LINEAR POSITION MODULATES INTERFERENCE FROM STRUCTURALLY INAPPROPRIATE ANTECEDENTS IN SPANISH PRONOUN RESOLUTION

by

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Chapter 1: Introduction

1.1 Starting Out: Coreference and Variable Binding

This paper examines the processing of object pronouns in Spanish as a tool for understanding how linguistic information is encoded and retrieved from memory during online sentence comprehension. Pronouns depend on antecedents from the preceding context for interpretation. These antecedents can be referential (1) or quantificational (2,3).

(1) *The linguist* likes the reviewers that praise *him*.

(2) *Every linguist* likes the reviewers that praise *him*.

(3) *No linguist* likes the reviewers that criticize *him*.

The referential status of its antecedent determines how a pronoun is to be interpreted. When the referential noun phrase (NP) the linguist is the antecedent of him in (1), the pronoun and the NP can enter a coreference relation: both pick out the same individual in the discourse model (Buring, 2005). Conversely, when the antecedent is a quantified NP (QP) such as in (2,3), the pronoun no longer picks out a unique individual. Instead, the pronoun is often described as functioning as a variable, bound by its antecedent (i.e., every linguist and no linguist). These bound-variable pronouns covary in interpretation with the QP and iterate through the individuals in the discourse model accordingly (Buring, 2005). For example, (2) is true if $\forall x \exists Y$[linguist(x) $\wedge$ reviewer(Y) $\wedge$ praise(Y,x) $\rightarrow$ likes(x,Y)][1].

All pronominal dependencies are governed by a series of morphological and syntactic constraints. Morphologically, antecedents must match the features of the pronoun (e.g., person, gender, number).

(4) *The* {man_i / $woman_j$} wanted the reviewers to praise $him_{i/*j}$.

(5) *No* {man_i / $woman_j$} wanted the reviewers to praise $him_{i/*j}$.

Syntactically, antecedent-pronoun relations must abide by Binding Principle B (Chomsky, 1981), which prevents pronouns from taking an antecedent in their local clause.

[1]Throughout this paper, we use upper case letters to indicate plural variables and lower case letters to refer to singular variables.

(6) *{*The*$_{\text{i}}$ / *No man*$_{\text{j}}$} praised *him*$_{*\text{i}/*\text{j}/\text{k}}$.

An additional constraint targets QP-pronoun binding dependencies specifically, illustrated in (7,8). In (7), the negative QP *no man* can bind the pronoun *him*, resulting in a bound interpretation in which the QP is the antecedent. However, the same QP in (8) cannot bind the pronoun in the matrix clause (MC) because it is embedded in a relative clause (RC), so *him* is treated as an unheralded pronoun referring to a separate individual.

(7) *No man*$_{\text{i}}$ dislikes the reviewers [that praise *him*$_{\text{i}}$].
$\forall$ x[man(x) $\rightarrow$ $\neg$ $\exists$ Y[[reviewer(Y) $\wedge$ praise(Y,x))] $\wedge$ dislikes(x,Y)]

(8) The reviewers [that *no man*$_{\text{i}}$ dislikes] praise *him*$_{*\text{i}/\text{j}}$.
$\exists$ X[reviewer(X) $\wedge$ $\forall$ y[man(y) $\rightarrow$ $\neg$dislikes(y,X)] $\wedge$ $\exists$ z[person(z) $\wedge$ praise(X,z))]][2]

In contrast, NP-pronoun coreference relations are not subject to this restriction. Consider, (9), where the referential NP *the man* in the same position as the QP in (8) is a grammatical antecedent for the pronoun.

(9) The reviewers [that *the man*$_{\text{i}}$ likes] praise *him*$_{\text{i}}$.
$\exists$ X $\exists$ y[reviewer(X) $\wedge$ man(y) $\wedge$ likes(y,X) $\wedge$ praise(X,y)]

This relational constraint on quantificational binding has been typically described in terms of *c-command*[3] (Reinhart, 1983). An item α c-commands an item β if β is contained in α's sister in the syntactic tree (or is α's sister itself). For example, the QP *no man* in (7) c-commands *him* because the pronoun is inside the verb phrase (VP) that is the QP's sister, but the same QP inside the RC in (8) does not c-command *him* because the pronoun is not contained within the QP's sister node. The c-command constraint on bound-variable pronouns is interesting from the perspective of modeling memory access during sentence processing because it poses a challenge to popular cue-based retrieval models (e.g., Lewis, Vasishth, & Van Dyke, 2006). In a cue-based architecture, linguistic items are represented as chunks in a content-addressable memory and encoded with item-specific features (e.g., [+subject], [+masculine], [+singular]). Retrieval operates by matching a set of retrieval cues against the contents of all items in memory in parallel. The chunk that best matches these cues becomes the most highly

[2]Where *z* is an extra-sentential referent.

[3]Although previous work has questioned whether c-command is the correct way of formalizing the constraint (e.g., Barker, 2012, but see Moulton & Han, 2018), it is generally agreed that some form of relational constraint is required.

activated item in memory and will thus be retrieved. In this framework, pronoun resolution involves cueing memory to identify a potential antecedent for a pronoun and retrieving the corresponding chunk if a match is found.

Encoding item-specific information such as morphological feature-match is straightforward because it is drawn from an item's lexical entry. As such, this information should be readily used as a cue to guide antecedent retrieval. Previous research supports this and demonstrates that morphological mismatch between a potential antecedent and an anaphor causes immediate disruption on early anaphor processing (e.g., Sturt, 2003; Badecker & Straub, 2002; Chow, Lewis, & Phillips, 2014). In contrast, c-command relations between a potential QP antecedent and a pronoun are inherently relational, since they encode the relative position of a QP in relation to a distant pronoun. Accordingly, a hypothetical "c-command feature" encoded on the QP would fail to represent the item-to-item nature of c-command relations.[4] This presents a challenge: if c-command information cannot be encoded as an item-specific cue, retrieval should not be able to distinguish between c-commanding and non-c-commanding QPs as potential antecedents for a bound-variable pronoun. However, as will be discussed in the following section, evidence from recent studies suggests otherwise.

The implementation of the c-command constraint on QP-pronoun binding dependencies is thus a valuable test case to probe how linguistic constraints interact with retrieval mechanisms during online sentence processing. By examining whether antecedent retrieval can use c-command relations to distinguish between appropriate and inappropriate QP antecedents for bound-variable pronouns, we can gain insight into how linguistic items are encoded and retrieved from memory. In the following section, we review relevant literature on the real-time implementation of the c-command constraint.

1.2 Previous Work

Recent work by Cunnings, Patterson, & Felser (2015) and Kush, Lidz, & Phillips (2015) has examined whether c-command influences antecedent retrieval during the online processing of QP-pronoun dependencies. Although both papers contained multiple experiments, we focus only on a subset of those experiments here to establish the basic empirical findings. Cunnings, Patterson, and Felser (2015, Exp. 2) conducted an eye-tracking study to test whether retrieval distinguishes between

[4]See Kush (2013) for why truly relational "c-command features" cannot be implemented in a cue-based parsing architecture.

c-commanding and non-c-commanding QPs as potential antecedents for a pronoun. The authors constructed sentences with a QP potential antecedent (e.g., *every man/woman*) that either c-commanded (10a,b) or did not c-command (10c,d) a later subject pronoun (e.g., *he*). They also manipulated whether the QP and the pronoun matched (10a,c) or mismatched (10b,d) in gender. Gender-match was used as an index of a QP's accessibility to retrieval (e.g., Sturt, 2003; van Gompel, Pickering & Traxler, 2000; Garnham et al., 1995, Kazanina et al., 2007). The matrix subject (e.g., *the surgeon)* was always a referential NP that matched the pronoun in gender and number. An example item set is given in (10).

(10a) C-command–Match
The surgeon saw that *every old man* on the emergency ward wished that he could go a little bit faster.

(10b) C-command–Mismatch
The surgeon saw that *every old woman* on the emergency ward wished that he could go a little bit faster.

(10c) No c-command–Match
The surgeon who *every old man* saw on the emergency ward wished that he could go a little bit faster.

(10d) No c-command–Mismatch
The surgeon who *every old woman* saw on the emergency ward wished that he could go a little bit faster.

Across test sentences, the QP was the linearly closest NP to the pronoun, while the matrix subject was more distant. This is important because in a previous study, Cunnings and colleagues found that comprehenders preferred to link a pronoun to the linearly closest potential antecedent (Cunnings, Patterson, & Felser, 2014). Since the QP was the closest potential antecedent and in the correct structural position to be the antecedent in the c-command conditions (10a,b), the authors expected gender-match to have an immediate effect on pronoun processing. Accordingly, they predicted undisrupted processing of the pronoun in (10a) because the closest potential antecedent, the QP *every old man*, matches the gender of the pronoun. Increased processing difficulty was expected in (10b) because the closest potential antecedent, the QP *every woman*, mismatches the pronoun. Thus, a gender-mismatch effect (GMME) was expected in the C-command conditions (10a,b), such that

reading times (RTs) at or immediately after the pronoun were expected to be longer for mismatching pronouns (10b) than for matching pronouns (10a).

If retrieval can use c-command relations to distinguish between appropriate and inappropriate QP antecedents, gender-match with the pronoun in the No c-command conditions (10c,d), where the QP is not a structurally plausible antecedent, should not yield any significant differences. The c-command constraint would rule out the QP *every old man/woman* as a potential antecedent. Thus, whether the QP matches the gender of the pronoun or not should have no effect on pronoun processing. RTs at or immediately after the pronoun should not vary significantly between (10c,d). The pronoun would likely be interpreted as referring to the more distant referential NP *the surgeon*. In contrast, if retrieval cannot effectively use c-command relations during online processing, gender-match with the QP should facilitate pronoun processing in the No c-command conditions. In particular, the linearly closest gender-matching QP *every old man* in (10c) would not yet have been ruled out by the constraint, and therefore would be treated as the closest potential antecedent. As such, the presence of a matching QP in (10c) would be expected to have a facilitatory effect on pronoun processing. Disruption would be expected at the pronoun in (10d) because the closest potential antecedent, the QP *every old woman*, mismatches the pronoun in gender. In this case, a GMME would be expected in the No c-command conditions, with longer RTs at or immediately after mismatching pronouns (12d), compared to matching pronouns (10c).

The results revealed that manipulating gender-match with a c-commanding QP produced a GMME: second-pass and total reading times were longer in the C-command–Mismatch condition (10b) than in the C-command–Match condition (10a). The same comparisons in the conditions where the QP did not c-command the pronoun (10c,d) did not yield any significant differences. The absence of a GMME in the No c-command conditions in Cunnings et al. (2015) is consistent with the hypothesis that retrieval can readily implement the c-command constraint to distinguish between c-commanding and non-c-commanding QP antecedents. Similarly, Kush et al. (2015, Exp. 1c) also found that retrieval could distinguish between appropriate and inappropriate QPs on the basis of c-command.

While Cunnings and colleagues (2015) compared the processing of c-commanding and non-c-commanding QPs, an eye-tracking study by Kush, Lidz, & Phillips (2015, Exp. 2b) compared the processing of non-c-commanding QPs to that of non-c-commanding referential NPs. Recall that c-command is a requirement for QP-pronoun binding relations, but not for NP-pronoun coreference

dependencies. Kush and colleagues sought to determine whether initial retrieval distinguishes between non-c-commanding referential NPs, which are structurally appropriate antecedents, and non-c-commanding QPs, which are ungrammatical antecedents for a later pronoun. The authors manipulated the gender of the potential antecedent and its referentiality, such that it was either a referential NP (e.g., *the boy/girl scout* in 11a,b) or a QP (e.g., *no boy/girl scout* in 11c,d). Potential antecedents were embedded in a relative clause from which they could not c-command the critical pronoun (e.g., *her*) in the main clause. The matrix subject (e.g, *the troop leaders*) was always plural and therefore was not a plausible antecedent for the singular object pronoun. An example item set is provided in (11).

(11a) Referential–Match
The troop leaders $_{RC}$[that *the girl scout* had no respect for] had scolded her after the incident at a scout camp.

(11b) Referential–Mismatch
The troop leaders $_{RC}$[that *the boy scout* had no respect for] had scolded her after the incident at a scout camp.

(11c) Quantificational–Match
The troopleaders $_{RC}$[that *no girl scout* had no respect for] had scolded her after the incident at a scout camp.

(11d) Quantificational–Mismatch
The troop leaders $_{RC}$[that *no boy scout* had no respect for] had scolded her after the incident at a scout camp.

In the Referential conditions (11a,b), NPs that match the pronoun in gender (e.g., *the girl scout* in 11a) were expected to be readily retrieved, as they are grammatical antecedents. In contrast, referential NPs that mismatch the gender of the pronoun (e.g., *the boy scout* in 11b) should not be retrieved, as they are not morphologically plausible antecedents. Thus, a GMME was expected in the Referential conditions, with faster RTs for matching pronouns (11a), relative to mismatching ones (11b). Turning to the Quantificational conditions (11c,d), if c-command constrains antecedent retrieval for QP-pronoun dependencies, gender-match with the pronoun should not influence pronoun processing. RTs at the pronoun should not differ significantly between (11c,d), as the pronoun is expected to be interpreted as lacking an antecedent in both conditions. If, however, c-command does not have an immediate effect on retrieval, gender-match with a non-c-commanding QP (e.g., *no boy scout* in 11c) should have a

facilitatory effect on pronoun processing during the earliest possible stage of retrieval. In that case, a GMME should emerge in the Quantificational conditions, with faster RTs for matching pronouns (11c), compared to mismatching ones (11d).

Kush and colleagues' results revealed a GMME in Referential (11a,b), but not in Quantificational conditions (11c,d) in first-pass and rightbound reading time measures. This pattern of effects is consistent with retrieval accessing gender-matching referential NPs that did not c-command the pronoun, but not QPs in the same position. Taken together, the findings from Cunnings, Patterson, & Felser (2015) and Kush, Lidz, & Phillips (2015) suggest that antecedent retrieval effectively implements c-command relations to distinguish between structurally appropriate and inappropriate QP potential antecedents. Their results align with current empirical evidence suggesting that antecedent-pronoun (Frazier & Clifton, 2000; Chow, Lewis, & Phillips, 2014) and antecedent-reflexive dependencies are relatively immune to *partial-match retrieval interference* (see Dillon, 2014 for an overview of reflexive processing; Sturt, 2003; Xiang et al., 2009; Dillon et al., 2013, but see Badecker & Straub, 2002, Exp. 3 & 4; Jäger et al., 2015), which occurs when an item in memory that partially matches the retrieval cues of the probe is incorrectly retrieved.

The findings from anaphora are surprising because partial-match facilitatory interference from structurally inappropriate distractors has been found across a range of dependencies such as subject-verb agreement (Bock & Miller, 1991; Pearlmutter et al. 1999; Wagers et al. 2009, Dillon et al., 2013) and negative polarity items (NPIs) (Xiang et al., 2009; Parker & Phillips, 2016; Muller et al., 2020; Muller, 2022; Wu, Khurana, & Kush, 2025). For example, Pearlmutter and colleagues (1999) found that when a structurally inappropriate distractor was plural (e.g., *the cabinets* in 12a), reading times for an unlicensed plural verb (e.g., *were*) were faster than when the distractor was singular (e.g., *the cabinet* in 12b), despite both sentences being ungrammatical.

