Eye-movement evidence in the reading of [RC to NP of NP] structures in EP and BP: do number and gender go in the same direction?

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“The problem of relative clauses with complex NPs”

(Background)

In a sentence like (1), below, the relative clause (RC) can be interpreted as modifying one of the nouns of the complex NP: N1(accomplice) or N2(thief)

(1) A man recognized the accomplice of the thief that escaped after the robbery.

\[
\begin{array}{c}
N1 \\ P \\ N2 \\
\end{array}
\]

Investigations in the area of sentence processing provided clues that the preferred interpretation could vary among languages.

The relevant question:
What is the reason for the differences found among languages?
Kimball (1973): proposed a parser that builds the surface structure based on a set of interconnected principles surveyed in the English language. Suggests an extension of his model to other languages.

Frazier & Fodor (1978): maintain a universal parser outlook, but suggest changes in Kimball’s proposal. The principles are simplified down to a basic formulation that forbids postulating potentially unnecessary knots (*minimal attachment*). Frazier (1979) includes the late closure principle to the model (as soon as possible the constituents are attached to the lowest knot in construction) *Minimal Attachment* and *Late Closure* are considered basic strategies deployed in the parser’s operational routines. The model is known as the Garden Path Theory.

The N1-P-N2-RC structure, as in (1), is analyzed on the basis of the late closure principle. In the face of an ambiguity like that *the RC would be preferentially attached to N2 (the thief)*.
Cuetos & Mitchell (1988): raised doubts about the proposal of a universal parser, presenting data that indicated that the Late Closure Principle did not hold in Spanish. In this language, data pointed to a preference towards another strategy (early closure): the RC attachment to N1 (the accomplice) rather than to N2 (the thief).

Since then, different proposals have been advanced to explain these differences, and they fall into two main categories: those that maintain the outlook of a universal parser whose operations are internally determined (Frazier & Clifton Jr, 1996; Fodor, 1998, among many others), and those that consider that the parser’s operational routines are essentially guided by parametric properties of grammar (e.g., Cuetos & Mitchell, 1988; Gibson et al., 1996, among many others).
Construal
(Frazier & Clifton, 1996)

• Late Closure would only apply to primary phrases (subjects, predicates, complements). Adjuncts and conjuncts are non-primary and must be associated to the current thematic domain and then interpreted. If N1 and N2 fall within the same theta domain, discourse-based principles determine that the parser should “preferentially construe a phrase as being relevant to the main assertion of the current sentence”. Relative Clauses should, therefore, be associated with N1.

• English can override Relativized Relevance because, as predicted by Grice’s Clarity principle, unambiguous constructions should be used whenever possible. English has both saxon and norman genitives and only the saxon variant unambiguously expresses high attachment. If speakers resort to the norman genitive, modification to the low noun is intended.

• Brazilian Portuguese has no alternative form to convey unambiguous attachment to the high noun and Relativized Relevance prevails, determining high attachment.

• Um homem reconheceu o cúmplice do ladrão [que fugiu depois do assalto ao banco].

• “A man recognized the accomplice of the thief [who ran away after the bank robbery].”
Attachment/binding dualism
(Hemforth et al., 1998)

• There is competition between structural attachment and anaphoric binding of the relative pronoun, which is in an anaphoric relation to the head noun.

• Structural attachment favors low attachment of the RC (syntactic recency). Anaphoric binding favors high attachment of RC because the higher noun is the more salient of the two possible hosts. Optionality of relative pronoun or complementizer reduces the reliance on anaphoric processes, allowing syntactic recency to prevail.

• English has optional relative pronoun/complementizer, relative pronoun does not agree with N1, therefore anaphoric binding is not reliable and recency prevails, determining low attachment of RC.

• Brazilian Portuguese has obligatory complementizers allowing syntactic recency to be overridden by anaphoric processes, determining high attachment of RC.

