On Pseudorelatives and Human Sentence Parsing

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Doctorate Dissertation in

Linguistics
Specialization in Psycholinguistics

September, 2020

Declaro que esta Dissertação é o resultado da minha investigação pessoal e independente. O seu conteúdo é original e todas as fontes consultadas estão devidamente mencionadas no texto, nas notas e na bibliografia.

A candidata,

Miriam Aguilar

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Declaro que esta Dissertação se encontra em condições de ser apreciada pelo júri a designar.

O orientador,   A co-orientadora,

João Costa   Maria Lobo

_____   _____

                                                     O co-orientador,

                                                     Nino Grillo

                                                     _____

To my family and friends.
To you.

Acknowledgements

This research would not have been possible without the opportunity and trust placed in me by João Costa and Maria Lobo at the start of this project. Maria, thank you for your help through the years. I appreciate your careful reading and revision of these chapters, and your critical and cautious approach.

I am very much indebted with Nino Grillo, a *molto vivace* supervisor, who at the height of the coronavirus crisis, which included confinement with kids, you still had time to read and review the last chapters of this thesis. Thank you for your generous time, your patience and critical view (also about my writing), which made me strive for a better draft each time. To work with you has been enriching and fun in equal amounts. Each experiment included in this thesis has been planned and discussed with Nino.

Thanks are also due to Andrea Santi for the chats and dinners. Also for teaching me eye-tracking analyses and for help with access to *Gorilla*. Thanks to Shayne Slogett for help with UMass software and statistical analyses.

I want to extend my gratitude to my former colleagues from Universitat Rovira i Virgili (Tarragona), Dani, Roger, Marc, Juan, Gavi, Pep, Pilar and José Eugenio. Chapter 6 is based in a work carried out in collaboration with Pilar Ferré, José M. Gavilán and Pep Demestre. It has been an honour to work with you. Thanks to Pep for his trust and motivation from the very beginning, and to Rosa María Sánchez-Casas for sparking off my curiosity and enthusiasm in this field.

I am also grateful for the friends I have made in Lisbon. Thanks to my T3 colleagues from Nova for such a wonderful first year of thesis, especially to Carolina, Margarida, Mara and Bia who have also been my connection with Lisbon during my (long) stage at University of York. To my friends in York, thanks for making life in the UK more bearable. I would not have survived all these years without our *parkruns*, ceilidhs, joint *pomodoro* sessions, and lots of tea and cakes at Berrick Saul building, with the occasional presence of W. B. Yeats. Thanks to Kathy, Marina, Paula, Paulina, for being an inspirational source and for their friendship, and to Kazuki, Chensu Dhama (M), John, Anna, Hongjie, Tincho, Josiño, Albas, Jorge, Javier, for their friendship and support.

Abstract

The debate over whether universal parsing mechanisms are necessary to explain sentence comprehension is clearly a fundamental one for cognitive science. This dissertation focuses on the relation between syntactic ambiguity and principles of economy in the parsing of ambiguous Pseudo Relative (PR)/ Relative Clause (RC) strings. While the principles of locality would predict local attachment in (exclusive) RC contexts, PR-*first* Hypothesis (Grillo & Costa, 2014) predicts high attachment (corresponding to a PR parse) in ambiguous PR/RC contexts.

We test the offline and online effects of PR availability in Spanish using a variety of research methods (eye-tracking while reading, sentence completion task, forced-choice questionnaire, acceptability judgement), while also looking at the interaction with other factors such as aspectual properties of the embedded predicate.

The results reported here are robust across studies and show an influence of PRs on the parsing of RCs: when PRs are not a confound, and relevant factors are controlled (e.g. length of the clauses), locality principles apply to RC attachment; when PRs are available, attachment preferences shift toward the non-local option. These results support the universality of parsing principles and suggest that cross-linguistic variation in RC attachment is epiphenomenal and largely attributable to the asymmetric availability of PRs across languages. This dissertation also provides a detailed description on PR-licensing contexts that might be useful for future research on RC attachment preferences to avoid the PR confound.