(12a) *The key to *the cabinets* were rusty from many years of disuse.

(12b) *The key to *the cabinet* were rusty from many years of disuse.

Wagers, Lau and Phillips (2009) argue that *agreement attraction* effects emerge in (12a) because the plural distractor *the cabinets* partially matches the retrieval cues for the verb's licensor. Namely, it matches the number feature of the verb (i.e., [+plural]). This cue-overlap can sometimes lead to partial-match interference, resulting in the mis-retrieval of the plural distractor. The absence of

interference from non-c-commanding QPs during pronoun resolution is particularly remarkable because other dependencies subject to a c-command constraint have been shown to be facilitated by the presence of non-c-commanding QPs in similar configurations. NPI licensing is such an example. Similar to bound-variable pronouns, NPIs require a c-commanding negative operator to be licensed[5] (see Giannakidou, 2011, for a review of the contexts that license NPIs). For example, the NPI *ever* in (13a) is licensed because it is c-commanded by the negative QP *no author*. When a negative QP is absent (13b), or fails to c-command the NPI (13c), *ever* is not licensed.

(13a) *No author* [that the critic recommended] has ever received acknowledgement for the book.

(13b) *The author [that the critic recommended] has ever received acknowledgement for the book.

(13c) *The author [that *no critic* recommended] has ever received acknowledgement for the book.

Despite the ungrammaticality of (13b) and (13c), a self-paced reading (SPR) study by Parker and Phillips (2016) found that when the non-c-commanding QP *no author* was present in (13c), RTs at the NPI were faster than when no QP distractor was present in (13b) (see also Vasishth et al., 2008; Xiang et al., 2009). Similar to subject-verb agreement, comprehenders appeared to access a structurally inappropriate distractor that partially matches the retrieval cues of the NPI (i.e., [+negative]), thereby temporarily licensing it. Recent work has found similar illusory licensing effects with the NPI *any* (Muller, 2022; Wu, Khurana, & Kush, 2025), suggesting that the illusion is not NPI-specific and may reflect general processing mechanisms that apply across lexical items[6].

Interestingly, Parker and Phillips demonstrated that the illusion can be "switched off" by increasing the linear distance between the end of the QP's c-command domain (i.e., the right edge of the RC) and the NPI itself. In a follow-up speeded acceptability judgment study where a complement clause was inserted to increase linear distance between the distractor and the QP, the percentage of 'yes' responses was similar for sentences where no QP distractor was present (14a) and sentences with a non-c-commanding QP distractor (14b).

(14a) *The author [that *the critic* recommended], has, as the editors mentioned, ever received acknowledgement for the book.

[5]More precisely, NPIs must be licensed by a downward-entailing operator, such as negation (Ladusaw, 1979).

[6]Barring the interaction between different NPIs and linear position/distance.

(14b) *The author [that *no critic* recommended], has, as the editors mentioned, ever received acknowledgement for the book.

The key finding from Parker and Phillips (2016) is that the probability of interference decreases as the distance between the end of the distractor QP's c-command domain and the NPI increases. The authors propose that interference decreases because, over time, the representation of the RC is compressed into a format where its internal constituents cannot be accessed, and that the likelihood of this representational change increases the further one moves from the edge of the RC. The closer one is to the edge of the RC, the less likely it is that this compression has been completed. In (13c), *ever* is close to the end of the relative clause. If the relevant representational change has not been completed by the time retrieval for a licensor begins, the non-c-commanding QP *no critic* may still be accessed. In (14b) *ever* is further away, so by the time comprehenders encounter the NPI, the processor has likely had sufficient time to change the representation, making the QP "invisible" to retrieval.

Stepping back from the specifics of Parker & Phillips' (2016) proposal, we can isolate the general idea that the explanation for reduced interference follows from a dynamic update at some level of representation that renders the QP inaccessible to retrieval. That this update coincides with the end of the RC aligns with observations from linguistic theory that the edge of the RC marks the edge of the QP's scope or c-command domain (Chomsky, 1981; Reinhart, 1997; Heim & Kratzer, 1998), and/or the "life-span" of the discourse referent associated with the QP (Karttunen, 1976; Kamp & Reyle, 1993; van Eijck & Kamp, 2011). Importantly, the idea that the accessibility of a QP varies as a function of distance from the edge of the RC is not only relevant to NPI licensing. If a single representational update governs the accessibility of QPs to retrieval for interpretive processes, it could potentially account for the absence of interference observed in early measures during retrieval for a pronoun's antecedent. A possibility that remains to be tested is whether pronoun resolution exhibits a similar intrusion profile from non-c-commanding QPs to NPI licensing when distance is reduced. To investigate this, we use the processing of Spanish preverbal and postverbal object pronouns as our test case.

1.3 Spanish Object Clitics

In Spanish, lexical objects (e.g., *al niño* 'the boy' in 15a) always follow the verb (e.g., *castigó* 'punished'). However, when the object is pronominal (e.g., *lo* 'him' in 15b), the pronoun precedes the verb.

(15a) La profesora castigó *al niño*.
The teacher punished *the boy*.
'The teacher punished the boy'.

(15b) La profesora *lo* castigó.
The teacher *him* punished.
'The teacher punished him'.

Spanish object pronouns are typically considered clitics. Cliticization is the process by which clitic pronouns form a single, unbreakable unit with a lexical item, known as the host (Zwicky, 1985). In Romance languages, the host is always a verb[7]. Unlike other Romance languages, Spanish allows object clitics in 'restructuring' configurations like (16) to attach to the end of a non-finite verb (e.g., *castigar* 'to punish' in (16a)) or before the main conjugated verb, (e.g., *quiere* 'want-$_{3rd.SG}$' in (16b)) a phenomenon known as *clitic climbing*. (González López, 2008). Due to orthographic conventions, when the pronoun attaches to the non-finite verb, as in (16a), the verb and the clitic are written together as a single word (e.g., *castigarlo*, 'punish-him').

(16a) La profesora quiere castigar*lo*.
The teacher wants to punish-*him*.
'The teacher wants to punish him'.

(16b) La profesora *lo* quiere castigar.
The teacher *him* wants to punish.
'The teacher wants to punish him'.

In this paper, we exploit the possibility of clitic climbing in Spanish to test how the distance, and therefore time, between the right edge of the RC where the QP is embedded and a later object pronoun in the MC impacts interference from non-c-commanding QPs. We ask whether interference from

[7]Treating object pronouns in the Romance family as clitics is not the only possible analysis. Some have argued that because they only attach to the verb they are the object of, they should be analyzed as affixes (Haspelmath, 2023). Although there is no consensus on this issue, it does not impact the idea pursued here.

non-c-commanding QPs (e.g., *ningún chico* 'no boy') is greater in preverbal configurations like (17a) than in postverbal configurations such as (17b).

(17a) Las profesoras $_{RC}$[a las que *ningún chico* respeta] lo quieren castigar,
The teachers $_{RC}$[DOM D.3PL.FEM C *no boy* respects] him want to punish.
'The teachers who no boy respects want to punish him'.

(17b) Las profesoras $_{RC}$[a las que *ningún chico* respeta] quieren castigarlo.
The teachers $_{RC}$[DOM D.3PL.FEM C *no boy* respects] want to punish-him.
'The teachers who no boy respects want to punish him'.

1.4 Linear Distance & Interference

Spanish clitic climbing allows us to test a hypothesis that cannot be examined in English, namely, whether linear distance modulates interference from non-c-commanding QPs. To explore this question, we conducted two self-paced reading studies.

The first experiment (Chapter 2: Experiment 1 – Postverbal clitics) is a high-powered conceptual replication of Kush, Lidz, & Phillips (2015) using Spanish postverbal object pronouns (as in 17b). We use an interference paradigm and compare the processing of gender-matching and -mismatching referential NPs or QPs that do not c-command a later pronoun as potential antecedents. Based on previous work, we expect matching QPs to exert minimal influence on initial retrieval, comparable to mismatching QPs. That is, we do not anticipate interference from inappropriate QPs in Experiment 1.

The second experiment (Chapter 3: Experiment 2 – Preverbal clitics) employs the same interference paradigm, but with critical pronouns in preverbal position (as in 17a). One potential explanation for the previously reported absence of facilitatory interference from non-c-commanding QPs is that the postverbal position of English object pronouns provided enough time to update the representation to make QPs inaccessible before antecedent retrieval began. If so, the reduced distance in Experiment 2 may increase the influence of gender-matching QPs on initial retrieval, similar to NPI licensing. Under this outcome, we expect pronoun position to modulate the incidence of interference from non-c-commanding QPs across experiments: no interference in Experiment 1, but observable interference in Experiment 2. Conversely, if an update procedure is not required to make QPs inaccessible, the distance manipulation should yield no differences between Experiments 1 and 2.

To preview the results, we find that interference from non-c-commanding QPs is higher when the pronoun appears in preverbal position, compared to postverbal position. We consider different accounts of how distance may affect the incidence of interference in Chapter 4 (General Discussion).

Chapter 2: Experiment 1 – Postverbal clitics

Experiment 1 was designed as a conceptual replication of previous studies in English, but using a higher-powered design in Spanish. Using a gender-mismatch manipulation, we test whether postverbal pronouns are subject to interference from non-c-commanding QPs. Following previous work (Chow et al. 2014; Cunnings et al. 2014; 2015; Kush et al. 2015), we expect a gender-mismatch effect to emerge at the pronoun if the potential antecedent is accessible.

2.1 Participants

85 native speakers of Spanish (49 male, mean age = 30) participated in the experiment. All participants were born in and resided in Spain and were recruited on Prolific. Participants were paid the equivalent of CAD$12 for their participation, which typically lasted 25 minutes.

2.2 Materials

Test sentences were made up of 24 item sets, each consisting of 4 conditions. An example item set is provided in Table 1. See Tables A1 and A2 in the Appendix for the full list of experimental items.

Table 1. Example item set for Experiment 1. Presentation regions are demarcated by forward slashes.

Condition	Sentence
Referential–Match	Los doctores/ $_{RC}$[a los /que/ *el enfermero*$_i$/ no ayudó/ en/ la ambulancia]/ deberían/ expulsar<u>lo$_i$</u> / del equipo / sanitario/ de emergencia.
	The doctors/ $_{RC}$[DOM D.3PL.MASC / C / *the nurse*$_{i\text{-MASC}}$/did not help/ in/ the ambulance]/ should / expel <u>him$_i$</u>/ from the team / for medical/ emergencies.
	'The doctors who the male nurse did not help in the ambulance should expel him from the emergency medical team'.

	Los doctores/ $_{RC}$[a los /que/ *la enfermera*$_i$/ no ayudó/ en/la ambulancia]/ deberían/ expulsar<u>lo$_i$</u> /del equipo /sanitario/ de emergencia.
Referential–Mismatch	The doctors $_{RC}$[DOM D.3PL.MASC / C / *the nurse*$_{i\text{-FEM}}$ / did not help/ in/ the ambulance]/ should/ expel <u>him$_i$</u>/ from the team / for medical/ emergencies. 'The doctors who the female nurse did not help in the ambulance should expel him from the emergency medical team'.
	Los doctores/ $_{RC}$[a los /que/ *ningún enfermero*$_i$/ ayudó /en/ la ambulancia]/ deberían/ expulsar<u>lo$_i$</u> /del equipo/ sanitario/ de emergencia.
Quantificational–Match	The doctors/ $_{RC}$[DOM D.3PL.MASC / C / *no nurse*$_{i\text{-MASC}}$/ helped /in/ the ambulance]/ should/ expel <u>him$_i$</u> /from the team / for medical/ emergencies. 'The doctors who no male nurse helped in the ambulance should expel him from the emergency medical team'.
	Los doctores/ $_{RC}$[a los /que/ *ninguna enfermera*$_i$/ ayudó /en/ la ambulancia]/ deberían/ expulsar<u>lo$_i$</u> /del equipo/ sanitario/ de emergencia.
Quantificational–Mismatch	The doctors/ $_{RC}$[DOM D.3PL.MASC / C / *no nurse*$_{i\text{-FEM}}$ / helped /in/ the ambulance]/ should/ expel <u>him$_i$</u> /from the team / for medical/ emergencies. 'The doctors who no female nurse helped in the ambulance should expel him from the emergency medical team'.

Test sentences followed a 2 × 2 within-subjects design that crossed the factors Referentiality and Gender-Match. In all sentences, a relative clause was attached to the main clause subject, and the subject of the relative clause was a potential antecedent for a later pronoun in the main clause. Referentiality manipulated whether the potential antecedent was a referential NP (e.g., *el enfermero* 'the nurse$_{MASC}$') or a negative QP (e.g., *ningún enfermero* 'no nurse$_{MASC}$'). Gender-Match manipulated whether the pronoun matched or mismatched the gender feature of the potential antecedent. This was done by changing the NP (e.g., *enfermero* 'the nurse$_{MASC}$' vs. *enfermera* 'the nurse$_{FEM}$') so that the gender of the critical pronoun was held constant within an item set.

Test sentences started with a plural referential NP (e.g., *los doctores* 'the doctors'), which was the head of a relative clause. The relative clause-internal noun phrase was either a referential NP (e.g., *el enfermero* 'the nurse$_{MASC}$') or a negative QP (e.g., *ningún enfermero* 'no nurse$_{MASC}$'). The relative clause verb was followed by a modifier (e.g., *en la ambulancia* 'in the ambulance'). The relative clause was followed by the main verb (e.g., *deberían* 'should') and an infinitive (e.g., *expulsar* 'expel'). Our critical pronoun was an enclitic singular pronoun that followed the infinitive. Due to Spanish

orthographic rules, the infinitive and the pronoun were written together as a single word (e.g., *expulsarlo* 'expel him'). Gender of the critical pronoun was counter-balanced across items: the masculine object pronoun *lo* ('him') was used in half of the test items, and its feminine counterpart *la* ('her') was used in the other half. The phrases following the infinitive and enclitic pronoun varied across sentences, but were usually prepositional or adverbial modifiers.

Test sentences were distributed in a Latin Square design across 4 lists containing 52 fillers for a total of 76 sentences. Filler items varied in length and structural complexity.

2.3 Predictions

2.3.1 Referential conditions

We predict that gender-matching referential NPs inside the RC should be easily accessed because coreference is not subject to the c-command constraint between an antecedent and a pronoun. Thus, we expect undisrupted processing of the pronoun in the Referential–Match sentences. We predict immediate difficulty at the pronoun in the Referential–Mismatch sentences, since they do not contain a matching antecedent for the pronoun. This processing difficulty at gender-mismatching pronouns, relative to gender-matching ones, is thought to reflect a failure to establish a dependency (Sturt, 2003; Kazanina et al., 2007).

2.3.2 Quantificational conditions

If initial retrieval is not sensitive to feature-matching distractors, as previously reported, there should be no processing differences between gender-matching and -mismatching pronouns in the Quantificational conditions. Gender-match between a QP and a later pronoun should not facilitate pronoun processing, as inappropriate QPs would be ruled out by the c-command constraint. Under this outcome, no GMME should emerge at the pronoun in the Quantificational conditions. Conversely, if initial retrieval is susceptible to interference from feature-matching distractors, similar to other interference-prone dependencies, non-c-commanding but gender-matching QPs should facilitate the processing of the pronoun, relative to gender-mismatching QPs. Under this outcome, a GMME should emerge at the pronoun in the Quantificational conditions.

