Locality and attachment preferences in preverbal versus post-verbal Relative Clauses

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ABSTRACT

The universality of locality is a long-standing debate that has endured in psycholinguistics in spite of the challenges. The non-local preference of attachment in Relative Clauses (RCs) with double antecedent (DP1-of-DP2-RC) reported in a subset of languages (i.e. Spanish) represented an important challenge that locality-based accounts had to address. The forces responsible for attachment preferences turned out to be multifactorial, with relevant roles for prosody, referentiality, lexical semantics and Pseudo-Relative availability. In the present eye-tracking study, we explore the timing of disambiguation in Spanish DP1-of-DP2-RC structures placed in preverbal and post-verbal positions, while also controlling for the previously mentioned influencing factors. Our results are straightforward: an early processing cost arises when the RC is disambiguated non-locally, irrespective of the position. The implications of this work contribute to a better understanding of parsing processes and suggest that locality is at the centre of the forces that influence RC attachment.

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1. Introduction

In psycholinguistics, the assumption that longer dependencies lead to increased parsing difficulty corresponds to a linguistic universal known as locality. The responsible for parsing difficulties in more distant sentential material is the pressure on working memory, explained by the difficulty to reactivate more distant material (Gibson, 1998, 2000) and the interference effects of the separation of two dependencies by an intervening element with similar features (Grillo, 2008, 2009; Rizzi, 2004). Several accounts from the last century (Frazier, 1979; Kimball, 1973), but also somewhat more recent (Gibson, 2000; Lewis & Vasishth, 2005), included locality as a fundamental component of parsing. However, studies on this research line have reported evidence in favour of and also against locality effects.

In the context of ambiguity resolution of Relative Clauses (RCs) with double antecedent [DP1 of DP2-RC], locality-based accounts predict local attachment to the second DP (i.e. the actress in example 1a) also called low attachment (LA) because of its structural position in the syntactic tree. On the other hand, high attachment (HA), represented in (1b), links the embedded verb to the first and more distant DP (i.e. the servant). This dependency is predicted to be more costly not only because of the increased distance but also because of the intervention of the second DP the actress.

(1) a. Someone shot [the servant1 [of [the actress2 [that was2 on the balcony.]]]]
   b. Someone shot [[the servant1 [of the actress2 [that was1 on the balcony.]]]

Cross-linguistic variation in attachment preferences was firstly observed between languages, Spanish being the first language shown to prefer non-local attachment, in contrast to English which displayed the expected local preference (Cuetos & Mitchell, 1988). The HA preference was later replicated and extended to other languages, creating a subset of so-called HA languages (e.g. French, Italian, Greek and Dutch, among others) and another subset of LA languages (including English, Basque, Romanian and Chinese, among others). The exception to locality was restricted to an (initially apparent) arbitrary subset of languages, in a well-defined and
narrow environment (principally, subject-extracted RCs placed in the post-verbal position headed by a complementiser/relativiser).

Extensive research on this topic showed that attachment preferences fluctuate depending on the properties of the linguistic materials such as lexical semantics (Rohde et al., 2011), prosody (Fodor, 1998, 2002), referentiality (Gilboy et al., 1995), information structure (Hemforth et al., 2015), and the latest development, selective PR-availability (Grillo & Costa, 2014). We will now briefly focus on the later approach. Grillo (2012) and Grillo and Costa (2014) pointed out the double ambiguity existing in some languages when testing RC attachment. Some languages’ grammar (including Spanish and most of the languages reported to prefer HA) allows a structure called Pseudo-Relative Small Clauses (PRs) which denotes direct perception of events and looks like RCs on the surface but not at the semantic, syntactic and prosodic levels. In this subset of languages, apart from the ambiguity of HA vs. LA, there is yet another level of structural ambiguity between an RC vs. a PR reading which, following Grillo and colleagues, should be resolved in favour of PRs (when the relevant factors such as prosody, lexical semantics or referentiality are controlled for), because of PRs syntactic, semantic and pragmatic properties (the so-called PR-first Hypothesis). Due to structural restrictions, given that PRs are complements of the verb, the only possible outcome under a PR parse looks like an HA interpretation, that is, attachment to the first DP (which is the subject of the embedded predicate).

