The emergence of early word segmentation abilities in typically developing infants and infants with Down Syndrome

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

- Segmentation abilities in typically developing infants (TD) have been shown to vary across languages (Mersad et al., 2010), and depend on the context of the word in the utterance (Johnson et al., 2014).

<table>
<thead>
<tr>
<th>Language</th>
<th>Monosyllabic</th>
<th>Edge</th>
<th>Medial</th>
<th>Not Controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>6 month</td>
<td></td>
<td>x</td>
<td>7,5 month</td>
</tr>
<tr>
<td>German</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td>7-9 month</td>
</tr>
<tr>
<td>French</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td>7,5 month</td>
</tr>
<tr>
<td>Spanish</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td>6 month</td>
</tr>
</tbody>
</table>
Introduction

- Position is CRUCIAL due to prosody and its properties, e.g. edge position is especially salient
  - Duration and pitch cues

- Studies on early segmentation abilities of infants with Down Syndrome (DS) are rare
  - Suggested that these abilities are strongly delayed (at least for English, Mason-Apps et al., 2011), but position was not taken into account.
Aims

- Investigate European Portuguese learning infants emerging segmentation abilities in typically developing infants and infants with DS
  - When do segmentation abilities emerge? Do infants with DS show delayed segmentation abilities?
  - Are words at the edge of phrases (next to prosodic boundaries) easier to segment than those in other positions (e.g. middle)?
Method

- **5-6 months:**
  - 20 infants from monolingual homes in the Lisbon area (11 boys, mean age 6m 3d, range 4m 19d – 7m 11d)
  - 2 infants excluded due to fussiness (1), risk of autism (1)

- **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

- **Infants with DS (study in progress):**
  - 6 infants between 7m 25d and 20m 24d. Split into 2 groups, 7-11m and 12m+
    - 7-11m, mean age 9m 20d, range 7m 25d – 11m 6d
    - 12m+, mean age 16m, range 12m 26d – 20m 24d
Method

- Materials: 4 monosyllabic pseudo-words
  - Ful, Queu, Pis, Sau

- Embedded in sentences either in the middle or at the edge

- 2 passages constructed for each word, one for middle and one for edge position


Procedure: modified version of the Visual Habituation Paradigm (Altvater-Mackensen & Mani, 2013)
### Method

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

<table>
<thead>
<tr>
<th>Passage 1 – End</th>
<th>SAU</th>
<th>Word 1 – familiar end</th>
</tr>
</thead>
<tbody>
<tr>
<td>Os vizinhos brincam com o teu SAU</td>
<td>FUL</td>
<td>Word 2 – familiar mid</td>
</tr>
<tr>
<td>Passage 2 – mid</td>
<td>QUEU</td>
<td>Word 3 – novel</td>
</tr>
<tr>
<td>A Marta pôs o seu FUL na mesa</td>
<td>PIS</td>
<td>Word 4 – novel</td>
</tr>
</tbody>
</table>

**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.
A repeated measures ANOVA with the within-subject factor of condition (end, mid, distracter) revealed a significant effect ($F(2,38) = 13.24$, $p < .001$, $\eta^2 = .41$).

Paired T-Tests revealed significant differences between end and middle ($t(19) = 3.38$, $p < .01$) and end and distracter ($t(19) = 4.72$, $p < .001$), but **NOT** between middle and distracter ($t(19) = .91$, $p = .37$).
A repeated measures ANOVA with the within-subject factor of condition (end, mid, distracter) revealed a significant effect ($F(2,38) = 16.72, p < .001, \eta^2 = .47$).

Paired T-Tests revealed significant differences between end and middle ($t(19) = 3.44, p < .01$), end and distracter ($t(19) = 6.71, p < .001$) and middle and distracter ($t(19) = 2.12, p < .05$).
Results - DS

Suggests **End segmentation** (novelty) **Promissing**

Suggests **Mixed behavior**: towards TD pattern
Conclusions

- EP learning infants at 5-6 months are able to segment continuous speech only when the word is located at the **edge** *(prosodic boundary)*
  - In line with recent findings for English learning infants (Johnson, Seidl & Tyler, 2014)

- At 8-9 months, EP infants able to segment words in the middle of sentences, but still demonstrate an **advantage** for words at the edge.
Conclusions

- Preliminary findings with EP learning infants with DS between 7-11 months showed an edge effect, demonstrated by a novelty preference.
- After 12 months, there is a mixed pattern with edge only or edge and middle segmentation, approaching the TD pattern.
- Suggests that DS infants are able to use prosodic cues in early segmentation, similar to TD infants.

Potential impact on early intervention to support language development.
Obrigada!

- P29 |

Horizon21: Early language development in Down Syndrome