2.4 Procedure

The experiment was conducted online on PC Ibex (Zehr & Schwarz, 2018). We used the non-cumulative phrase-by-phrase centered self-paced reading paradigm (Ferreira & Henderson, 1990). Regions for presentation consisted of one to three words, as demarcated by forward slashes in Table 1. Participants were instructed to press the spacebar to reveal the next region in the sentence. All sentences were followed by a two-choice comprehension question.

2.5 Analysis

One participant, whose accuracy was below 80% on comprehension questions, was excluded from later analysis. Reading times (RTs) below 100 ms and above 3000 ms were removed, affecting less than 0.3% of all data. RTs were subsequently log-transformed and the resulting logRTs were used as the dependent variable for analysis.

Analysis was restricted to three regions of interest: the *Pronoun -1* region, which immediately preceded the critical pronoun (e.g., *la ambulancia* 'the ambulance'), the *Pronoun* region, which consisted of the infinitive and the object pronoun (e.g., *expulsarlo* 'expel him') and the subsequent *Pronoun +1* region (e.g., *del equipo* 'from the team'). Statistical analyses for each region were conducted with linear mixed effects models using the *lme4* (Bates et al., 2015) and *lmerTest* packages (Kuznetsova, Brockhoff & Christensen, 2017) in R (R Core Team, 2025). Models included sum-coded fixed effects of Referentiality (Quantificational: 0.5, Referential: –0.5) and Gender-Match (Mismatch: 0.5, Match: –0.5). We initially fit maximal models to our data (Barr et al. 2013) and subsequently determined the parsimonious random effects structure for each model according to the selection procedure described in Matuschek et al. (2017). All models included random intercepts for participant and item and no random slopes. Estimated p-values were calculated using the Satterthwaite approximation in *lmerTest*. Planned comparisons to calculate the GMMEs were computed using the *emmeans* library (Lenth, 2025).

2.6 Results

2.6.1 Comprehension question accuracy

Average accuracy was very high across conditions (Referential-Match = 0.98, Referential-Mismatch = 0.99, Quantificational-Match= 0.99, Quantificational-Mismatch = 0.98).

2.6.2 Reading times

A summary of mean by-condition reading times for the Pronoun -1, Pronoun and Pronoun +1 regions can be found in Table 2. A summary of statistical effects for the regions of interest is provided in Table 3. Average log-transformed reading times for each region are plotted in Figure 1.

Table 2. By-condition RTs in milliseconds for the Pronoun -1, Pronoun and Pronoun +1 regions in Experiment 1.

Condition	Pronoun -1		Pronoun		Pronoun +1	
	M	*SE*	*M*	*SE*	*M*	*SE*
Referential-Match	497	11	497	11	463	8
Referential-Mismatch	508	12	537	15	529	14
Quantificational-Match	511	13	526	14	490	11
Quantificational-Mismatch	514	13	522	13	504	11

Pronoun -1

No effects or their interaction reached significance at the Pronoun -1 region.

Pronoun

At the Pronoun region, only the Referentiality × Gender-Match interaction reached significance ($p < 0.05$). Pairwise comparisons revealed a significant GMME in the Referential condition ($d = 0.17$, 95% CI [0.04, 0.29], $p < 0.01$). Gender-match with a referential NP facilitated processing of the pronoun: the ReferentialMatch condition was read more quickly than the Referential-Mismatch condition (average raw RT difference = 40 ms). There was not a significant GMME in the

Quantificational conditions (average raw RT difference = 4 ms,(d = -0.02, 95% CI [-0.15, 0.10], p > 0.69).

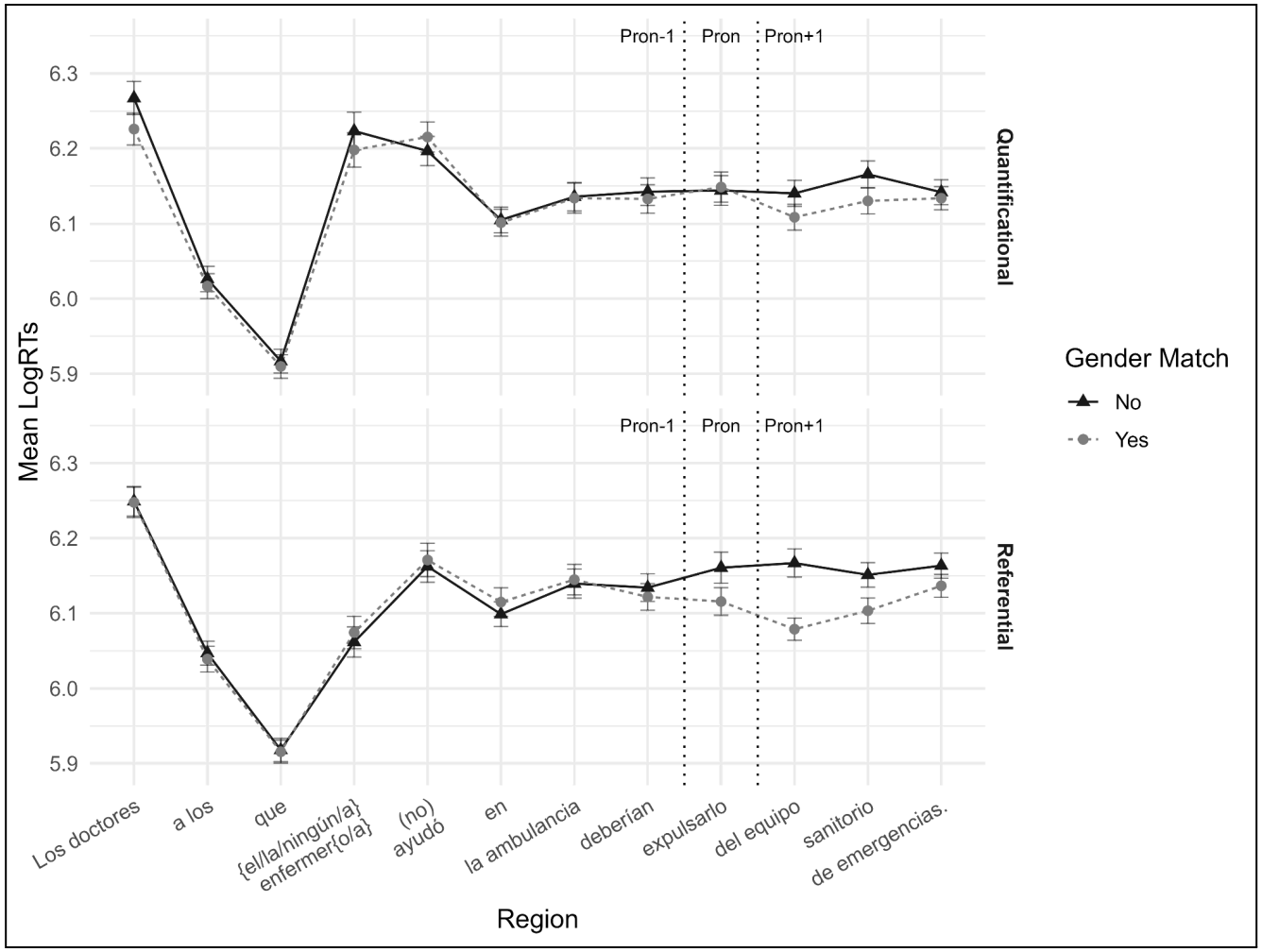
Pronoun +1

At the post-pronoun region, there was a significant main effect of Gender-Match (p < 0.001), qualified by a Referentiality × Gender-Match interaction (p < 0.05). As in the critical region, pairwise comparisons revealed a significant GMME in the Referential condition (d = 0.31, 95% CI [0.18, 0.43], p < 0.001), with faster reading times in the Referential-Match condition (average raw RT difference = 66 ms). In the Quantificational condition, gender-match yielded a small numerical difference (average RT difference = 14 ms). Pairwise comparisons showed that the quantificational GMME was only marginally significant (d = 0.11, 95% CI [−0.01, 0.24], p = 0.08).

Table 3. Summary of statistical effects for the Pronoun -1, Pronoun and Pronoun +1 regions in Experiment 1.

	Pronoun -1				Pronoun				Pronoun +1			
	β	*SE*	*t*	*p*	*β*	*SE*	*t*	*p*	*β*	*SE*	*t*	*p*
Referentiality	0.01	0.01	0.86	0.39	0.01	0.01	0.58	0.56	0.00	0.01	0.05	0.96
Gender-Match	0.01	0.01	0.85	0.40	0.02	0.01	1.58	0.11	0.06	0.01	4.67	0.000003
Referentiality × Gender-Match	0.00	0.03	-0.08	0.94	-0.06	0.03	-2.13	0.03	-0.06	0.03	-2.18	0.03

Figure 1. Region-by-region log-transformed reading times by Referentiality (Quantificational vs. Referential) and Gender-Match (Mismatch vs. Match) in Experiment 1. The Pronoun region is 'expulsarlo'.



2.7 Discussion

At the Pronoun region, the Referentiality × Gender-Match interaction indicated that there were clear processing differences between Referential and Quantificational sentences. The presence of a GMME in the Referential condition, and its absence in the Quantificational condition, suggests that gender-match between the pronoun and a non-c-commanding NP facilitated pronoun processing in the Referential conditions, but not in the Quantificational conditions. Thus, our earliest reading time measure suggests that antecedent retrieval is not susceptible to structurally inappropriate antecedents. At the Pronoun +1 region, gender-match continued to have a strong facilitatory effect in the Referential-Match condition, as indicated by the large Referential GMME. Gender-match also appeared

to have a small facilitative effect in the Quantificational–Match condition, as there was a numerical trend towards a GMME in the Quantificational conditions. However, pairwise comparisons indicated that this effect was only marginally significant. We abstain from interpreting this trend too strongly, as we found statistical evidence for an interaction in the Pronoun region, which we consider diagnostic for the absence of retrieval interference. We speculate, however, that the numerical trend toward a quantificational GMME might reflect a later *accommodation* strategy following the failure to find a grammatical antecedent for the pronoun. Under this hypothesis, a referent external to the current sentence may be more easily coerced from a gender-matching QP, allowing the pronoun to be interpreted as referring to this extra-sentential individual (see Filik, Sanford, & Leuthold, 2008; Nieuwland, 2014). Importantly, while a matching QP can ease pronoun processing under an accommodation account, the QP itself would not be considered the potential antecedent for the pronoun. We therefore take the possibility of accommodation to index a repair process, not an instance of retrieval interference.

Overall, our results suggest that immediately upon encountering a pronoun, comprehenders readily access a gender-matching referential NP that does not c-command the pronoun, but not a gender-matching QP in the same position. We replicated the findings from previous studies: antecedent retrieval appears to be initially insensitive to structurally inappropriate but feature-matching QPs as potential antecedents. As previously reported, c-command relations immediately influence antecedent retrieval for pronoun resolution. The lack of statistical evidence for facilitation from a QP's features in our study and prior work could suggest that antecedent retrieval is immune to partial-match interference. However, in all previous studies, the critical pronoun appeared in postverbal position, which could potentially reduce the influence of gender-matching QPs (see Kush & Phillips, 2014; Parker & Phillips, 2016). In order to test whether antecedent retrieval always ignores feature-matching distractors, regardless of surface-structure differences, or whether pronoun position has an effect on the incidence of facilitatory interference, we conducted Experiment 2 using the same test sentences as in Experiment 1, but with the critical pronoun in preverbal position.

Chapter 3: Experiment 2 – Preverbal clitics

Experiment 2 tests whether antecedent retrieval is subject to interference from non-c-commanding QPs when pronouns are linearly closer to the edge of a QP's c-command domain.

3.1 Participants

86 native speakers of Spanish (48 male, mean age = 29) participated in the experiment. All participants were born in and resided in Spain and were recruited on Prolific. Participants were paid CAD$12 for their participation, which typically lasted 25 minutes.

3.2 Materials

Test sentences were made up of 24 item sets, each consisting of 4 conditions. Sentences were identical to Experiment 1, except that the pronoun was moved to preverbal position. An example item set is provided in Table 4. See Tables A1 and A2 in the Appendix for the full list of experimental items.

Table 4. Example item set for Experiment 2. Presentation regions are demarcated by forward slashes.

Condition	Sentence
Referential–Match	Los doctores/ $_{RC}$[a los /que/ *el enfermero*$_i$/ no ayudó/ en/ la ambulancia]/ lo$_i$ deberían/ expulsar / del equipo / sanitario/ de emergencia. The doctors/ $_{RC}$[DOM D.3PL.MASC / C / *the nurse*$_{i\text{-MASC}}$/ did not help/ in/ the ambulance]/ him$_i$ should / expel/ from the team / for medical/ emergencies. 'The doctors who the male nurse did not help in the ambulance should expel him from the emergency medical team'.
Referential–Mismatch	Los doctores/ $_{RC}$[a los /que/ *la enfermera*$_i$/ no ayudó/ en/ la ambulancia]/ lo$_i$ deberían/ expulsar / del equipo / sanitario/ de emergencia. The doctors/ $_{RC}$[DOM D.3PL.MASC / C / *the nurse*$_{i\text{-FEM}}$/ did not help/ in/ the ambulance]/ him$_i$ should / expel/ from the team / for medical/ emergencies. 'The doctors who the female nurse did not help in the ambulance should expel him from the emergency medical team'.

	Los doctores/ $_{RC}$[a los /que/ *ningún enfermero*$_i$/ ayudó/ en/ la ambulancia]/ lo$_i$ deberían/ expulsar / del equipo / sanitario/ de emergencia.
Quantificational–Match	The doctors/ $_{RC}$[DOM D.3PL.MASC / C / *no* *nurse*$_{i\text{-MASC}}$/helped/ in/ the ambulance]/ him$_i$ should / expel/ from the team / for medical/ emergencies. 'The doctors who no male nurse helped in the ambulance should expel him from the emergency medical team'.
	Los doctores/ $_{RC}$[a los /que/ *ninguna enfermera*$_i$/ ayudó/ en/ la ambulancia]/ lo$_i$ deberían/ expulsar / del equipo / sanitario/ de emergencia.
Quantificational–Mismatch	The doctors/ $_{RC}$[DOM D.3PL.MASC / C / *no* *nurse*$_{i\text{-FEM}}$/ helped/ in/ the ambulance]/ him$_i$ should / expel/ from the team / for medical/ emergencies. 'The doctors who no female nurse helped in the ambulance should expel him from the emergency medical team'.

3.3 Predictions

3.3.1 Referential conditions

As in Experiment 1, we expect a gender-mismatch effect in the referential conditions, as Referential–Match sentences have a grammatical antecedent in the sentence, while Referential–Mismatch sentences do not.

3.3.2 Quantificational conditions

If pronoun position influences interference, the shorter distance between the QP and the pronoun in Experiment 2 should increase the QP's influence on retrieval. In this case, gender-match with a QP should facilitate pronoun processing more strongly than in Experiment 1, resulting in a GMME in the Quantificational condition. In contrast, if pronoun position does affect interference, the shorter distance between the QP and the pronoun in Experiment 2 should not increase the QP's influence on retrieval. Gender-match with a QP should not significantly facilitate pronoun processing, similar to the results of Experiment 1. Under this outcome, no GMME should emerge in the Quantificational condition.