PR-availability has been reported to modulate RC attachment in the following PR-languages: Italian (Grillo & Costa, 2014), Portuguese (Fernandes, 2021; Tomaz et al., 2014), Greek (Grillo & Spathas, 2014), French (Pozniak et al., 2019) and Spanish (Alguar et al., 2021; Aguilar & Grillo, 2021; Branco-Moreno, 2014, but see Alonso-Pascua, 2020). Most of this work is offline and builds on PR-restrictions on matrix verb type to create PR-compatible contexts (with perceptual verbs) and PR-incompatible contexts (with non-perceptual verbs).

Focusing on the results in Spanish, Aguilar et al.’s (2021) eye-tracking study reported an early preference for LA in exclusive RC environments (i.e. PR-incompatible) and an HA preference in ambiguous PR/RC contexts. The LA preference emerged early at first fixation duration and gaze duration, but disappeared in later measures (total times, regression path duration). The same materials tested in a fully ambiguous format in an offline questionnaire delivered an overall preference to attach high. Therefore, the online preference for RCs to attach low does not show up offline. The authors argued that the online effects of locality were eventually overridden by other factors, in particular the length of the RCs.

However, other experiments found that offline preferences were modulated by PR-availability. Aguilar and Grillo (2021) and Branco-Moreno (2014) reported HA preference in PR-compatible contexts, but LA in exclusive RCs.

Branco-Moreno (2014) further tested whether the preverbal or post-verbal position of the RC would affect attachment. The results showed a higher preference for HA in the preverbal position (54.7%) in comparison to the post-verbal position (46.1%). Branco-Moreno (2014) argued that the results could be explained by different prosodic properties (in terms of prominence) between both positions, or perhaps by pragmatic factors, given that the materials of the study were not matched by plausibility. The opposite pattern of results was reported by Hemforth et al. (2015). Hemforth and colleagues suggested that focus properties associated to subject and object syntactic positions in Spanish play a role in attachment preferences. Preverbal subjects in Spanish are topics (i.e. old/given information) and topic/nonfocused phrases resist modification, whereas focused phrases attract it. Hemforth et al. (2015) ran an offline questionnaire with long and short RCs placed in preverbal and post-verbal positions. They observed that the effect of length on attachment was modulated by position, as LA was preferred in preverbal RCs (explained by topic resistance to modification) irrespective of length, but in post-verbal RCs, which are focused and thus attract attachment, long RCs showed a preference for HA (55%) and short RCs preference for LA (41%). Finally, Alonso-Pascua (2020) tested subject and object-extracted RCs in preverbal and post-verbal positions (the latter included a few PR-compatible verbs together with PR-incompatible verbs) and the results showed a preference to attach low in preverbal RCs (45% of HA), in post-verbal object-extracted RCs (46% of HA) and a HA preference in post-verbal subject-extracted RCs (55% of HA) (although the differences did not reach significance). In a second experiment, post-verbal subject-extracted RCs were tested under the scope of PR-compatible and PR-incompatible verbs, finding an LA preference across the board. The materials of the second experiment contained very short RCs (complementizer que + verb), which calls for considering the interplay between length and PR-availability as a key factor explaining attachment preferences.

In the present eye-tracking study, we focus on the online resolution of preverbal and post-verbal RC attachment ambiguity in Spanish, introducing two
improvements with respect to previous work. First, we controlled for PR-availability, while keeping other relevant factors controlled for across conditions (such as RC length, referentiality and plausibility). Second, we avoided (object-biased) implicit causality verbs. The previous literature has shown the influencing effects of expectations about discourse coherence relations driven by the matrix verb on the resolution of RC attachment (Rohde et al., 2011). For instance, verbs like detest or scold prompt the comprehender to make additional assumptions to understand the eventuality involving the direct object (i.e. the friend, in example 2), and the material for these assumptions can be provided by the content of the RC.

(2) Maria detested/scolded the friend of the teacher who smokes Cuban cigars.

Verbs like detest or scold are object-biased implicit causality verbs, which means that comprehenders expect an explanation or property of the object that justifies the cause of detesting or scolding. RCs, being properties, can provide for that (e.g. Maria detests the friend of the teacher because s/he is a smoker, and she can’t bear the smell of cigars). Rohde et al. (2011) showed that object-biased verbs facilitate the RC disambiguation towards HA. In this study, we avoided this type of verbs.