• The thief [ that the police arrested] The thief [ ___ the police arrested]
• O ladrão [ que a polícia prendeu] * O ladrão [ ___ a polícia prendeu]
Predicate Proximity
(Gibson et al., 1996)

• There is competition between recency and parameterized Pred Prox principle:

• **Recency preference**: Preferentially attach structures for incoming lexical items to structures built more recently. (Gibson et al., p. 26)

• **Predicate proximity**: Attach as close as possible to the head of a predicate phrase. (Gibson et al., p. 41)

• In languages which allow arguments to occur after the verb in a non-adjacent position, the verb has to be activated more strongly so that enough activation is available when the non-adjacent argument is processed. Greater activation of the verb would lead to a stronger predicate proximity requirement, and hence, a stronger high attachment preference.

• Myamoto’s assumption is that BP has rigid SVO word order, allowing no ADV between V and Object

O aluno fez cuidadosamente o trabalho.
“The student did carefully the work”
Implicit Prosody Hypothesis
(Fodor 1998, 2002)

• “In silent reading, a default prosodic contour is projected onto the stimulus, and it may influence syntactic ambiguity resolution. Other things being equal, the parser favors the syntactic analysis associated with the most natural (default) prosodic contour for the construction”

• There is evidence that the distribution of prosodic breaks is influenced by length of constituents as well as by syntactic structure (Selkirk, 2000). For BP, Sandalo & Truckenbrodt (2002) also proposes that prosodic phrasing favors balanced structures in which sister constituents tend to display similar weight. Grammars include syntax-prosody alignment rules, which determine where prosodic breaks occur. If prosodic rules create a break after N1, low attachment is preferred; if break is after N2, high attachment is preferred.

  low  high

• Um homem reconheceu o cúmplice / do ladrão / que fugiu depois do assalto ao banco.
  “A man recognized the accomplice of the thief who ran away after the bank robbery.”
Theoretical and methodological questions about RCs emerged in a series of studies also in PB and PE

- Miyamoto (1999, 2005)
- Maia & Maia (1999, 2001)
- Mendes, Maia & Gomes (2010)
- Soares, Fraga, Comesãna & Piñeiro (2010)
- Lourenço-Gomes, Costa & Maia (2011)
- Lourenço-Gomes & Lindemann (2012)
- Grilo & Costa (2012)
- Fernandes (2012)
- Grillo, Tomaz, Lourenço-Gomes & Santi (to appear)
- Tomaz (ongoing Master Dissertation)
The present study
(Introduction)

• Eye-movements of European Portuguese (EP) and Brazilian Portuguese (BP) readers were monitored in four experiments to examine the influence of grammatical gender and number information on restrictive relative clauses (RCs) attachment.

• In the structure under examination, the two nouns of the complex noun phrase (NP) object of the matrix clause are candidates to the RC attachment, as below:

Someone shot the servant of the actress who was on the balcony

NP1    P    NP2    RC

high attachment

low attachment
In most self-paced studies in Portuguese the relative pronoun is followed by the auxiliary verb *estar* (to be) as to agree in number (*estava/estavam* - was/were) with one of the nouns of the complex NP and disambiguate the sentence (e.g., Ribeiro 2001; Maia et al. 2007).

In other studies, alternatively, the auxiliary verb was followed by a nominal form of a participle verb that in Portuguese can agree in number and/or gender to disambiguate the sentence (e.g., Lourenço-Gomes, 2008; Ribeiro & Teixeira 2011; Lourenço-Gomes, Costa & Maia 2011; Lourenço-Gomes & Lindemann, 2012).

Thus, conflicting results observed in these studies could not be reliably compared since number information is encountered first (at the auxiliary verb), while gender information appears later (in a participle after the auxiliary verb).

In the present study, we employ similar unambiguous constructions, but repositioning this participle form after the relative pronoun, allowing us to manipulate number and gender in the same region of the sentence.
Method

- **Participants**
  48 undergrad students from the University of Lisbon (Portugal) and 48 from the Federal University of Rio de Janeiro (Brazil) participated in the study.

- **Materials**
  24 experimental items and 48 fillers were created.

