Prosodic structure constrains word segmentation beyond the utterance edge factor

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Recent research has addressed the role of phrasal prosody in early word segmentation, focusing on the contrast between words at the edge and the middle of the utterance.

- An effect of utterance edge as early as 6 months, due to its prosodic saliency (Seidl & Johnson, 2006; Johnson et al., 2014)
- Later segmentation at utterance-internal position (Seidl & Johnson, 2006)

In previous studies, phrasal prosody was not taken into account when testing infant’s segmentation abilities in different languages (e.g., Jusczyk & Aslin, 1995; Jusczyk et al., 1999; Hohle & Weissenborn 2003, 2005; Bosch et al, 2013; Nazzi et al., 2006; Mersad et al., 2010; Nazzi et al., 2014)
This study revisits infant word segmentation beyond the edge factor, looking at the effects of two different utterance-internal prosodic conditions in European Portuguese:

- Target monosylable next to a word boundary > Prosodic Word (PW)
- Target monosylable next to a high phrasal boundary (without a pause) > Intonational Phrase (IP)

Segmentation of monosyllabic words in EP (Butler et al., 2015, submitted)

- Segmentation at utterance-edge > 6 month
- Segmentation in utterance-medial position > improved at 9 month, but still not successful (pseudo-words placed at PW or lower phrase boundary - Phonological Phrase)

Studies with more controlled prosodic phrasing (and no pause cue) are needed.
Introduction

Albeit different, both IP and PW edges are marked by a clear prosodic cues in European Portuguese (unlike in other Romance languages - Vigário, 2003; Frota 2014)

- **PW**: domain of word stress and prominence-related processes, such as vowel reduction; edge-phenomena, like phonotactic constrains, and many other processes (segmental and prominence cues) (Vigário, 2003).

- **IP**: marked with a variety of strong cues: segmental processes, domain of sandhi and resyllabification (similar to other Romance languages), final lengthening and pause, left-edge strengthening, pitch accent distribution, nuclear accent and boundary tone (Frota 2000, 2014)

Cues to prosodic edges may vary across languages, and infants show language-specific sensitivity (e.g., Wellmann et al., 2012)
Method: Participants

- 12 month-old infants from monolingual homes in the Lisbon area tested in two experiments

- **Utterance-medial PW:**
  - 20 infants (11 boys, mean age 12m 10d, range 10m 15d–14m 22d)
  - 3 infants excluded: 2 due to fussiness, 1 experimenter error

- **Utterance-medial IP:**
  - 20 infants (10 boys, mean age 12m 2d, range 10m 24d–13m 19d)
  - 2 infants excluded due to fussiness
Method: Materials

- 4 monosyllabic pseudo words: Ful, Queu, Pis, Sau
- Familiarization materials: 2 passages with 6 sentences each, one for PW edge, another for IP edge (range 11-13 syllables)
- Test materials: 4 isolated word lists
- 4 experimental conditions based on presentation onset in the familiarisation phase: Ful-Pis, Pis-Ful, Queu-Sau, Sau-Queu

As rãs gostam de ☐, em vez de musgo fresco.
Comprado o ☐, voltamos ao parque.
Desde que viu o ☐, não quis brincar mais.
Oferecemos-te ☐, mas ficaste triste.
Quanto à luz ☐, nunca foi testada.
Vocês prendem o ☐, porém ele fugiu.

PW edge > NOT Prominent

IP edge > Prosodically Prominent

A caixa contém ful vermelho na tampa.
Aquele grande ful branco é da Quica.
Comeram muito ful doce na praia.
Hoje vi um ful castanho mas duro.
O amigo do ful português fugiu.
O outro ful branco foi de mercedes.
Acoustic analyses to describe the prosodic cues in the stimuli were performed.
Procedure: modified version of the Visual Habituation Paradigm (Stager & Werker, 1997; Altvater-Mackensen & Mani, 2013)
**Procedure**

**Familiarisation**
- Alternating trials
- 45 secs accumulated listening time to each

**Passage 1 - Exp.1: PW_ Exp.2: IP**
- Word 1 - Familiar PW boundary
- Word 2 - Familiar PW boundary
- Word 3 - Novel PW boundary
- Word 4 - Novel PW boundary

**Passage 2 - Exp.1: PW_ Exp.2: IP**
- Word 1 - Familiar PW boundary
- Word 2 - Familiar PW boundary
- Word 3 - Novel PW boundary
- Word 4 - Novel PW boundary

**Test**
- Block 1
  - Randomised order
  - Word 1 - Familiar PW boundary
  - Word 2 - Familiar PW boundary
  - Word 3 - Novel PW boundary
  - Word 4 - Novel PW boundary

- Block 2
  - Randomised order
  - Word 1 - Familiar PW boundary
  - Word 2 - Familiar PW boundary
  - Word 3 - Novel PW boundary
  - Word 4 - Novel PW boundary

- Block 3
  - Randomised order
  - Word 1 - Familiar PW boundary
  - Word 2 - Familiar PW boundary
  - Word 3 - Novel PW boundary
  - Word 4 - Novel PW boundary

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

**Segmentation demonstrated by longer looking times to familiar word forms compared with novel**
Results

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

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

Similar behaviour, segmentation wise, to 5-6 month olds at final IP boundaries (=sentence edge):
See Butler at al. page 50

At internal IP edge

No!
Plain internal

PW boundary

Familiar
Novel

IP boundary

Familiar
Novel

Mean Looking Time

total_looking_to_familiarized_words
total_looking_to_novel_words

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

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

- Portuguese 12-month-old infants were able to segment words in **utterance-internal** position, when the target word is aligned with an **internal IP boundary** not signaled with a pause, but NOT when it precedes a word level boundary (PW)
  - Clarifies the ability to use other prosodic cues besides the pause, such as pitch and duration cues.
  - In the utterance-edge studies a pause was always involved (Seidl & Johnson, 2006; Johnson et al., 2014)

- Segmentation abilities rely on the location of the word in the **prosodic structure** of the utterance, occurring first when high-level phrasal boundaries are involved.

- This shows a sensitivity to prosody in early segmentation, beyond the edge vs. internal position
More studies addressing the role of phrasal prosody in early word segmentation abilities are needed, in other languages.

Examining early segmentation abilities at utterance-internal IP boundaries, younger infants are being tested in ongoing work.
Obrigada!
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