Regarding PR-availability, only PR-incompatible environments were included in this study. In the case of post-verbal RCs, only verbs that do not introduce PRs were selected for the matrix clause (i.e. perceptual verbs were avoided), and in the case of preverbal RCs, PRs are naturally banned in that position in Spanish independently from verb type.4

The goal of this study was to study online attachment preferences of RCs in preverbal and post-verbal positions. To that end, we tested temporarily ambiguous sentences with RCs disambiguated toward DP1 or DP2 in an eye-tracking while reading experiment. At the outset, given our efforts to avoid potential confounds deriving from implicit causality or perceptual verbs, and to keep (as much as we could) neutrality across conditions (in terms of plausibility, referentiality, length), we expect an early preference to attach locally in both preverbal and post-verbal positions, emerging with longer reading times when the RC is forced to disambiguate towards the first DP. However, if the effects of information structure play a role, we may expect an interaction with a stronger tendency for HA in comparison to the preverbal position.

There is yet another possible scenario here.5 The previous hypothesis was built on the assumption that the parser would quickly take structural optimal decisions on the basis of (accessible) information subcategorised by the verb. However, a strict modular parser, blind to predicate lexical semantics, may go for an argument over adjunct interpretation of the que-clause when possible. In such a scenario, an interaction would be expected across conditions given that preverbal RCs, as adjuncts, would display local attachment (or no initial preference), but, in contrast, an early preference for HA could be predicted in post-verbal RCs corresponding to an initial preference for an argument interpretation.

2. Method

2.1. Participants

Forty native speakers of Spanish participated in the experiment for course credit. Their age ranged from 18 to 29 years old (M=20.6, SD=2.5) and all of them had either normal or corrected-to-normal vision. All gave their informed consent before taking part in the study and were naive as to the goals of the experiment.

2.2. Materials

A total of 32 quartets of experimental items like the example in (3) were constructed6 Each quartet was composed of two sentences with the RC in the preverbal (subject) position of the type DP1-of-DP2-RC VP (3a–3b) and two sentences with the RC in the post-verbal (object) position of the type DP-V-DP1-of-DP2-RC (3c – 3d). In half of the materials, the RC was grammatically disambiguated towards the DP1 (3a and 3c), and in the other half, towards DP2 (3b and 3d). The materials were tested for plausibility in a norming study, to guarantee that both HA and LA are equally plausible (see the Supplementary materials for details of the norming study and the lexical properties of DP1 and DP2).

(3) a. El dermatólogo1 de la presentadora2 que fue apartado1 de la profesión vive en este bloque.
   “The dermatologist1 of the presenter2 who was removed1 from the profession lives in this building.”
   b. El dermatólogo1 de la presentadora2 que fue apartada2 de la profesión vive en este bloque.
   “The dermatologist1 of the presenter2 who was removed2 from the profession lives in this building.”
   c. Ángela se cruzó con el dermatólogo1 de la presentadora2 que fue apartado1 de la profesión.
   “Ángela bumped into the dermatologist1 of the
Experimental sentences were ambiguous until the embedded verb of the RC. All embedded verbs were past participle verbs, most of which were in perfect past, past imperfect or passive form, where the past participle contained gender features that only match with past, past imperfect or passive form, where the past participle verbs, most of which were in perfect past tense. Experimental sentences were randomised in a way that each item was presented in each of the four conditions but never twice in the same list. Experimental (32) and filler (96) sentences of each list were randomly presented to each participant. One out of four sentences was followed by a yes/no comprehension question.

2.3. Procedure

Participants were tested individually in a sound-attenuated room. An EyeLink 1000 (SR Research) eye tracker was used to record eye movements while participants read sentences. Stimuli were presented at a constant distance of 60 cm from a 19-inch computer screen set to a resolution of 1024 \times 768 pixels. Viewing was binocular but only the right eye’s movements were continuously recorded at a sampling rate of 1000 Hz. Sentences were presented in a centred single line in black lowercase (Arial, 24) implemented by SR Research Experiment Builder software. Before the experiment began, participants first read and signed an informed consent form, then read the instructions and completed a short practice of six sentences to become familiar with the procedure. Calibration was performed before and halfway through the experiment after a short break. The experiment lasted around 30 minutes.

3. Results

Trials with track loss or data collection error were not included in the analyses. Additionally, fixations shorter than 80 ms or longer than 1200 ms were deleted. Eye movement data were analysed at critical (removed) and post-critical (from the profession) regions as illustrated in (4). The critical region comprised the disambiguating inflected word, and the post-critical region the three words following it.

(4) El dermatólogo de la presentadora que fue |apartada| de la profesión

The dermatologist of the presenter who was |removed| from the profession

Four eye-tracking measures were computed in the critical region. First fixation duration is the duration of the first fixation in a region of interest when encountered on the first pass during reading. Gaze duration is the sum of fixation duration before the eyes leave that area, either to the left or to the right. Go-past time is the sum of fixation duration until an exit to the right, including any fixation to the left of the critical region as a result of regressive eye movements. Total reading time is the sum of all fixations, first, second and further passes included. The same eye-tracking measures were analysed in the post-critical region with the exception of first fixation duration which was excluded because this region covers more than one word.