3.4 Procedure & Analysis

The procedure, model selection and analysis were identical to Experiment 1. Reading times (RTs) below 100 ms and above 3000 ms were removed, affecting 0.3% of all data. Analysis was restricted to the same three regions of interest: the *Pronoun -1* region, which immediately preceded the critical pronoun (e.g., *la ambulancia* 'the ambulance') the *Pronoun* region, which consisted of the object pronoun (e.g., *lo* 'him') and the main verb (e.g., *deberían* 'should'), and the *Pronoun +1* region, which always contained an infinitive (e.g., *expulsar* 'expel'). Mixed effects models for the Pronoun -1 region included by-participant and by-item random intercepts. Models for the Pronoun and Pronoun +1 regions included by-participant random intercepts and slopes for Gender-Match, and by-item random intercepts.

3.6 Results

3.6.1 Comprehension question accuracy

Average accuracy was very high across conditions (Referential-Match = 0.98, Referential-Mismatch = 0.99, Quantificational-Match= 0.98, Quantificational-Mismatch = 0.99).

3.6.2 Reading times

A summary of mean by-condition reading times for the Pronoun -1, Pronoun and Pronoun +1 regions can be found in Table 4. A summary of statistical effects for the regions of interest is provided in Table 5. Average log-transformed reading times for each region are plotted in Figure 2.

Table 4. By-condition RTs in milliseconds for the Pronoun -1, Pronoun and Pronoun +1 regions in Experiment 2.

Condition	Pronoun -1		Pronoun		Pronoun +1	
	M	*SE*	*M*	*SE*	*M*	*SE*
Referential-Match	495	13	528	13	474	10
Referential-Mismatch	489	12	563	16	535	15
Quantificational-Match	508	13	548	14	492	10
Quantificational-Mismatch	518	13	557	14	520	11

Pronoun -1

No effects or their interaction reached significance at the Pronoun -1 region, although the main effect of Referentiality was marginally significant ($p = 0.054$).

Pronoun

No effects or their interaction reached significance at the Pronoun region.

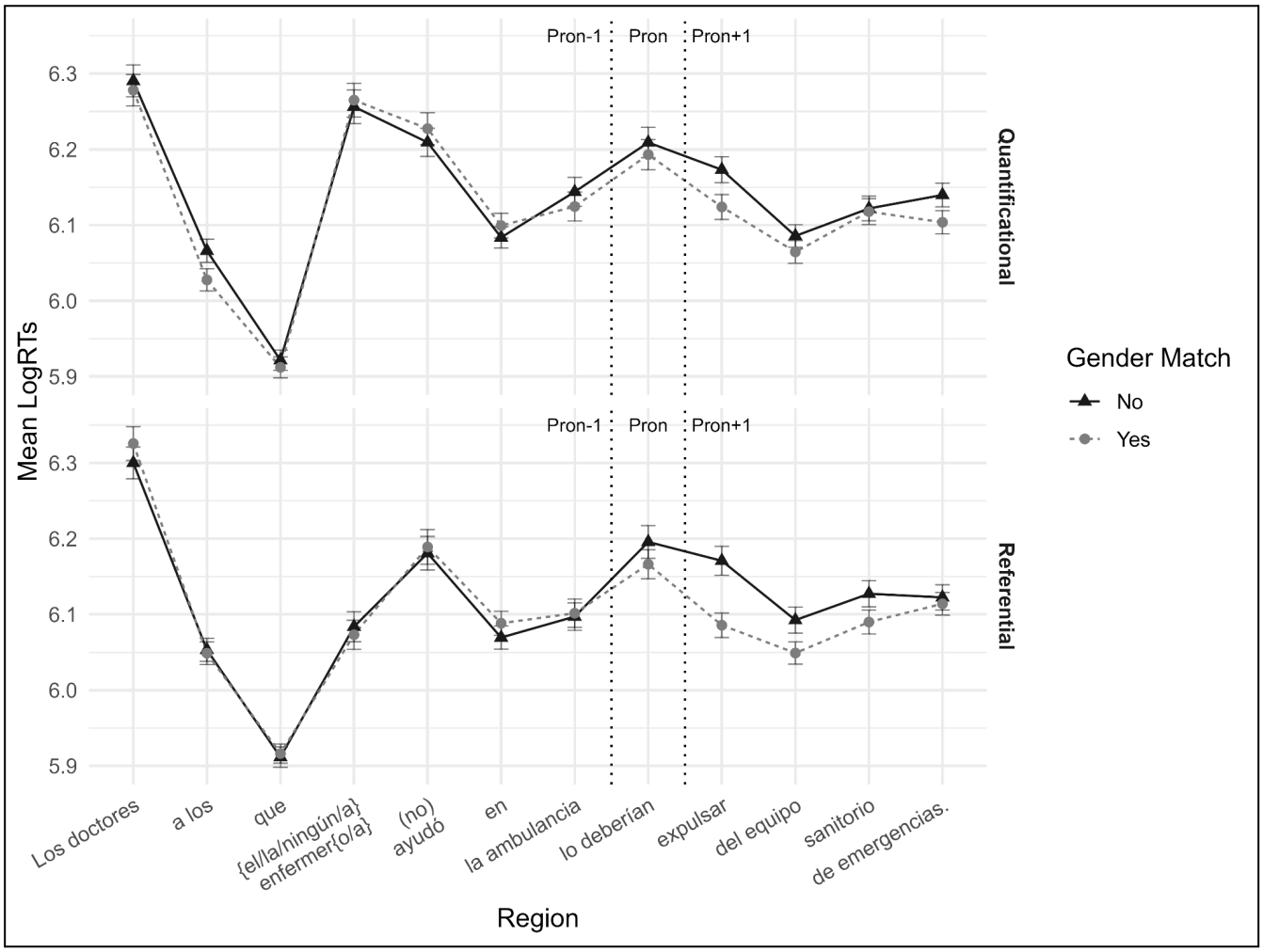
Pronoun +1

At the Pronoun +1 region there was only a statistically significant main effect of Gender-Match ($p < 0.001$): matching pronouns were read more quickly than mismatching pronouns (average raw RT difference = 40 ms). Pairwise comparisons revealed significant GMMEs in both the Referential ($d = 0.23$, 95% CI [0.09, 0.36], $p < 0.001$) and Quantificational ($d = 0.15$, 95% CI [0.01, 0.28], $p < 0.05$) conditions (raw RT differences: Referential GMME = 54 ms, Quantificational GMME: 26 ms). The Referentiality × Gender-Match interaction did not reach significance, indicating that the numeric difference in the magnitude of the GMME between Referential and Quantificational sentences was not reliable.

Table 5. Summary of statistical effects for the Pronoun -1 (‘la ambulancia’), Pronoun (‘lo deberían) and Pronoun +1 (‘expulsar’) regions in Experiment 2.

	Pronoun -1				Pronoun				Pronoun +1			
	β	*SE*	*t*	*p*	*β*	*SE*	*t*	*p*	*β*	*SE*	*t*	*p*
Referentiality	0.03	0.01	1.93	0.93	0.01	0.01	0.59	0.56	0.01	0.01	0.80	0.42
Gender-Match	0	0.01	-0.09	0.054	0.02	0.02	1.28	0.20	0.05	0.01	3.72	0.0003
Referentiality × Gender-Match	0.01	0.03	0.50	0.61	-0.02	0.03	-0.67	0.51	-0.02	0.03	-0.92	0.36

Figure 2. Region-by-region log-transformed reading times by Referentiality (Quantificational vs. Referential) and Gender-Match (Mismatch vs. Match) in Experiment 2. The Pronoun region is 'lo deberían'.



3.7 Discussion

At the Pronoun +1 region, the Referential conditions exhibited a clear GMME. As expected, comprehenders can rapidly retrieve gender-matching referential NPs that do not c-command a later pronoun, but not mismatching referential NPs. Interestingly, and contrary to previous studies, we also found a statistically significant GMME in the Quantificational conditions: reading times were faster when a non-c-commanding QP matched the pronoun in gender than when it mismatched it. We interpret this facilitatory effect as evidence that gender-matching non-c-commanding QPs were retrieved. The absence of a Referentiality × Gender-Match interaction, further suggests that the referential status of the previous NP did not have a reliable effect on its accessibility to retrieval.

To our knowledge, this is the first study to demonstrate partial-match facilitatory interference from non-c-commanding QPs during pronoun resolution. In conjunction with the results from Experiment 1, our findings suggest that the influence of structurally inappropriate QP's on antecedent retrieval varies as a function of distance. We now consider potential mechanisms by which pronoun position may modulate susceptibility to interference in the General Discussion.

Chapter 4: General Discussion

4.1 Summary of Results

QP-pronoun binding relations are subject to a relational constraint that does not restrict NP-pronoun coreference relations; QPs must c-command a critical pronoun to license quantificational binding. In a previous study in English, Kush, Lidz, & Phillips (2015) found that non-c-commanding QPs do not interfere with antecedent retrieval. Analogizing from results on illusory NPI licensing, we hypothesized that the absence of facilitatory interference from non-c-commanding QPs in previous work could be attributed to the linear position of English object pronouns. Because object pronouns are always postverbal in English, we hypothesized that the distance between the right edge of the relative clause (the QP's c-command domain) might have provided enough time to make the QP inaccessible before antecedent retrieval occurred. In two online self-paced reading studies in Spanish, we used a gender-mismatch paradigm to gauge whether a non-c-commanding potential antecedent NP was accessible to antecedent retrieval for a critical pronoun. We manipulated whether the NP was referential (and therefore a grammatical antecedent) or quantificational (and hence was not a grammatical antecedent). We expected that the referential NP would be accessible, but were interested in determining how much the quantificational NP would interfere with retrieval. We further tested if distance between the pronoun and the right edge of an RC containing the potential antecedent modulated interference using clitic climbing configurations: critical pronouns came after the main clause VP in Experiment 1, but before the main clause VP in Experiment 2. If distance has an effect on interference, we expected greater interference when the pronoun was closer to the RC than when it was further away.

In Experiment 1 we found a Referentiality × Gender-Match interaction at the Pronoun region: gender-match with the pronoun had a clear facilitatory effect in the Referential conditions, but we did not find evidence of facilitation in the Quantificational conditions. Overall, our results align with the findings from Kush, Lidz, & Phillips (2015) that non-c-commanding QPs were not accessible to initial retrieval when the pronoun is postverbal. In Experiment 2, when the critical pronoun was preverbal, we found significant GMMEs in both Referential and Quantificational conditions, indicating that gender-match facilitated pronoun processing regardless of the referential status of the potential

antecedent. This pattern of effects suggests that retrieval accessed matching non-c-commanding QPs when the pronoun was in preverbal position.

Overall, we find that the incidence of interference from non-c-commanding QPs is higher when the pronoun appears in preverbal position, compared to postverbal position. In what follows, we address our (perhaps) surprising results in conjunction with the idea that a representational update for the QP must occur at the edge of the RC to eventually make it "invisible" to retrieval. We furthermore discuss the time-course of this update and how being linearly closer to the edge of the RC might increase the possibility that the update has not been completed.

4.2 Scope & Quantificational Binding

Quantifiers can bind a pronoun insofar as they scope over it. In most cases, a QP's scope domain is the portion of the sentence that it c-commands. For example, *no boy* in (1) scopes over the pronoun *him* because it c-commands the relative clause that contains the pronoun.

(1) *No boy*$_{i}$ respects the teachers [that want to punish *him*$_{i}$].

(2a) The teachers [that *no boy*$_{i}$ respects…

(2b) The teachers [that *no boy*$_{i}$ respects] want…

(2c) The teachers [that *no boy*$_{i}$ respects] want to punish *him*$_{*i/j}$.

Now compare *no boy* in (1) to the same QP in (2). In the truncated sentence in (2a), the QP is embedded in an RC that modifies the matrix subject *the teachers*. At this stage in processing, the QP can scope over anything in the RC, as it corresponds to the part of the sentence that it currently c-commands. Importantly, a quantifier can lose its ability to bind a later pronoun as soon as material outside of the quantifier's scope domain begins to be built . For example, the edge of the QP's scope domain in (2b) corresponds to the right edge of the RC (as demarcated by the right square bracket). But how does the processor recognize the edges of the RC? Ultimately, linguistic input does not come annotated with clause boundaries. Evidence for the end of the RC can come from bottom-up syntactic evidence that a higher clause is being processed (Frazier, 1979). In (2b) unambiguous bottom-up evidence comes from the main verb *want*. The main verb signals the end of the RC, since low attachment of *want* is not possible, and cues the processor to resume parsing material in the MC.

Having identified the edge of the QP's scope domain, the processor should now be able to recognize that the QP is not a grammatical binder for the pronoun *him* in (2c), as it falls outside its scope domain.

We hypothesize that a representational update is required at the edge of the RC to reflect that ungrammatical QP binders should not be accessed by antecedent retrieval. The fact that this update coincides with the end of the RC aligns with the observation that the RC marks the edge of the QP's scope domain (e.g., Reinhart, 1997; Heim & Kratzer, 1998), or, alternatively, the "life-span" of the discourse referent associated with the QP (e.g., Karttunen, 1976; Kamp & Reyle, 1993). We discuss three possible mechanisms by which an incremental processor could implement the hypothesized representational change, and explore how distance may affect the time-course of this update.

4.3 Dynamic Encodings

4.3.1 Feature compression (Parker & Phillips, 2016)

A key assumption of the cue-based architecture is that the individual features of a linguistic representation can be evaluated independently, creating the opportunity for partial-match interference at retrieval. In contrast, Parker & Phillips (2016) suggest that the format of a representation in memory changes over time. Specifically, they propose that the encoding of the chunk-based representation of a sentence occurs in two stages. In the first stage, the processor builds a representation in which features can be independently evaluated. At this stage, individual features such as [+masculine] and [+singular] can still be accessed, potentially giving rise to partial-match interference effects. In the second stage, the previously independent features [+masculine] and [+singular] are compressed into an atomic composite (e.g. [+masculinesingular]). Because individual feature values are no longer accessible at this stage[8], the new compressed representation must exhibit an all-or-nothing match of the retrieval cues of the probe to be recovered, thus preventing the possibility of partial-match interference.

Under this view, partial-match interference is only possible if retrieval probes an encoding before the consolidation process has taken place. Partial-match interference from an inappropriate QP should not be possible if retrieval occurs after the features of the QP have been compressed into a bound representation, which is more likely to have happened the later the pronoun comes in the sentence.

[8]Though note that "the component items are not forever inaccessible. The sub-components of a representation may be recovered later via decoding processes that unpack the contents of the representation" (Parker & Phillips, 2016, p. 336).

However, if the critical pronoun appears at a time where the feature values of the individual constituents of the RC are still independently accessible, such as in preverbal position, individual features such as [+masculine] might be used to access gender-matching non-c-commanding QPs.

To illustrate how interference might arise with preverbal but not postverbal pronouns, consider (3a,b), which mirror the clitic climbing manipulations in our study. Since pronouns require antecedents that match their morphological features, we can assume that cues such as [+masculine] and [+singular] are used to retrieve an antecedent[9].