Experimental items were selected after a pre-test: all sentences on their ambiguous masculine singular form were presented to 20 native-spakers of EP and 20 of BP which had to evaluate the acceptability of each sentence on a five-point scale (1- “totally not acceptable” and 5 . “completely acceptable”).

The experimental items were modified to undo the ambiguity through number/gender agreement using the complete agreement paradigm between one of the nouns of the complex NP and the RC verb, four conditions being created.
**Experimental conditions**

- **Gender experiment**
  
  Forced High Attachment  
  MFM: A Carla criticou o herdeiro da empresária que, abalado, conduzia distraidamente.  
  FMF: A Carla criticou a herdeira do empresário que, abalada, conduzia distraidamente.

  Forced Low Attachment  
  MFF: A Carla criticou o herdeiro da empresária que, abalada, conduzia distraidamente.  
  FMM: A Carla criticou a herdeira do empresário que, abalado, conduzia distraidamente.

- **Number experiment**
  
  Forced High Attachment  
  SPS: A Carla criticou o herdeiro dos empresários que, abalado, conduzia distraidamente.  
  PSP: A Carla criticou os herdeiros do empresário que, abalados, conduziam distraidamente.

  Forced Low Attachment  
  SPP: A Carla criticou o herdeiro dos empresários que, abalados, conduziam distraidamente.  
  PSS: A Carla criticou os herdeiros do empresário que, abalado, conduzia distraidamente.
• **Procedure**

The experimental sentences were distributed in versions in a Latin Square Design. Sentences were presented on the middle center of the screen, on Courier New, 24, in just one line of text.

All items were followed by a comprehension question with two alternative answers, but in the experimental items this question surveyed the understanding about the RC attachment to N1 or to N2:

<table>
<thead>
<tr>
<th>Gender Experiment</th>
<th>Number Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quem conduzia?</td>
<td>Quem conduzia?</td>
</tr>
<tr>
<td>o herdeiro</td>
<td>o herdeiro</td>
</tr>
<tr>
<td>a empresária</td>
<td>os empresários</td>
</tr>
</tbody>
</table>

European Portuguese participants had to choose the right answer with a mouse click, while Brazilian participants had to fixate the correct answer for three seconds and press the space bar afterwards.

Participants had to fixate a red rectangle on the top right corner of the screen, for 500ms, before the stimulus was presented, and the down left corner, for 250ms, after reading the sentence.

Each session took no longer than 45 minutes.
Method

• **Apparatus**
  An SMI IVIEW X™ HI-SPEED, at a 500Hz speed, was used for the experiments in EP. The mean accuracy error of each participant was never greater than 0,5º visual angle.

  In PB was used a Tobii TX300, at a register rate of 300Hz.

• **Analyses**
  For each sentence, different areas of interest (AOIs) were created.

  Areas of interest:

  A Carla criticou o herdeiro da empresária que, abalado, conduzia distraídentemente.

  Subject  Verb  N1  N2  Critical  Post-crit  Final

  “N1”, “N2”, “Critical” and “Post-critical” were analyzed.

  For each of these areas, to compare EP with BP, only the Total Time Fixation Duration was calculated, since Tobii software does not allow the extraction of any other dependent measure.

  For EP, we also analyzed the First-Pass Reading Time for the Critical and the Post-critical regions and also the Second-Pass Reading Time for the four selected AOIs.
Results
Off-line tasks

Figure 1 - Percentage of Correct answers on the off-line questionnaire in the Gender and in the Number experiments both in Brazilian Portuguese (BP) and in European Portuguese (EP)
Total Fixation Duration in Critical Region: Gender

**European Portuguese**

<table>
<thead>
<tr>
<th>Gender</th>
<th>FMF</th>
<th>MFM</th>
<th>MFF</th>
<th>FMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical</td>
<td>996</td>
<td>898</td>
<td>1058</td>
<td>1089</td>
</tr>
<tr>
<td>SD</td>
<td>(328)</td>
<td>(299)</td>
<td>(431)</td>
<td>(479)</td>
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</table>