3.1. Analyses of the critical region

Data were analysed with R (R Core Team, 2018) version 4.0.4 fitting linear mixed-effects model to the reading times data using the lme4 package (Bates et al., 2015) for each dependent measure in each region of interest. The model included Attachment (High vs. Low) and Position (Object vs. Subject) as fixed effects, with the interaction term in the model, and participants and items as random effects. Analyses were conducted on log-transformed reading times to minimise skew (Vasishth & Nicenboim, 2016). Maximal random effect structure was attempted first in all analyses: Attachment * Position + (1 + Attachment * Position | Participant) + (1 + Attachment * Position | Item). If the model failed to converge, we first removed correlation parameters between random intercepts and random slopes, then interactions between random slopes. If the model still failed to converge, we then iteratively removed the random effects that accounted for the least variance in the maximal model until convergence was achieved. Each of the fixed factors was sum-coded as follows: Attachment, High = −0.5, Low = 0.5; Position, Subject = −0.5, Object = 0.5.

The data set and R code for all analyses reported in this section are available at this Open Science Framework project.
Table 1. Mean reading times (in ms) and standard deviation at the critical region.

| Position Attachment | First fixation | Gaze duration | Go-past time | Total time |
|---------------------|----------------|---------------|--------------|------------|
| Subject             |                |               |              |            |
| High                | 243.8 (87.5)   | 342 (167)     | 363.6 (205)  | 574 (268.7) |
| Low                 | 229 (62.7)     | 313 (149.8)   | 345.1 (172.6)| 515.9 (340.5)|
| Object              |                |               |              |            |
| High                | 250.6 (94)     | 335.1 (188.3) | 370.2 (209)  | 510.9 (227.1)|
| Low                 | 232.5 (85.7)   | 306.2 (153)   | 319.8 (157.8)| 416.7 (134.8)|

Table 1 provides information about descriptive statistics and Table 2 about inferential statistics.

The results showed an early effect of attachment, with longer reading time in first fixation duration ($\beta = -0.054$, $SE=0.019$, $t=-2.828$, $p=.010$) and gaze duration ($\beta = -0.082$, $SE = 0.024$, $t=-3.346$, $p=.002$) when RCs were attached high. Go-past ($\beta = -0.083$, $SE=0.023$, $t=-3.547$, $p=.001$) and total reading time ($\beta = -0.188$, $SE=0.029$, $t=-6.361$, $p=.001$) confirmed the previous early effect of attachment with slower reading when HA occurs. As for the effect of position, none of the earliest measures showed any significant effect (all $ps > .05$), but total reading times showed longer duration times when placed in the preverbal position in comparison to the post-verbal position ($\beta = -0.091$, $SE=0.041$, $t=-2.177$, $p=.037$). There were no signs of an interaction between Attachment and Position (all $ps>.05$).

3.2. Analyses of the post-critical region

The analyses in this region followed the same steps as those described in the critical region. Gaze duration was considered the earliest measure here, since the region comprised more than one word. Table 3 provides information on descriptive statistics and Table 4 on inferential statistics.

Effects of attachment showed up in gaze duration ($\beta = -0.066$, $SE = 0.029$, $t=-2.27$, $p=.032$), go-past time ($\beta = -0.071$, $SE=0.030$, $t=-2.32$, $p=.027$) and total time ($\beta = -0.117$, $SE=0.026$, $t=-4.44$, $p=.001$), where HA is penalised with longer reading times (mirroring the results observed at the critical region). Effects of position appeared more clearly in this region. Both go-past time ($\beta = -0.080$, $SE=0.038$, $t=-2.08$, $p=.044$) and total time ($\beta = -0.087$, $SE=0.031$, $t=-2.76$, $p=.008$) showed significant slower times in preverbal versus post-verbal positions. The effect of attachment did not interact with the effect of position (all $ps>.05$).

4. Discussion

The results of this study show a processing cost when the RC is disambiguated non-locally. This effect arises early on in the critical region and extends to the following region, irrespective of the position of the RC. The effect manifests significantly in early measures as well as in late measures in both preverbal and post-verbal positions, revealing that the effect is observed in both positions to the same extent.