(3a) The teachers [that *no boy* respects] *him* want to punish.
[+masc] [+masc]
[+sing] [+sing]

(3b) The teachers [that *no boy* respects] want to punish *him*.
[+mascsing] [+masc]
[+sing]

The QP *no boy* in (3) matches the gender and number features of the pronoun *him*. However, it is not a grammatical antecedent because it does not scope over it. Following Parker & Phillips' proposal, the closer the pronoun is to the edge of the RC, the less likely it is that the compression of features of the RC has been completed. Therefore, it is likely that individual features are still evaluable when the pronoun is preverbal in (3a) because it both immediately follows the RC and precedes bottom-up syntactic evidence that the end of the RC has been reached (i.e., the main verb *want*). Since partial-match interference is possible in this initial stage, the feature-matching QP *no boy* may be incorrectly retrieved. This is consistent with the pattern of facilitatory interference we found in our preverbal experiment, where gender-matching QPs initially exerted a facilitatory effect on retrieval.

Now consider (3b), where the pronoun is in postverbal position. Given that it is further away from the RC, Parker & Phillips' account predicts that the relevant compression of the RC should be completed by the time retrieval for the pronoun's antecedent begins. If that is the case, the individual feature values of the QP in the RC would have been bound together into a representation that cannot be accessed with partial-matching, thus preventing interference from inappropriate QPs. The results from Experiment 2 are consistent with this prediction, as initial retrieval seemed to not access gender-matching non-c-commanding QPs.

[9]Note that this is an oversimplification. Presumably, retrieval uses other cues such as [+animate] or [+subject].

Importantly, while the feature compression account makes the right predictions about the (in)accessibility of non-c-commanding QPs, it appears to make the wrong prediction for referential NPs in the same position. Recall that non-c-commanding referential NPs are grammatical antecedents for an anaphor and should therefore be accessible. If the compression procedure applies to all items inside the RC uniformly, it should make the referential NP *the boy* in (4) inaccessible to retrieval, as it did with the QP *no boy* in the same position in (3b).

(4) The teachers [that *the boy* respects] want to punish *him*.
[+mascsing] [+masc]
[+sing]

However, evidence from our postverbal experiment, as well as previous studies (Kush, Lidz, & Phillips, 2015; Cunnings et al., 2015), indicates that comprehenders rapidly access referential NPs that do not c-command a pronoun. This challenges the prediction that the feature compression mechanism applies uniformly at the edge of the RC.

An additional consideration about Parker and Phillips' account is that the compression procedure is, in some sense, independent of any semantic motivation. The account does not make any reference to scope, and the relevant changes in feature encodings at the end of the RC occur independently of whether a QP takes scope or not. An alternative strategy would be to use a feature to distinguish QPs that no longer take scope over the part of the structure being processed from other items in memory. We explore this possibility below.

4.3.2 ACCESSIBLE feature (Kush, 2013)

Kush (2013) proposed the use of a dynamically updated "bookkeeping" feature, called ACCESSIBLE, to track whether an NP is accessible to antecedent retrieval at the current state of processing. NPs that are possible antecedents bear [+ACCESSIBLE], and those that are not are marked as [-ACCESSIBLE]. Pronouns are assumed to cue for [+ACCESSIBLE] antecedents and items that are marked as [-ACCESSIBLE] should be excluded from retrieval via some sort of gating effect (Van Dyke & McElree, 2011).[10] Under these assumptions, the ACCESSIBLE feature can be used to

[10]This gating function could be implemented either through a linear cue-combinatorics scheme that preferentially weights ACCESSIBLE over morphological feature-match, or through a nonlinear (i.e., multiplicative) scheme that responds only to the conjunction of cues (e.g., morphological match *and* +ACCESSIBLE).

implement the scope constraint on quantificational binding if QPs that do not c-command a pronoun are marked as [-ACCESSIBLE] by the time that pronoun is encountered. By contrast, referential NPs in the same configuration should still bear [+ACCESSIBLE]. The examples in (5,6) illustrate the desired distribution of the ACCESSIBLE feature when the pronoun *him* is encountered.

(5) The psychologists [that *the linguist*$_{[+\text{ACCESSIBLE}]}$ liked] waved at *him*.

(6) The psychologists [that *no linguist*$_{[-\text{ACCESSIBLE}]}$ liked] waved at *him*.

Importantly, although the feature tracks distinctions that could be stated in terms of item-to-item c-command relations, ACCESSIBLE was not envisioned as a "c-command feature"; that is, it does not encode a relation between a QP and a specific pronoun. Instead, it encodes a QP's potential accessibility as an antecedent for *any* pronoun given the current parse state. As the parse state changes, the feature value of a QP can be dynamically changed if the parser reaches a portion of the structure where the QP stops taking scope. At that point, the QP's feature value has to be updated from [+ACCESSIBLE] to [-ACCESSIBLE] to reflect that it is no longer a viable retrieval target. A step-by-step illustration of the proposed updating process, based on an item from Experiment 1, is provided in (7).

Kush (2013) proposes that all NPs are initially introduced as [+ACCESSIBLE]. Accordingly, when the QP *ningún chico* 'no boy' in (7) is initially encoded, it is assigned a value of [+ACCESSIBLE]. As long as as more material is built inside the RC, the QP will continue to be marked as [+ACCESSIBLE], as it takes scope over that material. The main verb *quieren* 'want' marks the right edge of the QP's scope domain. At that point, the QP's ACCESSIBLE value must be recoded to [-ACCESSIBLE]. Lastly, the object clitic *lo* 'him', attached to the infinitive *castigar* 'punish', triggers retrieval for a [+ACCESSIBLE] antecedent. The QP does not bear the correct ACCESSIBLE value and should therefore not be retrieved.

(7) Las profesoras [a las que ningún chico$_{[+\text{ACC}]}$...	*Encode QP as* +ACC
Las profesoras [a las que ningún chico$_{[+\text{ACC}]}$ *respeta*…	*Continue*
Las profesoras [a las que ningún chico$_{[+\text{ACC}]}$ respeta] *quieren*…	*'quieren' marks end of the QP's scope domain*
Las profesoras [a las que ningún chico$_{[-\text{ACC}]}$ respeta] *quieren*	*Recode* ACC *on QP*

Las profesoras [a las que ningún chico$_{[-ACC]}$ respeta] quieren *castigar**lo***	*Retrieve* +ACC *antecedent; QP not retrieved*

For the processor to update the ACCESSIBLE feature of a QP that no longer takes scope, it has to first recognize when it has reached the end of the RC. In the example in (7), the main verb is the bottom-up evidence of the RC's right edge. However, if the critical pronoun preceded the main verb, as in Experiment 2 , the processor might not have enough time to update the QP's ACCESSIBLE feature before antecedent retrieval for the pronoun begins. Thus, we would predict interference.

Let's walk through how interference would arise with an item from Experiment 2. As above, we assume that the QP is encoded as [+ACCESSIBLE] when it is first introduced and remains [+ACCESSIBLE] throughout the RC. Importantly, the first word after the RC is the object clitic *lo*. If antecedent retrieval starts before the processor has time to process that the pronoun is in a part of the structure that the QP cannot scope over, the QP would still bear [+ACCESSIBLE]. Assuming that retrieval uses the cues [+masculine], [+singular] and [+ACCESSIBLE], the QP matches all three cues at the point of retrieval, giving rise to interference. This pattern of effects is consistent with our results from Experiment 2, where we found evidence of interference from gender-matching non-c-commanding QPs.

(8) Las profesoras [a las que *ningún chico*$_{[+ACC]}$...	*Encode QP as* +ACC
Las profesoras [a las que ningún chico$_{[+ACC]}$ *respeta*…	*Continue*
Las profesoras [a las que ningún chico$_{[+ACC]}$ respeta] ***lo*** *quieren*	*Retrieve* [+ACC] *antecedent, QP retrieved*
Las profesoras [a las que ningún chico$_{[-ACC]}$ respeta] *lo quieren*	*Recode* ACC *on QP*
Las profesoras [a las que ningún chico$_{[+ACC]}$ respeta] lo quieren *castigar*.	*End*

4.3.3 Discourse representation theory (DRT)

The proposals of Parker and Phillips (2016) and Kush (2013)/Kush et al. (2015) share the assumption that retrieval targets chunks in memory that correspond to constituents in the syntactic representation. A limitation of this approach, however, is that referential identity is not explicitly

encoded in the syntax. To illustrate this, consider (9), where the pronoun *him* is coreferent with the NP *the man*.

(9) *The man*$_i$ said that the girl punched *him*$_i$.

Both *the man* and *him* "point" to the same individual (i.e., the same man denoted by 'the man'), but this identity is not transparently represented in the syntactic structure. Rather, we need a level of representation in which *the man* and *he* are represented as being equivalent, that is, as referring to the same discourse entity. In what follows, we explore the possibility that retrieval accesses antecedents directly in the discourse representation, which has a structure that follows the principles from *Discourse Representation Theory* (DRT, Kamp & Reyle, 1993; Geurts, Beaver & Maier, 2007). The discourse representation is, arguably, the only level of representation where both coreference and variable binding are represented. As such, we believe that modeling retrieval for a pronoun's antecedent at the discourse level is a worthy endeavour.

The key feature of DRT is that comprehenders build a discourse representation that tracks individuals, called discourse referents, and information about them, represented as predicates. On this account, NPs in the syntactic representation are mapped onto discourse referents in the discourse model. For example, the NPs *the man* and *the girl* in (9) would introduce the discourse referents *x* and *y*, as well as the predicates *man(x)* and *girl(y)*. Pronouns (under normal circumstances) are interpreted by being linked to established discourse referents. Accordingly, coreference between *him* and *the man* in (9) is mediated through the discourse referent *x*, as shown in logical form in (10) and in box format in (11)

(10) $\exists x \exists y[\text{man}(x) \wedge \text{girl}(y) \wedge \text{said}(x, \text{punched}(y,x))]$

(11)

x, *y*
man(x) girl(y) said(x, punched(y,x))

Although DRT was not originally proposed as a theory of word-by-word processing, some authors have adapted principles from DRT to model incremental pronoun resolution (e.g., Discourse Prominence Theory, Gordon & Hendrick, 1998). In this paper, we adopt two central ideas from Discourse Prominence Theory. First, a sentence's discourse representation is dynamically constructed as linguistic input unfolds over time. Second, the processor actively maintains a set of accessible discourse referents that are potential antecedents for a pronoun. Resolving an anaphor involves selecting a discourse referent from this set.[11] We diverge from Discourse Prominence Theory in the following two respects. In addition to being introduced into the accessible set, we propose that discourse referents can be deleted from this set if they are no longer viable antecedents for a pronoun. We show that this deletion procedure can be used to block access to QPs that no longer take scope. Furthermore, while Discourse Prominence Theory assumes a serial search of the accessible set, we adopt a parallel cue-based retrieval mechanism. Accordingly, we assume that discourse referents in the set are annotated with features that can be used as retrieval cues. In this approach, encountering a pronoun triggers retrieval from the set of accessible discourse referents to find a suitable antecedent. To illustrate how the basic case might work, we sketch how antecedent retrieval for a referential item from Experiment 1 would proceed in an incremental DRT-based model of pronoun resolution.

First, the NP *las profesoras* 'the teachers' introduces the discourse referent *x* and the predicate *profesoras(x)* into the discourse representation. The set of accessible discourse referents at the current parse state thus consists of {x}, which is marked as [+feminine] and [+singular]. As more input is processed, the NP *el chico* 'the boy' in the RC similarly introduces the discourse referent *y* and the predicate *chico(y)*. Now the accessible set includes {x, y}, and *y* is marked as [+masculine] and [+singular]. Encountering the object pronoun *lo* 'him' triggers antecedent retrieval from the set of accessible discourse referents {x, y}. *Lo* cues for a [+masculine] and [+singular] discourse referent, and within the set, only *y* matches the retrieval cues of the pronoun. Thus, *y* would be identified as a potential referent and would consequently be retrieved. Lastly, the pronoun would be interpreted as coreferring with *el chico* via its discourse referent *y*.

[11]Gordon & Hendrick (1998) posit that the set of accessible discourse referents is ordered in terms of syntactic prominence. Retrieval then searches the list of discourse referents in order of accessibility and preferentially selects the most accessible (i.e., prominent) suitable antecedent. The specifics of Discourse Prominence Theory are not relevant for the current discussion.

(12) Las profesoras [a las que el chico no respeta] quieren castigarlo.
The teachers [who the boy does not respect] want to punish him.

(13) Las profesoras…
The teachers…

X
profesora(X)

Active discourse referents: $\{X_{[+fem,+pl]}\}$

Las profesoras [a las que el chico…
The teachers [who the boy…

X, y
profesora(X) chico(y)

Active discourse referents: $\{X_{[+fem,+pl]}, y_{[+masc,+sg]}\}$

Las profesoras [a las que el chico no respeta…
The teachers [who the boy does not respect…

X, y
profesora(X) chico(y) ¬respeta(y,X)

Active discourse referents: $\{X_{[+fem,+pl]}, y_{[+masc,+sg]}\}$

Las profesoras [a las que el chico no respeta] quieren…
The teachers [who the boy does not respect] want…

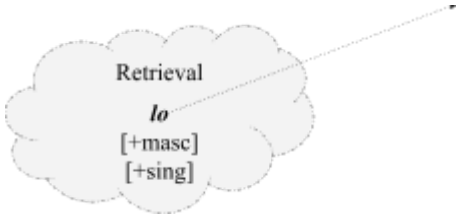
X, y
profesora(X) chico(y) ¬respeta(y,X) quieren(X,

Active discourse referents: $\{X_{[+fem,+pl]}, y_{[+masc,+sg]}\}$

Las profesoras [a las que el chico no respeta] quieren castigar**lo**.
The teachers [who the boy does not respect] want to punish **him**.

X, y
profesora(X) chico(y) ¬respeta(y,X) quieren(X, castigar(X,

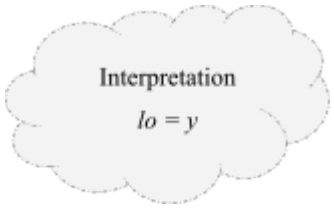
Active discourse referents: {$X_{[+fem,+pl]}$, $\mathbf{y}_{[+masc,+sg]}$}



Las profesoras [a las que el chico no respeta] quieren castigarlo.
The teachers [who the boy does not respect] want to punish him.