**Brazilian Portuguese**

<table>
<thead>
<tr>
<th>Gender</th>
<th>FMF</th>
<th>MFM</th>
<th>MFF</th>
<th>FMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical</td>
<td>1219</td>
<td>1233</td>
<td>1462</td>
<td>1363</td>
</tr>
<tr>
<td>SD</td>
<td>(532)</td>
<td>(548)</td>
<td>(802)</td>
<td>(766)</td>
</tr>
</tbody>
</table>

**Analysis**

- **European Portuguese**
  - Attachment: $F(1, 23) = 5.178; p = 0.052$, M = 9477 (SD = 30) vs. M = 1073 (SD = 44)
  - Gender: $F(1, 23) = 2.253; p = 0.028$, M = 1195 (SD = 30) vs. M = 1268 (SD = 44)
  - Interaction: $F(1, 23) = 0.973; p = 0.029$, M = 1129 (SD = 30) vs. M = 1229 (SD = 44)

- **Brazilian Portuguese**
  - Attachment: $F(1, 23) = 3.177; p = 0.033$, M = 1277 (SD = 103) vs. M = 1413 (SD = 154)
  - Gender: $F(1, 23) = 0.620; p = 0.439$, M = 1228 (SD = 49) vs. M = 1413 (SD = 57)
  - Interaction: $F(1, 23) = 0.871; p = 0.360$, M = 1233 (SD = 49) vs. M = 1413 (SD = 57)
Total Fixation Duration in PostCritical Region: Gender

### European Portuguese

**Gender**

- **- POST-CRITICAL -**
  - FMF
  - MFM
  - MFF
  - FMM

**Mean**
- 645 (237)
- 604 (259)
- 620 (277)
- 712 (344)

**Brazilian Portuguese**

**Gender**

- **- POST-CRITICAL -**
  - FMF
  - MFM
  - MFF
  - FMM

**Mean**
- 796 (414)
- 847 (441)
- 956 (567)
- 1013 (748)

**Table**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Post-critical (TFD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FMF</td>
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<tr>
<td>European</td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>SD</td>
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<tr>
<td>Brazilian</td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>SD</td>
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</table>

**Interaction:** lower reading times on Masculine High Attachment and on Feminine Low Attachment.
**Total Fixation Duration in Critical Region: Number**

<table>
<thead>
<tr>
<th></th>
<th>European Portuguese</th>
<th></th>
<th>Brazilian Portuguese</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>SPS</td>
<td>PSP</td>
<td>PSS</td>
</tr>
<tr>
<td></td>
<td>Critical (TFD)</td>
<td>SPS</td>
<td>PSP</td>
<td>PSS</td>
</tr>
<tr>
<td>Mean</td>
<td>926</td>
<td>909</td>
<td>1032</td>
<td>1028</td>
</tr>
<tr>
<td>SD</td>
<td>(482)</td>
<td>(429)</td>
<td>(767)</td>
<td>(587)</td>
</tr>
<tr>
<td>Mean</td>
<td>1263</td>
<td>1285</td>
<td>1121</td>
<td>1133</td>
</tr>
<tr>
<td>SD</td>
<td>(495)</td>
<td>(398)</td>
<td>(405)</td>
<td>(413)</td>
</tr>
</tbody>
</table>

**European Portuguese**

- Attachment
  - F1(1,23) = 3,394; p = 0.078
  - F2(1,23) = 2,860; p = 0.104

- Number
  - F1(1,23) = 0.090; p = 0.767
  - F2(1,23) = 0.065; p = 0.802

- Interaction
  - F1(1,23) = 0.037; p = 0.850
  - F2(1,23) = 0.007; p = 0.933

**Brazilian Portuguese**

- Attachment
  - F1(1,23) = 3,550; p = 0.072
  - F2(1,23) = 3,777; p = 0.064

- Number
  - F1(1,23) = 0.090; p = 0.767
  - F2(1,23) = 0.065; p = 0.802

- Interaction
  - F1(1,23) = 0.005; p = 0.942
  - F2(1,23) = 0.006; p = 0.939

**Notes:**

- **Interaction:** lower reading times on Masculine High Attachment and on Feminine Low Attachment.
Total Fixation Duration in PostCritical Region: Number