The previously reported bias to HA in Spanish, a preference observed online in eye-tracking (Carreiras & Clifton, 1999) and Event-Related Potential (ERP) measures (Carreiras et al., 2004), among many other self-paced reading and offline studies, are not observed in our study. Although comparison between studies in this literature is difficult given the multifactorial nature of the phenomenon, we consider that the control of PR-availability and the avoidance of implicit causality verbs, together with the control of other properties described in the introduction (e.g. referentiality, prosody, plausibility), are essential and could probably be

Table 2. Summary of linear mixed effects models (LMM) fitted on log-transformed reading times at the critical region.

| Measure and Predictors | Estimate | SE | $t$-Value | Slope | $p$-Value |
|------------------------|----------|----|-----------|-------|-----------|
| First fixation duration |          |    |           |       |           |
| Attachment             | -0.054   | 0.019 | -2.83     |       | .010 *    |
| Position               | 0.012    | 0.020 | 0.61      |       | .547      |
| Verb Attachment*Position | -0.015 | 0.035 | -0.45     |       | .659      |
| Gaze duration          |          |    |           |       |           |
| Attachment             | -0.082   | 0.024 | -3.35     |       | .002 **   |
| Position               | -0.033   | 0.027 | -1.12     |       | .243      |
| Attachment*Position     | 0.027    | 0.051 | 0.54      |       | .594      |
| Go-past time           |          |    |           |       |           |
| Attachment             | -0.083   | 0.023 | -3.55     |       | .001 ***  |
| Position               | -0.032   | 0.029 | -1.13     |       | .268      |
| Attachment*Position     | -0.068   | 0.05  | -1.46     |       | .143      |
| Total Time             |          |    |           |       |           |
| Attachment             | -0.188   | 0.029 | -6.36     |       | <.001 *** |
| Position               | -0.091   | 0.041 | -2.17     |       | .037 *    |
| Attachment*Position     | 0.056    | 0.06  | 0.86      |       | .395      |

Notes: Estimates, standard errors, $t$-values and $p$-values are reported for the main effects of Attachment and Position, as well as for the interaction of these two factors in each reading measure. The "Slope" column indicates whether the model included the corresponding predictor as a random slope for participants (p), items (i) or both (p,i). $p$-Values for fixed effects were calculated using Satterthwaite approximations and the model fitted using REML. * $p<.05$ ** $p<.01$ *** $p<.001$.

Table 3. Mean reading times (in ms) and standard deviation at the post-critical region.

| Position Attachment | Gaze duration | Go-past time | Total time |
|---------------------|---------------|--------------|------------|
| Subject             |               |              |            |
| High                | 460.7 (244.8) | 556.7 (287.8)| 641.5 (267.7)|
| Low                 | 416.9 (177.6) | 501.8 (225)  | 587.7 (285.1)|
| Object              |               |              |            |
| High                | 432.1 (209.9) | 491.6 (239.1)| 579.8 (236.2)|
| Low                 | 379.4 (108.5) | 443.6 (144.1)| 510.9 (161.1)|
explain the divergent results with respect to previous studies. The current results are in line with those reported by Aguilar et al. (2021) in finding LA facilitation in the condition with exclusive RC (PR-incompatible) environments. Aguilar and colleagues also found that the initial local preference can be eventually overridden in later stages of processing by other factors such as prosodic weight of the RCs. In the present study, contrary to Aguilar et al. (2021), we do not find an eventual shift to HA in later reading measures or in the spillover region in spite of the rather long sentences (14 syllables on average) in comparison to the attachee size. Prosodic effects stemming from RC size have been widely reported. Longer RCs tend to impose an intonational break between the complex DP and the RC, which triggers attachment to the first DP, in a way that the size of the attachee and the RC are similar (Balanced Sister Hypothesis, Fodor, 1998). Research in Spanish, in both comprehension and production, supports this hypothesis (for studies in Spanish in reading comprehension tasks, see Fernández, 2003b; Hemforth et al., 2015; for auditory comprehension tasks Fromont et al., 2017; Teira & Igoa, 2007; and for production studies De la Cruz-Pavia, 2010; de la Cruz-Pavia & Elordieta, 2015; Teira & Igoa, 2007, where participants tend to place intonational breaks in the production of longer RCs). Although prosodic weight is definitely a key factor in this literature, it cannot explain the current results.