X, y
profesora(X) chico(y) ¬respeta(y,X) quieren(X,castigar(X,y))

Active discourse referents: {$X_{[+fem,+pl]}$, $y_{[+masc,+sg]}$}



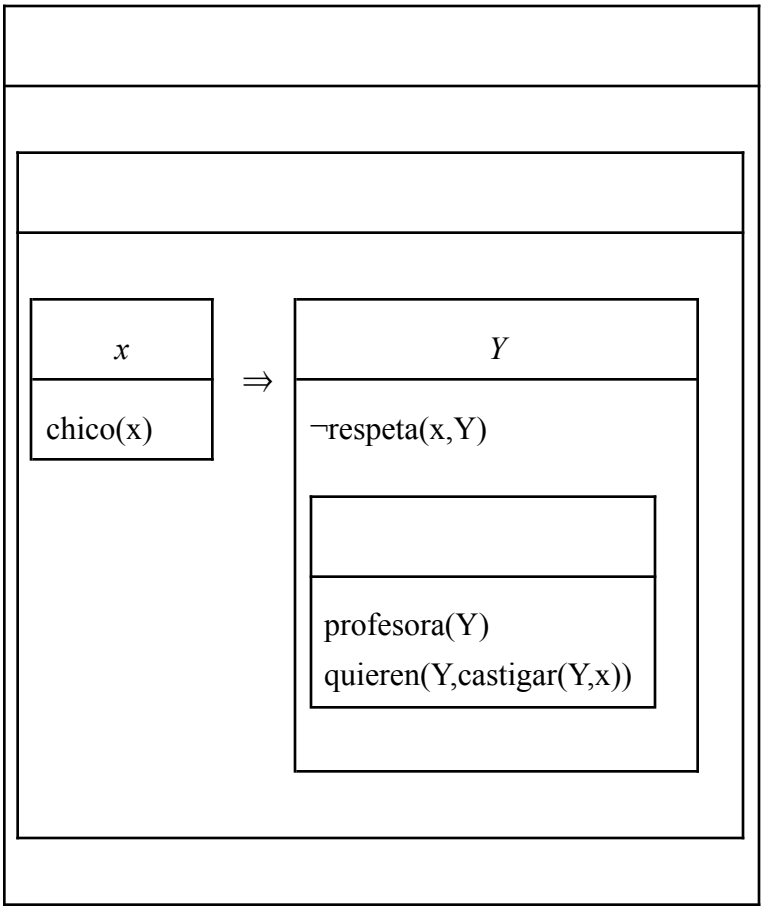
Having seen how the system deals with referential NPs and coreferential pronouns, let's now turn to how QPs are resolved in a DRT-based approach. A non-standard assumption of DRT is that QPs introduce discourse referents, just as referential NPs do[12]. Thus, for QP-pronoun binding relations such as (14), pronoun resolution involves retrieving the discourse referent *x* associated with the QP *ningún chico* 'no boy' and interpreting it as the antecedent of *lo* 'him' (15,16).

(14) *Ningún chico* respeta a las profesoras que quieren castigar*lo*.
No boy respects the teachers who want to punish-*him*.

(15) $\forall x[boy(x) \rightarrow \neg \exists y[teacher(Y) \wedge want(Y,punish(Y,x)) \wedge respects(x,Y)]]$

[12]In this sense, discourse referents in DRT function as variables.

(16)



The reader will notice that the discourse referent *x* for the QP *ningún chico* is not introduced in the main discourse (i.e., the outer box), as its referential counterpart *el chic*o in (13) was. Instead, it is introduced in a *subdiscourse* (i.e., the large inner box) contained within the main discourse in (16) (van Eijck & Kamp, 2011). This key difference between referential NPs and QPs arises from the semantics of quantification, which introduces a conditional relation between subdiscourses, represented by ⇒. Everything in the scope of a QP is contained within the subdiscourse where it is introduced. Thus, QP discourse referents are accessible as antecedents for a pronoun only if the pronoun falls within a part of the structure that corresponds to this subdiscourse. In order to represent that a QP in a subdiscourse is no longer accessible once it stops taking scope, we propose that its discourse referent ought to be deleted from the set of available discourse referents. Below we sketch how this deletion procedure could be implemented at the right edge of the RC of a quantificational item from Experiment 1 (17,18).

As in (13), the NP *las profesoras* 'the teachers' in (17) introduces a discourse referent, *x*, and a predicate, *profesoras(x)*, into the discourse representation. The set of accessible discourse referents at the current parse state consists of {x}, which bears [+feminine] and [+plural]. The QP *ningún chico* 'no boy' introduces a discourse referent, *y*, and a predicate, *chico(y)*, in a subdiscourse. At this point, the set of accessible discourse referents includes {x, y}, and *y* is marked as [+masculine] and [+singular]. Encountering the main verb *quieren* 'want' at the right edge of the RC signals the processor that it is now parsing a part of the structure outside of the QP's subdiscourse. At this stage, the QP no longer takes scope, and is therefore not a suitable antecedent for anaphoric purposes. As such, *y* must be deleted from the set of accessible discourse referents. By the time the postverbal pronoun *lo* is encountered and antecedent retrieval begins, the accessible set no longer contains *y* (nor any other discourse referent that matches the retrieval cues of the pronoun). Therefore, retrieval would fail to identify a suitable antecedent for *lo*. Presumably, failure to retrieve an antecedent would lead to the accommodation of a new discourse referent, *z*, for the pronoun to be interpreted[13].

(17) *Las profesoras* [a las que ningún chico respeta] quieren castigar*lo*.
The teachers [who no boy respects] want to punish *him*.

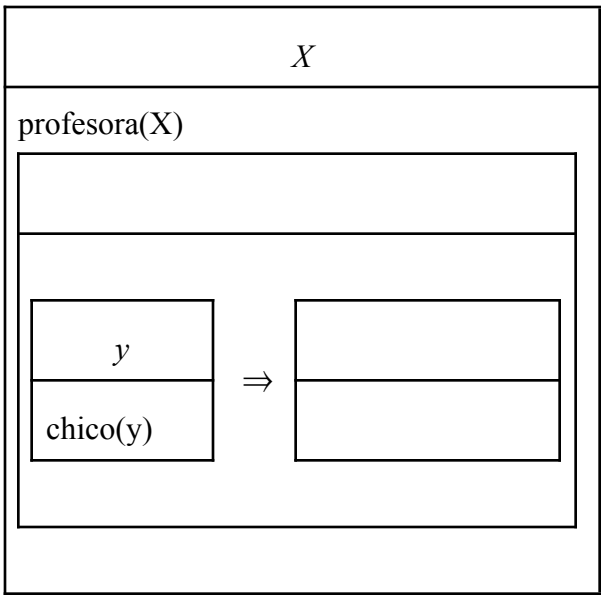
(18) Las profesoras…
The teachers…

X
profesora(X)

Active discourse referents: $\{X_{[+fem,+pl}\}$

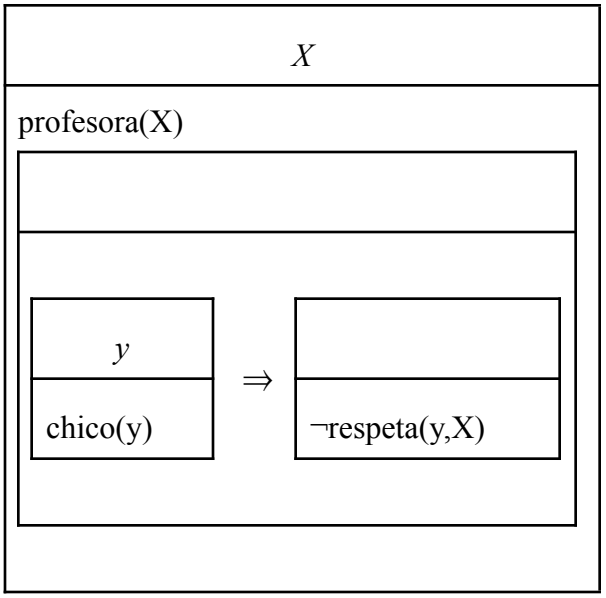
[13]The presence of a feature-matching QP such as *ningún chico* might ease the process of accommodation by providing salient properties that can be attributed to the coerced, extra-sentential referent (e.g., [+masculine], [+singular]) (Gerrig & O'Brien, 2005). However, while a matching QP can facilitate pronoun processing, the QP is never considered as an antecedent for the pronoun.

Las profesoras [a las que ningún chico…
The teachers [who no boy…



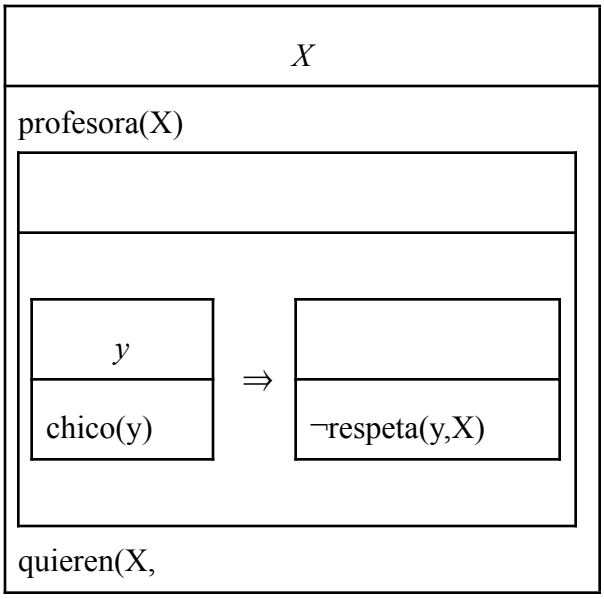
Active discourse referents: $\{X_{[+fem,+pl]}, y_{[+masc,+sg]}\}$

Las profesoras [a las que ningún chico respeta…
The teachers [who no boy respects…



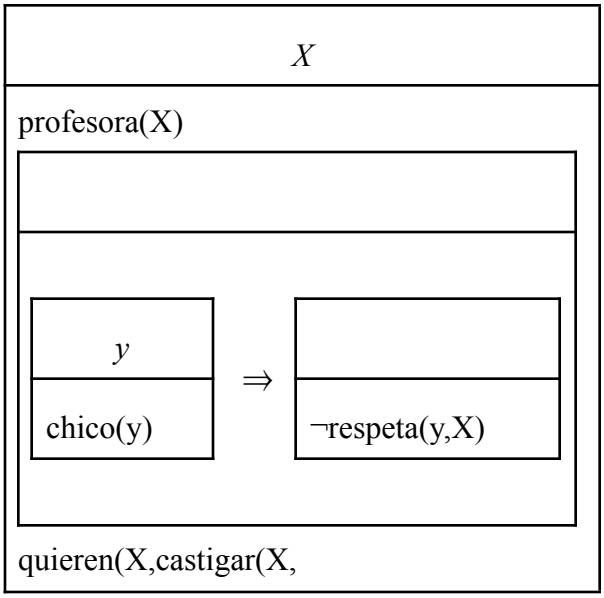
Active discourse referents: $\{X_{[+fem,+pl]}, y_{[+masc,+sg]}\}$

Las profesoras [a las que ningún chico respeta] quieren…
The teachers [who no boy respects] want…

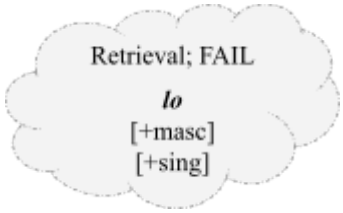


Active discourse referents: $\{X_{[+fem,+pl]}, \cancel{y}_{[+masc,+sg]}\}$

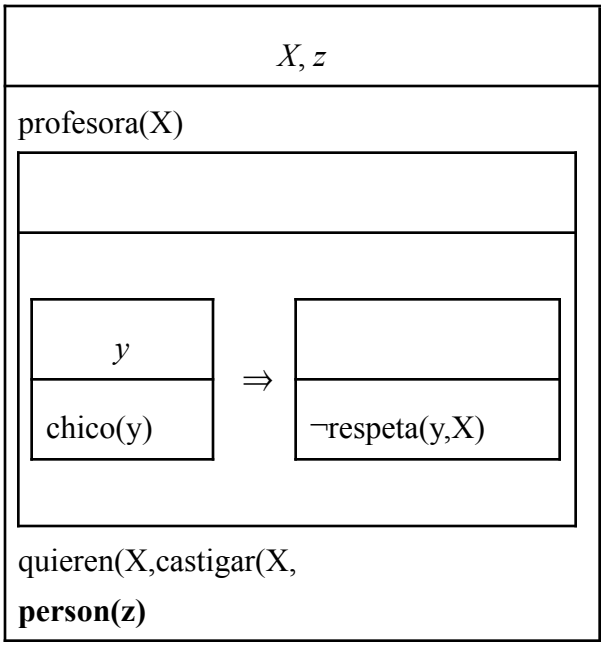
Las profesoras [a las que ningún chico respeta] quieren castigar**lo**.
The teachers [who no boy respects] want to punish **him**.



Active discourse referents: $\{X_{[+fem,+pl]}\}$

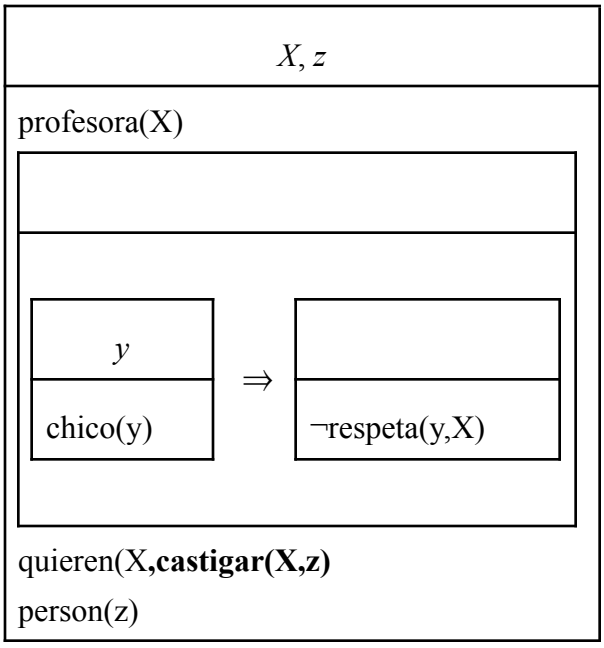


Las profesoras [a las que ningún chico respeta] quieren castigarlo.
The teachers [who no boy respects] want to punish him.

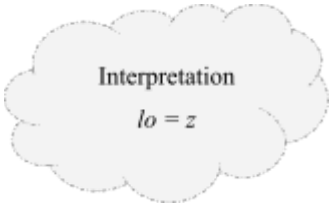


Active discourse referents: $\{X_{[+fem,+pl]}, z_{[+masc,+sg]}\}$

Las profesoras [a las que ningún chico respeta] quieren castigarlo.
The teachers [who no boy respects] want to punish him.



Active discourse referents: $\{X_{[+fem,+pl]}, z_{[+masc,+sg]}\}$

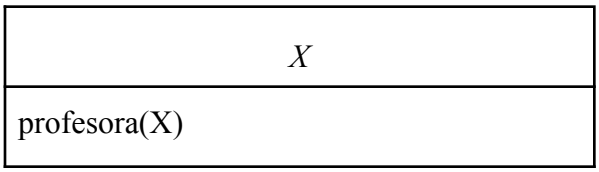


Encountering the main verb immediately after the RC in Experiment 1 provides evidence that the edge of the QP's scope domain has been reached before the postverbal pronoun is encountered. Thus, it

is likely that the deletion of the QP's discourse referent from the set of accessible antecedents has been completed by the time antecedent retrieval for the pronoun initiates. As such, gender-matching QPs that no longer take scope should not interfere with retrieval, consistent with our results from Experiment 1. However, if the pronoun precedes any explicit evidence of the edge of the RC, as in Experiment 2, the deletion procedure might not be completed before antecedent retrieval for the preverbal pronoun begins. Under this scenario, the pronoun might be treated as though it were part of the QP's subdiscourse. Accordingly, if the QP's discourse referent has not yet been deleted from the set of accessible antecedents, interference from gender-matching QPs is expected. An incremental sketch of how the deletion procedure might be delayed in an item from Experiment 2 (19) is provided in (20).