**European Portuguese**

<table>
<thead>
<tr>
<th>Attachment</th>
<th>Post-critical (TFD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>SPS</td>
</tr>
<tr>
<td>F1(1,23)= 10.683; p=0.002</td>
<td>M=584 (SD=26) vs. M=650 (SD=46)</td>
</tr>
<tr>
<td>F2(1,23)= 8.596; p=0.002</td>
<td>M=584 (SD=17) vs. M=650 (SD=19)</td>
</tr>
<tr>
<td>Interaction</td>
<td>F1(1,23)= 1.287; p=0.268</td>
</tr>
</tbody>
</table>

**Brazilian Portuguese**

<table>
<thead>
<tr>
<th>Attachment</th>
<th>Post-critical (TFD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>SPS</td>
</tr>
<tr>
<td>F1(1,23)= 0.026; p=0.873</td>
<td></td>
</tr>
<tr>
<td>F2(1,23)= 0.011; p=0.919</td>
<td></td>
</tr>
<tr>
<td>Interaction</td>
<td>F1(1,23)= 3.504; p=0.074</td>
</tr>
</tbody>
</table>

**Interaction:** lower reading times on Singular Low Attachment and on Plural High Attachment.

**Mean and SD**

<table>
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<tr>
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<th>PSP</th>
<th>PSS</th>
<th>SPP</th>
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<tr>
<td>European</td>
<td>595</td>
<td>573</td>
<td>627</td>
<td>673</td>
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<tr>
<td>Portuguese</td>
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<td></td>
</tr>
<tr>
<td>SD</td>
<td>(192)</td>
<td>(196)</td>
<td>(282)</td>
<td>(254)</td>
</tr>
<tr>
<td>Brazilian</td>
<td>816</td>
<td>718</td>
<td>663</td>
<td>750</td>
</tr>
<tr>
<td>Portuguese</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>(402)</td>
<td>(268)</td>
<td>(234)</td>
<td>(235)</td>
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**European Portuguese**

<table>
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<tr>
<th></th>
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<td>750</td>
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</tr>
<tr>
<td>SD</td>
<td>(402)</td>
<td>(268)</td>
<td>(234)</td>
<td>(235)</td>
</tr>
</tbody>
</table>
Total Fixation Duration in N1 Region: Gender

**European Portuguese**
- Gender
  - Attachment: 
    - F(1, 23) = 0.983; p = 0.332
    - F(2, 123) = 1.151; p = 0.294
  - Gender: 
    - F(1, 23) = 0.001; p = 0.971
    - F(2, 123) = 0.001; p = 0.981
  - Interaction: 
    - F(1, 23) = 2.228; p = 0.149
    - F(2, 123) = 2.674; p = 0.116

**Brazilian Portuguese**
- Gender
  - Attachment: 
    - F(1, 23) = 0.027; p = 0.871
    - F(2, 123) = 0.010; p = 0.923
  - Gender: 
    - F(1, 23) = 0.063; p = 0.805
    - F(2, 123) = 0.015; p = 0.909
  - Interaction: 
    - F(1, 23) = 1.658; p = 0.211
    - F(2, 123) = 0.911; p = 0.350
Total Fixation Duration in N1 Region: Number

European Portuguese
Number
- N1 -
(TFD)

Brazilian Portuguese
Number
- N1 -
(TFD)