Regarding the effect of position, the results indicate that there is no differential attachment preference across positions, in line with Alonso-Pascua’s (2020) findings. Previous studies that aimed to examine RC attachment in preverbal and post-verbal positions were offline and delivered contradictory results (Alonso-Pascua, 2020; Branco-Moreno, 2014; Hemforth et al., 2015). On the one hand, Branco-Moreno (2014) found HA preference in the preverbal position and LA in the post-verbal position in a study where the materials were controlled for the availability of PRs, but not for plausibility. On the other hand, Hemforth et al. (2015) manipulated the position and the length of the RCs (on average: 14 for long, 5 syllables for short RCs) but their materials were not controlled for PR-availability or implicit causality effects. The results in preverbal (short and long) RCs and in post-verbal short RCs showed a general LA preference (just like the results in our study), but post-verbal long RCs showed a tendency towards HA. Here we presented the first online study that addresses this question, controlling for PR-availability and avoiding implicit causality verbs. We found shorter RTs for RCs in the post-verbal position in comparison to the preverbal position, but this main effect of position did not interact with attachment, which in response to one of the questions raised in the introduction, may tell us that the parser does have an early access to information subcategorised by the verb. The observed difference between both positions could simply indicate a faster reading when a richer context is provided because readers can link incoming words to it (Just & Carpenter, 1980), reflecting the incremental predictive nature of parsing. The same effects have been observed over different tasks and paradigms, from tone monitoring (Lobina et al., 2017) to ERPs (Payne et al., 2015). Sentence build-up processes are slow-paced at the beginning of a sentence and accelerate toward the end, as more information is available for the parser to generate predictions.

The reported pattern of results could be easily explained by locality principles, which widely apply in this study across positions. The results replicate the LA finding in genuine post-verbal RC environments in Spanish reported in Aguilar et al. (2021) and further extend the results to the preverbal position, which is out of the scope of the main predicate. Future research may explore other potential influences that the predicate semantics may exert on the eventual resolution of RC attachment. Although the current results leave some open questions, the highly controlled materials of this work contribute to a better understanding of parsing processes and suggest that locality is central in this debate.

### Notes

1. For a recent review on RC attachment in Spanish and the different factors reported to modulate attachment, see Stetie (2021).

### Table 4. Summary of LMEM analyses of log reading times at the post-critical region.

| Measure and predictors | Estimate | SE | t-Value | Slope | p-Value |
|------------------------|----------|----|---------|-------|---------|
| Gaze duration          |          |    |         |       |         |
| Attachment             | -0.066   | 0.029 | -2.27   | (p,i) | .032**  |
| Position               | -0.035   | 0.034 | -1.03   | (p,i) | .310    |
| Attachment*Position    | -0.009   | 0.05  | -0.177  | (p,i) | .860    |
| Go-post time           |          |    |         |       |         |
| Attachment             | -0.071   | 0.030 | -2.32   | (p,i) | .027**  |
| Position               | -0.080   | 0.038 | -2.08   | (p,i) | .044**  |
| Attachment*Position    | 0.028    | 0.04  | 0.629   | (p)   | .533    |
| Total Time             |          |    |         |       |         |
| Attachment             | -0.117   | 0.026 | -4.44   | (p,i) | <.001***|
| Position               | -0.087   | 0.031 | -2.76   | (p,i) | .008**  |
| Attachment*Position    | 0.020    | 0.044 | 0.45    | (p)   | .651    |

Notes: Estimates, standard errors, t-values and p-values are reported for the main effects of Attachment and Position, as well as for the interaction of these two factors in each reading measure. The “Slope” column indicates whether the model included the corresponding predictor as a random slope for participants (p), items (i) or both (p,i). p-Values for fixed effects were calculated using Satterthwaite approximations and the model fitted using REML. * p < .05 ** p < .01 *** p < .001.
2. Grillo and Costa (2014) and Grillo (2012) offer an extensive characterisation of PRs, and Grillo and Turco (2016) identify the prosodic differences between RCs and PRs.

3. PRs denote the direct perception of events, and thus, they can be easily introduced by perceptual verbs (e.g. to see) which introduce ambiguous PR/RC environments, but they are banned under non-perceptual predicates (e.g. to know) which can only introduce RCs.

4. PRs in subject position are kind-denoting PRs (Grillo & Moulton, n.d.), which contain the representation of multiple instances of an event. Spanish does not allow kind-denoting PRs, only PRs that depict a single episodic event, which explains why PRs are not allowed in subject position in this language.

5. There is one exception to this: when using number agreement as a source of disambiguation (Carreiras et al., 2001; Fernández, 2003a; Fernández & Sainz, 2004; Ferreira, 2003), preference to attach high was not always found in Spanish.

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