When prosody is (not) needed or enough: an eye-tracking study of prosodic disambiguation in European Portuguese
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The role of prosody in speech processing, how it constrains lexical access and syntactic analysis, has been addressed by examining the processing of ambiguous utterances. It has been shown that prosodic boundaries aligned with word boundaries favor lexical selection in word-recognition processes. Moreover, listeners may rely on information related to different types of prosodic boundaries to achieve disambiguity, namely in the case of intonational phrase boundaries (IP), although differences across languages have been found (Wightman et al., 1992; Salverda et al., 2003; Cho et al., 2007; Snedeker & Yuan, 2007; Diley & MacAulley, 2008; Millotte et al., 2008). For European Portuguese (EP), it was shown that prosody guided the resolution of temporary ambiguous sentences by adults (Frota et al, 2010; Severino, 2011). However, different tasks presented different results, showing that online tasks were more sensitive to prosodic boundaries in word-level disambiguation, and offline tasks showed higher sensitivity to boundaries in phrase-level disambiguation. Task type effects were also reported in studies involving relative clause attachment. Maia et al. (2004, 2007) describe a preference for high attachment in Portuguese with an offline task, showing more errors when material forced low attachment, but an initial advantage for low attachment in online tasks, with longer reaction times when materials forced high attachment. However, in the latter studies prosody was not fully controlled.

To better understand the role prosody plays in the resolution of lexical and phrasal ambiguity, we used eye-tracking to measure gaze direction and fixation to relevant Areas of Interest (AoI). Pairs of ambiguous sentences were created for two conditions, which differed on type of prosodic boundary only: No Boundary vs. Prosodic Word (NBound/PW) and Phonological Phrase vs. Intonational Phrase (PhP/IP – see (1)). Acoustic measures and intonational analysis confirmed that the test items showed the expected contrasting prosodic cues according to the language (Table 1; Frota 2014). Each of the sentences was associated to a meaning-related image (images were previously validated in a pilot test). During a test trial, images for each sentence pair were first presented side by side, then subjects listened to the ambiguous sentence, and finally the images reappeared on screen (Fig.1). The experiment included 8 test trials and 8 matched control trials (i.e. unambiguous sentences), pseudo-randomly presented. Twenty adult subjects were tested.

Subjects’ gaze behavior was as expected in controls, showing that they understood the task (Fig.2). The NBound/PW condition revealed a difference in gaze pattern consistent with a prosodic disambiguation effect (in the 500-800ms window), indicating that EP subjects are sensitive to prosodic boundary cues and use them in speech processing (Fig.3). However, the PhP/IP condition showed no gaze difference, a pattern consistent with a strong high attachment preference, even in the absence of any phrasal prosodic boundary cues that would trigger the high-attachment (IP-level) interpretation (Fig.4). Contra previous suggestions (Vigário 2003), the PhP boundary did not favor an ambiguous interpretation which fades away in the presence of an IP boundary, nor did a low attachment preference emerged in an online task.

In a following-up study, phrasal level ambiguity will be tested in a prosodic condition that militates against the default high-attachment preference (as in 2), further examining the weigh of prosody and high-attachment as a default processing strategy in European Portuguese.
(1) a. No boundary: O Tito levou uma pisadela.
   (Someone stepped on Tito.)
   PW boundary: O Tito levou uma pizza\textsubscript{PW dela}.
   (Tito took one of her pizzas.)

   a’ control: O Tito levou uma borboleta.
   (Tito took a butterfly.)

b. PhP boundary: O Tito anda de baloiço\textsubscript{PhP} e escorrega.
   (Tito played on the swing set and on the slide.)

   IP boundary: O Tito anda de baloiço\textsubscript{IP} e escorrega.
   (Tito played on the swing set and fell.)

   b’ control: O Tito anda the baloiço no recreio.
   (Tito played on the swing set in the playground.)

(2) c. O Tito anda\textsubscript{IP} de baloiço e escorrega.
   (Tito played on the swing set and on the slide.)

Table 1

<table>
<thead>
<tr>
<th>Tonal Events</th>
<th>Duration</th>
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<tbody>
<tr>
<td></td>
<td>Stressed Syllable</td>
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<tr>
<td>No Boundary</td>
<td>___</td>
</tr>
<tr>
<td>PW</td>
<td>H+L*</td>
</tr>
<tr>
<td>PhP</td>
<td>___</td>
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<tr>
<td>IP</td>
<td>H+L* L%</td>
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Fig. 1. Experimental Design

Baseline (3s) (image presentation) | OIba’ (Look!) |
Sound Presentation (2s) (sound offset aligned with picture offset) | O Tito levou uma pizza\textsubscript{PW dela}, (Tito took one of her pizzas) |
Test (3s) | No sound |

Fig. 2. Proportion of Looks for control. Dotted line signals target picture.
Fig. 3. Proportion of Looks for NBound/PW. NBound condition on the left. PW condition on the right. Dotted line signal target picture.

Fig. 4. Proportion of Looks for PhP/IP. PhP condition on the left. IP condition on the right. Dotted line signal target picture.

Selected References