When prosody matters!

Emerging word segmentation abilities in European Portuguese learning infants

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Introduction

The word segmentation problem: when and how infants begin to segment word-like forms from the continuous speech stream?

Early word segmentation plays a crucial role in language acquisition (i.e., word learning, syntax)
Introduction

- Segmentation abilities in typically developing infants have been shown to vary across languages (e.g., Mersad at al., 2010)

<table>
<thead>
<tr>
<th>Language</th>
<th>Monosyllabic</th>
<th>Bisyllabic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Trochaic</td>
</tr>
<tr>
<td>English</td>
<td>7.5m</td>
<td>7.5m</td>
</tr>
<tr>
<td>German</td>
<td>7-9m</td>
<td>9m</td>
</tr>
<tr>
<td>Spanish/Catalan</td>
<td>6m</td>
<td></td>
</tr>
<tr>
<td>French</td>
<td>7.5m?</td>
<td>16m</td>
</tr>
</tbody>
</table>
Introduction

- **Rhythmic properties** of a language (i.e., stress based, syllable based) may be utilised to begin segmenting continuous speech (what the infant relies on)

- Word position may be crucial also due to prosody: Words at **utterance edges/boundaries** easier to segment than those in the middle (Seidl & Johnson, 2006; Johnson et al., 2014)
  - Edge provides particularly **salient cues** e.g. duration and pitch cues

<table>
<thead>
<tr>
<th>Language</th>
<th>Rhythm</th>
<th>Unit</th>
<th>Edge</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>Stress-timed</td>
<td>Word</td>
<td>earlier</td>
</tr>
<tr>
<td>German</td>
<td>Stress-timed</td>
<td>Word</td>
<td></td>
</tr>
<tr>
<td>Spanish</td>
<td>Syllable-timed</td>
<td>Syllable</td>
<td></td>
</tr>
</tbody>
</table>
Present study

- First attempt to study emerging segmentation abilities in European Portuguese (EP) learning infants

- EP rhythm displays both stress and syllable timing properties, unlike English or Spanish (Frota & Vigário 2001)

- Also, unlike other languages, EP provides strong cues to high prosodic phrase boundaries and word boundaries, but not to lower phrase boundaries (Vigário, 2003; Frota 2014)
Aims

- Identify at what point in development segmentation abilities emerge
- Investigate whether **prosody** constrains early word segmentation abilities in EP in comparison with other languages
  - Monosyllabic segmentation earlier/later
  - Effect of **prosodic salience** (prosodic boundaries)
Two studies

EP learning infants’ ability to segment monosyllabic word forms

STUDY 1
5-6 months and 8-9 months

STUDY 2
12 months
Method

Participants

- **5-6 months:**
  - 20 infants from monolingual homes in the Lisbon area
    (11 boys, mean age 6m 3d, range 4m 19d – 7m 11d)
  - 5 infants excluded due to fussiness (1), risk of autism (1), not needed (3)

- **8-9 months:**
  - 20 infants from monolingual homes in the Lisbon area
    (12 boys, mean age 9m 2d, range 7m 27d – 10m 8d)
  - 0 infants excluded

- **12 months:**
  - 20 infants from monolingual homes in the Lisbon area
    (10 boys, mean age 12m 2d, range 10m 24d – 13m 19d)
  - 2 infants excluded due to fussiness
Method – Study 1

Materials

- 4 monosyllabic pseudo words
  - Ful, Queu, Pis, Sau
- 2 passages constructed for each word, one for middle and one for end sentences

A Marta pôs o seu Ful na mesa.
Fizemos festas ao Vermelho.
Nunca comi Ful com morangos.
O Tó desenho um Ful bonito.
Conheço doce do Algarve.
Eles disseram muitas vezes.

Os vizinhos brincam com o teu Ful.
Estão sempre a falar-nos do Ful.
Elas viajavam muito de Ful.
Os anões adoram bolachas e Ful.
Quero agradecer tudo ao Ful.
A Dora anda no seu grande Ful.
Procedure: modified version of the Visual Habituation Paradigm (Stager & Werker, 1997; Altvater-Mackensen & Mani, 2013)
## Method Study 1

### Familiarisation
- Alternating trials
- 25 secs accumulated listening time to each

### Test
- Block 1
  - Randomised order
  - Word 1 – familiar end
  - Word 2 – familiar mid
  - Word 3 – novel
  - Word 4 – novel

- Block 2
  - Randomised order
  - Word 1 – familiar end
  - Word 2 – familiar mid
  - Word 3 – novel
  - Word 4 – novel

- Block 3
  - Randomised order
  - Word 1 – familiar end
  - Word 2 – familiar mid
  - Word 3 – novel
  - Word 4 – novel

Trials continue until infant looks away for more than 2 consecutive seconds, or the sound file ends.

Segmentation demonstrated by longer looking times to familiar word forms compared with novel.
Results Study 1

5-6 months:
- Significant effect of item status ($F(2,38) = 13.24, p < .001, \eta^2 = .41$).
  - end and middle ($t(19) = 3.38, p < .01$)
  - end and distracter ($t(19) = 4.72, p < .001$)
  - middle and distracter ($t(19) = .91, p = .37$).

8-9 months:
- Significant effect of item status ($F(2,38) = 16.72, p < .001, \eta^2 = .47$).
  - end and middle ($t(19) = 3.44, p < .01$)
  - end and distracter ($t(19) = 6.71, p < .001$)
  - middle and distracter ($t(19) = 2.12, p < .05$).
Method Study 2

Materials

- Same 4 monosyllabic pseudo words
  - Ful, Queu, Pis, Sau

Procedure similar as for younger age groups
  - Only familiarised with words in middle of sentences
Method Study 2

Materials

- Same 4 monosyllabic pseudo words
  - Ful, Queu, Pis, Sau

Procedure similar as for younger age groups
  - Only familiarised with words in middle of sentences
Results Study 2

- Significant effect of item status - $F(1,18) = 23.6$, $p < .001$, $\eta^2 = .57$

At internal IP edge

Similar behaviour, segmentation wise, to 5-6 month olds at final IP boundaries (=sentence edge)
Results Study 2

- Significant effect of item status - $F(1, 18) = 23.6, p < .001, \eta^2 = .57$
- No significant effect of item status - $F(1, 18) = 1.776, p > .1, \eta^2 = .090$
Conclusions

- EP learning infants at **5-6 months** are able to segment continuous speech **only when the word is located at the high prosodic edge** (IP boundary, the end of the sentence)
  - In line with recent findings for English learning infants, but against those for Spanish/Catalan infants showing segmentation at 6 months regardless of prosody

- At **8-9 months**, EP infants start to segment words in the middle of sentences (lower boundaries), but still demonstrate an advantage for words at the end of sentences
Conclusions

- Portuguese 12-month-old infants are able to segment words in sentence medial position, when target word precedes a IP boundary (despite the absence of a pause).
- This shows a sensitivity to prosody in early segmentation, beyond the edge vs. internal position.
Prosody constrains the emergence and development of early segmentation in EP, in the first year.
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Obrigada!

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