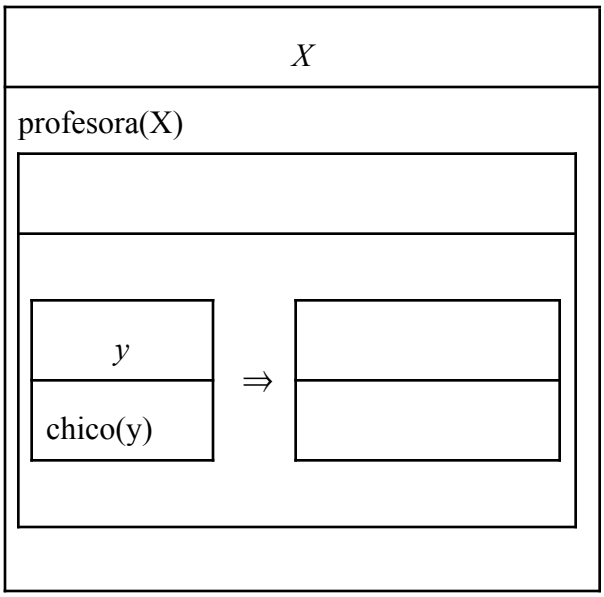
(19) Las profesoras [a las que ningún chico respeta] quieren castigarlo.
The teachers [who no boy respects] want to punish him.

(20) Las profesoras…
The teachers…



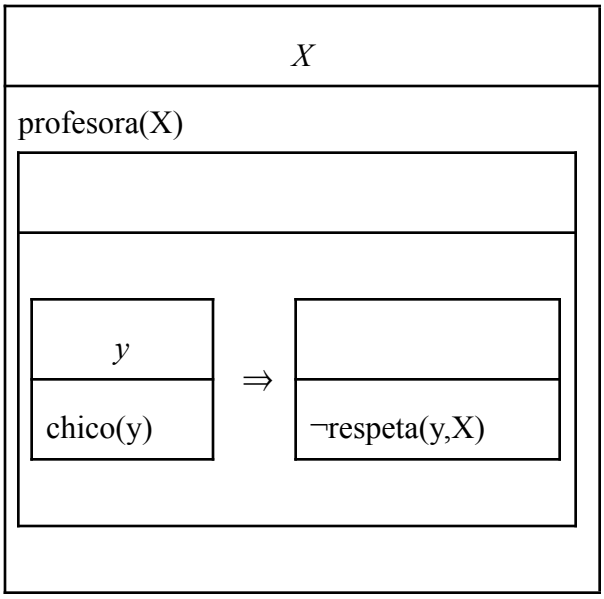
Active discourse referents: $\{X_{[+fem,+pl]}\}$

Las profesoras [a las que ningún chico…
The teachers [who no boy…



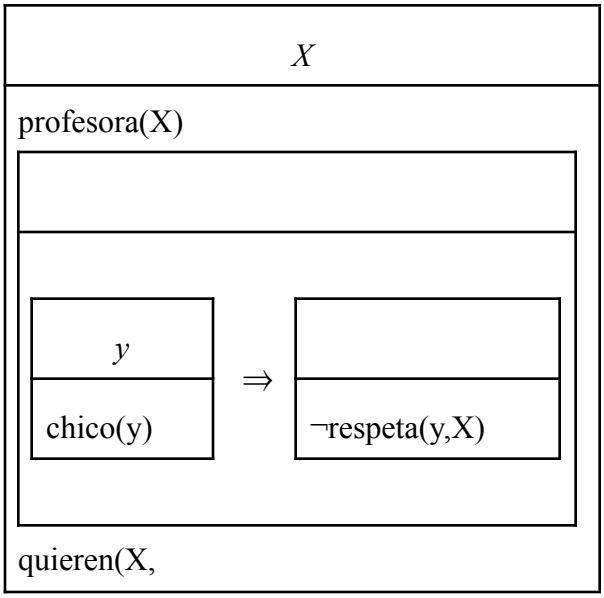
Active discourse referents: $\{X_{[+fem,+pl]}, y_{[+masc,+sg]}\}$

Las profesoras [a las que ningún chico respeta…
The teachers [who no boy respects…

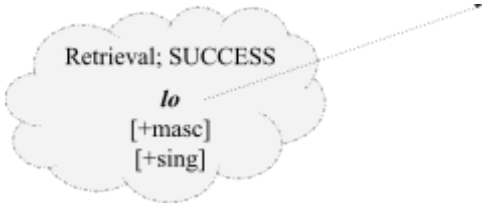


Active discourse referents: $\{X_{[+fem,+pl]}, y_{[+masc,+sg]}\}$

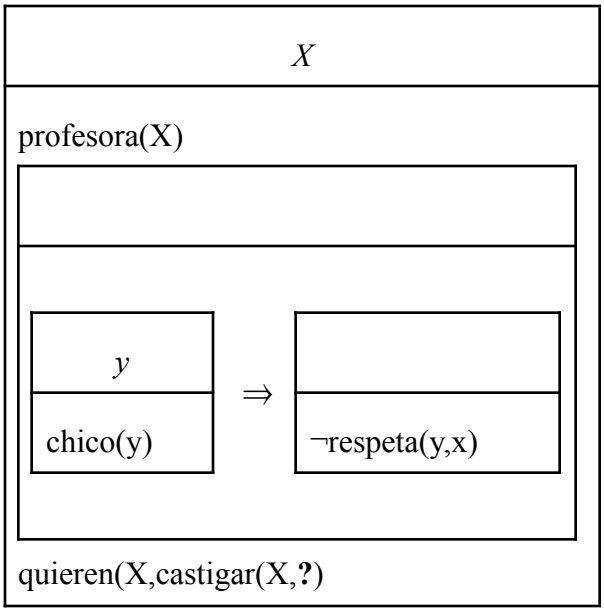
Las profesoras [a las que ningún chico respeta] **lo** quieren…
The teachers [who no boy respects] **him** want…



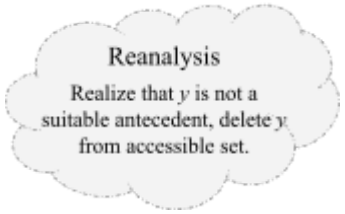
Active discourse referents: $\{X_{[+fem,+pl]}, y_{[+masc,+sg]}\}$



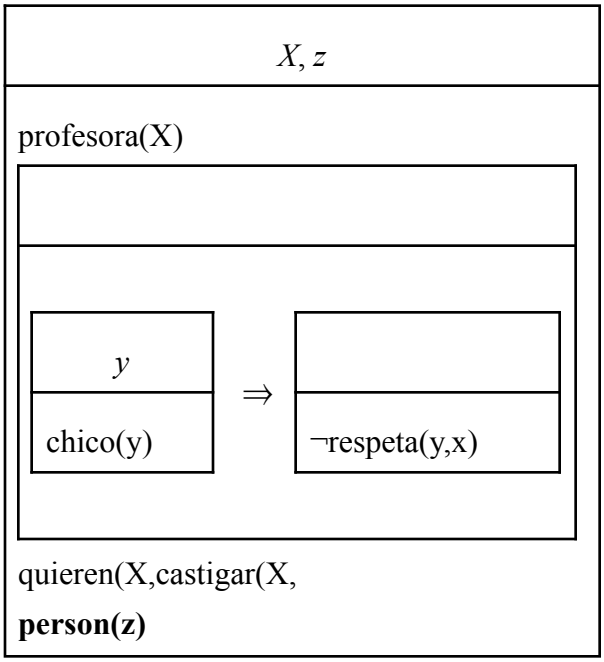
Las profesoras [a las que ningún chico respeta] lo quieren castigar.
The teachers [who no boy respects] him want to punish.



Active discourse referents: $\{X_{[+fem,+pl]}, \cancel{y}_{[+masc,+sg]}\}$

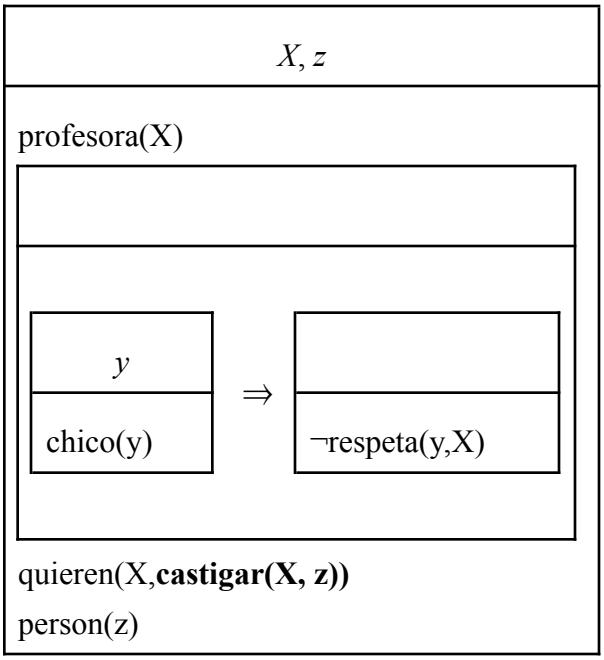


Las profesoras [a las que ningún chico respeta] lo quieren castigar.
The teachers [who no boy respects] him want to punish.

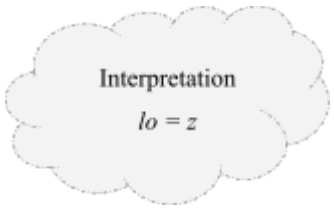


Active discourse referents: $\{X_{[+fem,+pl]}, z_{[+masc,+sg]}\}$

Las profesoras [a las que ningún chico respeta] lo quieren castigar.
The teachers [who no boy respects] him want to punish.



Active discourse referents: $\{X_{[+fem,+pl]}, z_{[+masc,+sg]}\}$



Similar to the ACCESSIBLE feature, the set of accessible discourse referents provides a method to block access to QPs that no longer take scope without encoding relational information on individual discourse referents. Thus, this data structure is useful for the purposes of modeling pronoun resolution because, unlike the discourse representation itself, it distinguishes between accessible and inaccessible antecedents in a way that is fast enough to support online processing and compatible with cue-based retrieval. The set pre-computes a discourse referent's accessibility and outputs only those that are accessible, such that accessibility is represented by virtue of membership to the set. Overall, we show that a DRT-based approach to incremental pronoun resolution with active tracking and dynamic updating of the set of accessible discourse referents can account for the pattern of interference in our clitic climbing experiments.

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Appendix

Table A1. Full list of test sentences for Experiments 1 and 2. Critical pronouns are bounded by braces "{...}" for Experiment 1 (postverbal) and by brackets "[...]" for Experiment 2 (preverbal).

Item	Condition	Sentence
1	*Referential–Match*	Las profesoras a las que el chico no conocía de cursos anteriores [lo] quieren presentar{lo} ante el prestigioso grupo de debate.
	Referential–Mismatch	Las profesoras a las que la chica no conocía de cursos anteriores [lo] quieren presentar{lo} ante el prestigioso grupo de debate.
	Quantificational–Match	Las profesoras a las que ningún chico conocía de cursos anteriores [lo] quieren presentar{lo} ante el prestigioso grupo de debate.
	Quantificational–Mismatch	Las profesoras a las que ninguna chica conocía de cursos anteriores [lo] quieren presentar{lo} ante el prestigioso grupo de debate.
2	*Referential–Match*	Los doctores a los que el enfermero no ayudó en la ambulancia [lo] deberían expulsar{lo} del equipo sanitario de emergencias.
	Referential–Mismatch	Los doctores a los que la enfermera no ayudó en la ambulancia [lo] deberían expulsar{lo} del equipo sanitario de emergencias.
	Quantificational–Match	Los doctores a los que ningún enfermero ayudó en la ambulancia [lo] deberían expulsar{lo} del equipo sanitario de emergencias.
	Quantificational–Mismatch	Los doctores a los que ninguna enfermera ayudó en la ambulancia [lo] deberían expulsar{lo} del equipo sanitario de emergencias.
3	*Referential–Match*	Las atletas a las que el corredor no felicitó en el pódium [lo] van a confrontar{lo} después de la carrera de relevos.
	Referential–Mismatch	Las atletas a las que la corredora no felicitó en el pódium [lo] van a confrontar{lo} después de la carrera de relevos.
	Quantificational–Match	Las atletas a las que ningún corredor felicitó en el pódium [lo] van a confrontar{lo} después de la carrera de relevos.
	Quantificational–Mismatch	Las atletas a las que ninguna corredora felicitó en el pódium [lo] van a confrontar{lo} después de la carrera de relevos.
4	*Referential–Match*	Los espías a los que el conde no invitó al banquete navideño [lo] intentaron asesinar{lo} delante de todos los comensales.
	Referential–Mismatch	Los espías a los que la condesa no invitó al banquete navideño [lo] intentaron asesinar{lo} delante de todos los comensales.
	Quantificational–Match	Los espías a los que ningún conde invitó al banquete navideño [lo] intentaron asesinar{lo} delante de todos los comensales.
	Quantificational–Mismatch	Los espías a los que ninguna condesa invitó al banquete navideño [lo] intentaron asesinar{lo} delante de todos los comensales.

5	*Referential–Match*	Las diseñadoras a las que el costurero no ayudó en el taller [lo] quieren sabotear{lo} durante el desfile de la colección de invierno.
	Referential–Mismatch	Las diseñadoras a las que la costurera no ayudó en el taller [lo] quieren sabotear{lo} durante el desfile de la colección de invierno.
	Quantificational–Match	Las diseñadoras a las que ningún costurero ayudó en el taller [lo] quieren sabotear{lo} durante el desfile de la colección de invierno.
	Quantificational–Mismatch	Las diseñadoras a las que ninguna costurera ayudó en el taller [lo] quieren sabotear{lo} durante el desfile de la colección de invierno
6	*Referential–Match*	Los voluntarios a los que el refugiado no vio en la comisaría [lo] intentaron defender{lo} contra la Policía Municipal.
	Referential–Mismatch	Los voluntarios a los que la refugiada no vio en la comisaría [lo] intentaron defender{lo} contra la Policía Municipal.
	Quantificational–Match	Los voluntarios a los que ningún refugiado vio en la comisaría [lo] intentaron defender{lo} contra la Policía Municipal.
	Quantificational–Mismatch	Los voluntarios a los que ninguna refugiada vio en la comisaría {lo}intentaron defender{lo} contra la Policía Municipal.
7	*Referential–Match*	Las mujeres a las que el jefe no nombró en la asamblea [lo] deberían contactar{lo} antes de la junta del jueves.
	Referential–Mismatch	Las mujeres a las que la jefa no nombró en la asamblea [lo] deberían contactar{lo} antes de la junta del jueves.
	Quantificational–Match	Las mujeres a las que ningún jefe nombró en la asamblea [lo] deberían contactar{lo} antes de la junta del jueves.
	Quantificational–Mismatch	Las mujeres a las que ninguna jefa nombró en la asamblea [lo] deberían contactar{lo} antes de la junta del jueves.
8	*Referential–Match*	Los ingenieros a los que el arquitecto no quiere en el equipo [lo] van a sabotear{lo} durante la reunión con los directivos.
	Referential–Mismatch	Los ingenieros a los que la arquitecta no quiere en el equipo [lo] van a sabotear{lo} durante la reunión con los directivos.
	Quantificational–Match	Los ingenieros a los que ningún arquitecto quiere en el equipo [lo] van a sabotear{lo} durante la reunión con los directivos.
	Quantificational–Mismatch	Los ingenieros a los que ninguna arquitecta quiere en el equipo [lo] van a sabotear{lo} durante la reunión con los directivos.
9	*Referential–Match*	Las clientas a las que el abogado no representó ante el tribunal [lo] quieren contratar{lo} para los trámites del divorcio.
	Referential–Mismatch	Las clientas a las que la abogada no representó ante el tribunal [lo] quieren contratar{lo} para los trámites del divorcio.
	Quantificational–Match	Las clientas a las que ningún abogado representó ante el tribunal [lo] quieren contratar{lo} para los trámites del divorcio.
	Quantificational–Mismatch	Las clientas a las que ninguna abogada representó ante el tribunal [lo] quieren contratar{lo} para los trámites del divorcio.