European Portuguese
Attachment
F1(1,23)=2,422; p=0,133
F2(1,23)=1,123; p=0,300

Number
F1(1,23)=0,008; p=0,928
F2(1,23)=0,001; p=0,973

Interaction
F1(1,23)=0,557; p=0,463
F2(1,23)=0,181; p=0,674

Brazilian Portuguese
Attachment
F1(1,23)=0,412; p=0,527
F2(1,23)=0,146; p=0,706

Number
F1(1,23)=1,982; p=0,173
F2(1,23)=0,652; p=0,428

Interaction
F1(1,23)=0,157; p=0,695
F2(1,23)=0,064; p=0,803
Total Fixation Duration in N2 Region: Gender

**European Portuguese**

- Gender:
  - M = 1282 (SD = 115) vs. M = 1171 (SD = 90)
  - F1(1,23) = 6.609; p = 0.011
  - F2(1,23) = 4.549; p = 0.044

**Brazilian Portuguese**

- Gender:
  - M = 1361 (SD = 151) vs. M = 1559 (SD = 61)
  - F1(1,23) = 6.479; p = 0.013
  - F2(1,23) = 4.174; p = 0.053

**Interaction**

- European Portuguese:
  - F1(1,23) = 2.576; p = 0.122
  - F2(1,23) = 0.963; p = 0.337

- Brazilian Portuguese:
  - F1(1,23) = 14.312; p = 0.001
  - F2(1,23) = 12.089; p = 0.002

**Interaction**: lower reading times on Feminine High Attachment (1181) and on Masculine Low Attachment (1408).
EP x BP

EP vs. BP
Attachment
El(1,46)=12.081; p<0.001
M=1266 (SD=50) vs. M=1421 (SD=44)
E(1,46)=7.893; p=0.001
M=1266 (SD=35) vs. M=1421 (SD=44)

Attachment*Gender
El(1,46)=16.882; p<0.001
E(1,46)=11.311; p=0.003

6. Ligação * Género

<table>
<thead>
<tr>
<th>Ligação</th>
<th>Género</th>
<th>Mean</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1157.521</td>
<td>74.662</td>
<td>1007.236</td>
<td>1307.807</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1374.188</td>
<td>94.188</td>
<td>1184.598</td>
<td>1563.777</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1509.188</td>
<td>103.899</td>
<td>1300.049</td>
<td>1718.326</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1332.003</td>
<td>95.578</td>
<td>1139.611</td>
<td>1524.389</td>
</tr>
</tbody>
</table>

Ligação 1 = High Attachment / Ligação 2 = Low Attachment
Género 1 = Feminine / Género 2 = Masculine

Attachment*Gender*Variety
El(1,46)=7.862; p=0.003
E(1,46)=5.497; p<0.002

7. Variedade * Ligação * Género

<table>
<thead>
<tr>
<th>Variedade</th>
<th>Ligação</th>
<th>Género</th>
<th>Mean</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
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<tr>
<td>European Portuguese</td>
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<td>1</td>
<td>1134.042</td>
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<td>133.201</td>
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<tr>
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<td>1</td>
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<td>146.936</td>
<td>1012.192</td>
<td>1603.724</td>
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<tr>
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<td>135.168</td>
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<td>1528.204</td>
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<tr>
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<td>1407.875</td>
<td>135.168</td>
<td>1135.796</td>
<td>1679.954</td>
</tr>
</tbody>
</table>

Ligação 1 = High Attachment / Ligação 2 = Low Attachment
Género 1 = Feminine / Género 2 = Masculine
Variety
E(1,46)=16.688; p<0.001
M=1226 (SD=40) vs. M=1460 (SD=41)
Total Fixation Duration in N2 Region: Number

**European Portuguese**

- Attachment
  - $F(1,23)=3.370; p=0.079$
  - $F(1,23)=13.078; p=0.001$
- Number
  - $F(1,23)=2.170; p=0.154$
  - $F(2,123)=0.334; p=0.569$
- Interaction
  - $F(1,23)=3.534; p=0.073$
  - $F(2,123)=1.496; p=0.234$

**Brazilian Portuguese**

- Attachment
  - $F(1,23)=6.939; p=0.013$
  - $M=1108 (SD=37)\ vs. M=1307 (SD=47)$
- Number
  - $F(1,23)=2.051; p=0.166$
  - $F(2,123)=0.298; p=0.590$
- Interaction
  - $F(1,23)=7.169; p=0.013$
  - $F(2,123)=1.751; p=0.199$

