discussion

• The 3 experiments

Exp.3 results largely support the previous results by showing higher discrimination across the identification boundaries defined in Exp.1

The 3 experiments provide converging evidence that EP listeners, not only produce but also perceive the two pitch accent categories in a discrete way; and that differences in F0 alignment are enough to trigger a perceptual change between neutral and focus interpretation

They also show an effect of the focus accent base that leads to more focus responses at the end of the continuum than the neutral accent base leads to neutral responses: the duration cue to focus helps to promote focus responses in F-based continua, but the absence of the duration cue has not a symmetrical effect in preventing focus responses in the N continua.

These findings support the claim that the neutral/focus accent distinction is essentially and primarily an alignment contrast phonological encoded at the pitch accent level: H+L*, H*+L
Summary and discussion

• Implications

Methodologically, these findings argue for the use of semantically motivated tasks to study intonational meaning, including a semantic motivated discrimination task, and not just acoustic auditory tasks (along the lines of Schneider et al. 2009).

For the field of intonational phonology, they strengthen the view that some of the timing variation present in intonation may be phonologized in some languages resulting in discrete contrasts that are meaning-related (Gussenhoven 1999); this, in turn, lends support to the AM approach, where pitch accents may be distinguished on the basis of F0 alignment.

Future research: Examine the reasons behind the less clear results obtained for the J series: the journalists sentence is too long (4 PWs, 20 syllables)...; Test a context-matching discrimination task pairing stimuli of adjacent steps; Assess the role of duration as a complementary cue to prosodic focus
Investigate the acquisition and development of the neutral/focus accent in production and perception
Acknowledgments

• Aoju Chen, Barbara Gili Fivela, Carlos Gussenhoven, Pilar Prieto, Vicent van Heuven
• Research assistant Marisa Cruz
• Cátia Severino for help with SuperLab
• All the participants in the experiments

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