10	*Referential–Match*	Las admiradoras a las que el actor no saludó en la premier deberían abuchear{lo} durante el próximo festival de cine.
	Referential–Mismatch	Las admiradoras a las que la actriz no saludó en la premier [lo] deberían abuchear{lo} durante el próximo festival de cine.
	Quantificational–Match	Las admiradoras a las que ningún actor saludó en la premier [lo] deberían abuchear{lo} durante el próximo festival de cine.
	Quantificational–Mismatch	Las admiradoras a las que ninguna actriz saludó en la premier [lo] deberían abuchear{lo} durante el próximo festival de cine.
11	*Referential–Match*	Los asesinos a los que el investigador no atrapó tras la persecución [lo] van a despistar{lo} mediante pistas falsas en el correo.
	Referential–Mismatch	Los asesinos a los que la investigadora no atrapó tras la persecución [lo] van a despistar{lo} mediante pistas falsas en el correo.
	Quantificational–Match	Los asesinos a los que ningún investigador atrapó tras la persecución [lo] van a despistar{lo} mediante pistas falsas en el correo.
	Quantificational–Mismatch	Los asesinos a los que ninguna investigadora atrapó tras la persecución [lo] van a despistar{lo} mediante pistas falsas en el correo.
12	*Referential–Match*	Los soldados a los que el capitán no entrenó en el castillo [lo] intentaron entregar{lo} al ejército del príncipe enemigo.
	Referential–Mismatch	Los soldados a los que la capitana no entrenó en el castillo [lo] intentaron entregar{lo} al ejército del príncipe enemigo.
	Quantificational–Match	Los soldados a los que ningún capitán entrenó en el castillo [lo] intentaron entregar{lo} al ejército del príncipe enemigo.
	Quantificational–Mismatch	Los soldados a los que ninguna capitana entrenó en el castillo [lo] intentaron entregar{lo} al ejército del príncipe enemigo.
13	*Referential–Match*	Los candidatos a los que la directora no consideró para el ascenso [la] quieren denunciar{la} ante el Comité de Recursos Humanos.
	Referential–Mismatch	Los candidatos a los que el director no consideró para el ascenso [la] quieren denunciar{la} ante el Comité de Recursos Humanos.
	Quantificational–Match	Los candidatos a los que ninguna directora consideró para el ascenso [la] quieren denunciar{la} ante el Comité de Recursos Humanos.
	Quantificational–Mismatch	Los candidatos a los que ningún director consideró para el ascenso [la] quieren denunciar{la} ante el Comité de Recursos Humanos.
14	*Referential–Match*	Los científicos a los que la alumna no escuchó en el laboratorio [la] deberían echar{la} del curso de Química orgánica.
	Referential–Mismatch	Los científicos a los que el alumno no escuchó en el laboratorio [la] deberían echar{la} del curso de Química orgánica.
	Quantificational–Match	Los científicos a los que ninguna alumna escuchó en el laboratorio [la] deberían echar{la} del curso de Química orgánica.
	Quantificational–Mismatch	Los científicos a los que ningún alumno escuchó en el laboratorio [la] deberían echar{la} del curso de Química orgánica.

15	*Referential–Match*	Los biólogos a los que la presidenta no atendió en la conferencia [la] intentaron educar{la} sobre los efectos del cambio climático.
	Referential–Mismatch	Los biólogos a los que el presidente no atendió en la conferencia [la] intentaron educar{la} sobre los efectos del cambio climático.
	Quantificational–Match	Los biólogos a los que ninguna presidenta atendió en la conferencia [la] intentaron educar{la} sobre los efectos del cambio climático.
	Quantificational–Mismatch	Los biólogos a los que ningún presidente atendió en la conferencia [la] intentaron educar{la} sobre los efectos del cambio climático.
16	*Referential–Match*	Los políticos a los que la senadora no votó en el pleno [la] deberían ignorar{la} durante la próxima sesión del Senado.
	Referential–Mismatch	Los políticos a los que el senador no votó en el pleno [la] deberían ignorar{la} durante la próxima sesión del Senado.
	Quantificational–Match	Los políticos a los que ninguna senadora votó en el pleno {la}deberían ignorar{la} durante la próxima sesión del Senado.
	Quantificational–Mismatch	Los políticos a los que ningún senador votó en el pleno [la] deberían ignorar{la} durante la próxima sesión del Senado.
17	*Referential–Match*	Las futbolistas a las que la inversora no patrocina en la liga [la] van a invitar{la} al partido contra el equipo alemán.
	Referential–Mismatch	Las futbolistas a las que el inversor no patrocina en la liga{la} van a invitar{la} al partido contra el equipo alemán.
	Quantificational–Match	Las futbolistas a las que ninguna inversora patrocina en la liga [la] van a invitar{la} al partido contra el equipo alemán.
	Quantificational–Mismatch	Las futbolistas a las que ningún inversor patrocina en la liga [la] van a invitar{la} al partido contra el equipo alemán.
18	*Referential–Match*	Los nietos a los que la abuela no ve desde Año Nuevo [la] intentaron llamar{la} desde el teléfono de la escuela.
	Referential–Mismatch	Los nietos a los que el abuelo no ve desde Año Nuevo [la] intentaron llamar{la} desde el teléfono de la escuela.
	Quantificational–Match	Los nietos a los que ninguna abuela ve desde Año Nuevo [la] intentaron llamar{la} desde el teléfono de la escuela.
	Quantificational–Mismatch	Los nietos a los que ningún abuelo ve desde Año Nuevo [la] intentaron llamar{la} desde el teléfono de la escuela.
19	*Referential–Match*	Las camareras a las que la cocinera no pagó el mes pasado [la] quieren delatar{la} ante el inspector de seguridad laboral.
	Referential–Mismatch	Las camareras a las que el cocinero no pagó el mes pasado [la] quieren delatar{la} ante el inspector de seguridad laboral.
	Quantificational–Match	Las camareras a las que ninguna cocinera pagó el mes pasado [la] quieren delatar{la} ante el inspector de seguridad laboral.
	Quantificational–Mismatch	Las camareras a las que ningún cocinero pagó el mes pasado [la] quieren delatar{la} ante el inspector de seguridad laboral.

20	*Referential–Match*	Las patinadoras a las que la entrenadora no animó durante la competición [la] deberían despedir{la} antes del próximo campeonato europeo.
	Referential–Mismatch	Las patinadoras a las que el entrenador no animó durante la competición [la] deberían despedir{la} antes del próximo campeonato europeo.
	Quantificational–Match	Las patinadoras a las que ninguna entrenadora animó durante la competición [la] deberían despedir{la} antes del próximo campeonato europeo.
	Quantificational–Mismatch	Las patinadoras a las que ningún entrenador animó durante la competición [la] deberían despedir{la} antes del próximo campeonato europeo.
21	*Referential–Match*	Las modelos a las que la universitaria no fotografió para la revista [la] quieren descalificar{la} del concurso para jóvenes artistas.
	Referential–Mismatch	Las modelos a las que el universitario no fotografió para la revista [la] quieren descalificar{la} del concurso para jóvenes artistas.
	Quantificational–Match	Las modelos a las que ninguna universitaria fotografió para la revista [la] quieren descalificar{la} del concurso para jóvenes artistas.
	Quantificational–Mismatch	Las modelos a las que ningún universitario fotografió para la revista [la] quieren descalificar{la} del concurso para jóvenes artistas.
22	*Referential–Match*	Los músicos a los que la directora no admitió en el conservatorio [la] intentaron golpear{la} después de las audiciones.
	Referential–Mismatch	Los músicos a los que el director no admitió en el conservatorio [la] intentaron golpear{la} después de las audiciones.
	Quantificational–Match	Los músicos a los que ninguna directora admitió en el conservatorio [la] intentaron golpear{la} después de las audiciones.
	Quantificational–Mismatch	Los músicos a los que ningún director admitió en el conservatorio [la] intentaron golpear{la} después de las audiciones.
23	*Referential–Match*	Las bailarinas a las que la espectadora no aplaudió durante la función [la] deberían regañar{la} después del espectáculo de ballet.
	Referential–Mismatch	Las bailarinas a las que el espectador no aplaudió durante la función [la] deberían regañar{la} después del espectáculo de ballet.
	Quantificational–Match	Las bailarinas a las que ninguna espectadora aplaudió durante la función [la] deberían regañar{la} después del espectáculo de ballet.
	Quantificational–Mismatch	Las bailarinas a las que ningún espectadora aplaudió durante la función [la] deberían regañar{la} después del espectáculo de ballet.
24	*Referential–Match*	Las pacientes a las que la psicóloga no diagnósticó tras varias sesiones [la] van a despedir{la} durante la próxima consulta online.
	Referential–Mismatch	Las pacientes a las que el psicólogo no diagnósticó tras varias sesiones [la] van a despedir{la} durante la próxima consulta online.
	Quantificational–Match	Las pacientes a las que ninguna psicóloga diagnósticó tras varias sesiones [la] van a despedir{la} durante la próxima consulta online.
	Quantificational–Mismatch	Las pacientes a las que ningún psicólogo diagnósticó tras varias sesiones [la] van a despedir{la} durante la próxima consulta online.

Table A2. Full list of fillers for Experiments 1 and 2.

Item	Filler
1	A pesar de graduarse en tan solo tres años, Miriam tardó cuatro años en conseguir el trabajo de sus sueños.
2	A Rosa le gustan las novelas de misterio mientras que Linda prefiere las de aventura.
3	A Will le gusta la música country pero si alguien le pregunta siempre dice que escucha pop-rock.
4	Al llegar a casa el pianista se dio cuenta de que había olvidado las partituras en el conservatorio.
5	Al salir de la universidad Óscar fue a la biblioteca a corregir los exámenes de Física.
6	Alberto no entendía por qué se le daba tan mal el kárate especialmente tras haber hecho cinco años de kung-fu.
7	Alejandro nunca lleva maquillaje porque no quiere que su madre se ría de él.
8	Antes de su actual trabajo como contable Tina se ganaba la vida trabajando como cajera.
9	Aunque Marina quería unirse al club de rugby su padre la apuntó a clases de natación.
10	Aunque Mercedes tenía buena puntería, Javier la venció jugando a los dardos.
11	Blanca escuchó que Hugo dijo que Isabel intentó sabotearlo en el concurso de talentos.
12	Brenda le dijo a Alyssa que había pintado un cuadro para ella.
13	Cada español piensa que el árbitro francés quiere dejarlo en evidencia en el torneo de ajedrez.
14	Cada niña quería que el pastor la llevase a pasear a las ovejas.
15	Cada piloto pensó que el equipo lo había saboteado tras sufrir dos pinchazos durante la carrera.
16	Darío solo pasó cinco días en Indonesia pero se habría quedado allí durante meses.
17	David soñó que Roberto ganaba el premio Nobel de Economía.
18	Después de un largo día Daniel echó la siesta en el sofá y Maura en la cama de matrimonio.
19	Días después de firmar el contrato la actriz le confesó al productor que no quería participar en la película.
20	Diego adoptó un gato para que le hiciera compañía en su nuevo hogar.

21 El agricultor mencionó que los tomates de la nueva cosecha los había plantado su esposa.

22 El atleta sufrió un esguince en el tobillo así que su entrenador le prohibió participar en el campeonato europeo.

23 El boxeador que todos los hombres admiraban los decepcionó en el torneo regional.

24 El chico ayudó a su hermana con el proyecto de ciencias a pesar de que estaba muy ocupado.

25 El comentarista habló con la nadadora que ganó dos medallas de plata y una de bronce.

26 El mayordomo fregó la cocina pero olvidó quitar el polvo del salón.

27 El sacerdote ortodoxo visitó una mezquita durante su estancia en Estambul.

28 El sargento que todos los soldados temían amenazó con mandarlos de vuelta a los barracones.

29 Emilia cree que Omar espera que el nuevo delantero lo vaya a sustituir en el equipo de fútbol.

30 Jaime firmó la hipoteca en julio pero no se mudó a su nuevo apartamento hasta mediados de septiembre.

31 John no respondía a los mensajes de Victoria y ella empezó a preocuparse por el bienestar de su amigo.

32 La animadora que algunas chicas criticaron durante el partido de baloncesto no quiso invitarlas a la fiesta de disfraces.

33 La charla sobre filosofía existencialista que organizó la facultad de Humanidades fue un éxito.

34 La criada pensaba que el emperador tenía una aventura con una mujer más joven.

35 La guitarrista que todos los músicos querían en su grupo los sorprendió con el lanzamiento de un nuevo álbum.

36 La profesora que algunos alumnos no respetan quiere echarlos de clase porque no paran de hablar entre ellos.

37 Las dos amigas brindaron con zumo de manzana para celebrar el fin del semestre.

38 Las gimnastas a las que algunos fans reconocieron por la calle los saludaron desde el autobús del equipo.

39 Las pasteleras hornearon una tarta de frambuesa y una docena de buñuelos de crema.

40 Lidia sospecha que Paco sabe que Alba lo quiere matar.

41 Los gamberros ofrecieron cien euros al informático para que cortara la electricidad del colegio.

42 Los padres de Ingrid felicitaron a Sandra por su maravillosa actuación en la obra de teatro.

43	Luis preparó la comida de su hija mientras Elena hablaba con unos clientes en el salón.
44	Manuel piensa que Alicia intuye que Fernando la quiere invitar a cenar.
45	Marta no sabía que Juan había invitado a Lucas al concierto de fin de curso.
46	Nerea esperó en el andén mientras su hermana compraba los billetes de tren en el mostrador.
47	Ningún mandatario sabía que el portavoz lo había traicionado ante el Tribunal Supremo.
48	Ninguna adolescente soporta que la tutora la trate con condescendencia en las clases de introducción a la astronomía.
49	Ninguna licenciada cree que la rectora vaya a contratarla para el semestre de verano.
50	Se dice que es la perseverancia la que hace grandes a los hombres, no la fuerza.
51	Sol preguntó al cajero del supermercado dónde estaban las verduras congeladas.
52	Tras revisar las mochilas de sus compañeros, la delegada descubrió quién había cogido la calculadora de Miguel.