**Interaction:** lower reading times on Plural High Attachment (1270) and on Singular Low Attachment (1339).
### EP vs. BP

**Attachment**

- $E(1, 46) = 7.613; \ p = 0.006$  
- $E(2, 46) = 9.626; \ p = 0.003$

- $M = 1211 \ (SD = 79) \ vs. \ M = 1375 \ (SD = 100)$
- $M = 1211 \ (SD = 40) \ vs. \ M = 1375 \ (SD = 39)$

**Attachment * Number**

- $E(1, 46) = 9.981; \ p = 0.002$
- $E(2, 46) = 3.249; \ p = 0.078$

### 6. Ligação * Número

<table>
<thead>
<tr>
<th>Ligação</th>
<th>Número</th>
<th>Mean</th>
<th>Std. Error</th>
<th>95% Confidence Interval</th>
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</tbody>
</table>

**Variety**

- $E(1, 46) = 9.443; \ p = 0.004$

- $M = 1207 \ (SD = 39) \ vs. \ M = 1379 \ (SD = 39)$
So, do gender and number go in the same direction?

What did we learn from the present experiment, in a nutshell?

1. In off-line measures, percentages of incorrect answers are overall higher in low attachment conditions than in high attachment conditions both in Number and Gender agreement disambiguation in EP and BP.

2. In on-line measures:
   
   2.1. In critical regions, there are significant differences in favor of high attachment both in BP (F1 & F2) and in EP (F2) only for Gender;
   
   2.2. In postcritical regions, there are significant differences in favor of high attachment in Gender disambiguation only for BP and significant differences in favor of high attachment in Number disambiguation only for EP.
   
   2.3. In the N1 region, there is no evidence for attachment preference in both EP and BP in Gender or Number disambiguation.
   
   2.4. In the N2 region, there is evidence in favor of high attachment both in BP (F1 & F2) and in EP (F1 & F2) in Gender disambiguation. In Number disambiguation, evidence for high attachment is not so clearly established in both varieties: BP (F1) and EP (F2).
Stronger Evidence for High Attachment in Gender than in Number Agreement

<table>
<thead>
<tr>
<th>Measure/Type of AGR</th>
<th>GENDER</th>
<th>NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EP</td>
<td>BP</td>
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<tr>
<td>Final questions</td>
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<td>High F2</td>
<td>High F1 &amp; F2</td>
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<td>TFD Postcritical</td>
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<td>High F1 &amp; F2</td>
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<tr>
<td>TFD N1</td>
<td>------</td>
<td>--------</td>
</tr>
<tr>
<td>TFD N2</td>
<td>High F1 &amp; F2</td>
<td>High F1 &amp; F2</td>
</tr>
</tbody>
</table>
Assumptions for next steps...

1. Gender has been generally analyzed as a more lexical feature of the stem than number which is analyzed as a morphosyntactic feature that combines with the root it modifies. (Ritter, 1988; Harris, 1991; Barber & Carreiras, 2005).

2. Low attachment has been analyzed as more structural than high attachment, which would reflect influence of nonstructural factors.

3. If Gender Agreement indeed tends to facilitate high attachment more than Number Agreement, Late Closure which is a structurally sensitive principle should be preferably instantiated on the basis of Number, but not Gender agreement computation.

4. Based on these assumptions we plan:
   1. Replicate the BP eyetracking experiment in an equipment (Eyelink 1000) more comparable with the equipment used in the EP experiment (SMI 1000).
   2. Manipulate previous context to assess its influence in Number and Gender AGR
   3. Develop experiments based on the EEG technique
References


We wish to thank

The participating subjects

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Laboratório de Psicolinguística da Faculdade de Letras da UL (FLUL).

Laboratório de Psicologia Experimental (LAPEX-UFRJ)
Thank you!!