Keywords: Universality of parsing Principles; Syntactic ambiguities; Optimal Computation; PR-first Hypothesis; Pseudo Relatives; Relative Clause attachment; Aspect; Eye-tracking.

Resumo

O debate sobre se os mecanismos de análise universal são necessários para explicar a compreensão de frases é claramente fundamental para a Ciência Cognitiva. Esta dissertação centra-se na relação entre ambiguidade sintática e princípios de economia na análise de estruturaspseudorelativas (PR)/ orações relativas (OR) ambíguas. Enquanto os princípios de localidade prediriam a ligação local em contextos (exclusivos) das OR, a PR-*first* Hypothesis (Grillo & Costa, 2014) prevê uma alta ligação (correspondente a uma análise da PR) em contextos PR/OR ambíguos.

Nesta tese testamos os efeitos *offline* e *online* da disponibilidade das PRs em Espanhol, utilizando uma variedade de métodos de investigação (técnica de registo dos comportamentos oculares (eye-tracking) durante a leitura, tarefa de preenchimento de frases, questionários, julgamento da aceitabilidade), ao mesmo tempo que também analisamos a interação com as propriedades aspetuais do predicado encaixado.

Os resultados obtidos nesta dissertação mostram uma influência das PRs na análise das ORs: quando as PRs estão disponíveis e os fatores relevantes são controlados (por exemplo, o comprimento das orações), os princípios da localidade aplicam-se à adjunção das ORs; quando as PRs estão disponíveis, as preferências de adjunção mudam para a opção não-local. Estes resultados apoiam a universalidade dos princípios de análise e sugerem que a variação linguística na adjunção da OR é epifenomenal e amplamente atribuível à disponibilidade assimétrica das PRs entre línguas. Esta dissertação também fornece uma descrição detalhada dos contextos de licenciamento da PR, que podem ser úteis para evitar a ambiguidade PR/OR em futuras pesquisas sobre as preferências da ligação da OR.

Contents

INTRODUCTION

Linguistic communication takes place under time pressure, with language being produced and parsed incrementally, making use of limited cognitive resources. In addition, the nature of the linguistic input is frequently underspecified or ambiguous. The sum of these conditions makes it reasonable to assume that the human language processor is designed to be ready to take quick decisions incrementally, choosing the simplest or most optimal structure to minimise cognitive resources cost. This observation led psycholinguists to formulate the existence of universal parsing principles that guide parsing decisions. Economy principles of this sort have been very successful in accounting for observed parsing preferences in structure building and dependency formation processes. Strategies for minimizing computational load have been proposed for both types of processes together with a great wealth of empirical support that shows better comprehension and faster processing times for structures involving simpler structures/interpretations over more complex ones (e.g. preference for the instrumental over the restrictive interpretation of PPs in sentences like: *John saw the man **with the binoculars***) and more local dependencies over long distance ones (e.g. preference for local attachment of temporal modifiers in *John said that Mary left **yesterday***).

However, the finding that speakers of different languages appeared to be guided by different parsing strategies when attaching Relative Clauses such as in example (1)(Cuetos et al., 1988) questioned the universality of principles of locality and raised a number of issues for learnability and acquisition.

(1)   Someone shot the servant$_1$ of the actress$_2$ that was$_{1/2}$ on the balcony.

Variation in parsing preferences of the same grammatical structures is highly problematic given the assumption that parsing preferences are grounded in universal principles of economy of computation. This problem affects, in turn, any theory of language acquisition as it challenges these theories to explain how children can acquire a language while simultaneously also having to acquire language specific parsing strategies (J. D. Fodor, 1998). The exceptionality and specificity of the apparent variation in parsing, limited to the realm of Relative Clause (RC) attachment ambiguity under specific contextual properties, have made it difficult for theories of sentence processing and syntactic ambiguities to provide a valid framework able to explain the observed differences across and within languages.

Chapter II introduces the apparent cross-linguistic variation in RC attachment preferences, one of the most long-lasting debates in the psycholinguistics literature. The chapter reviews the main findings in this literature together with the different approaches developed to solve the theoretical issues they raise. We will see that while each of the approaches successfully capture some aspect of the variation and bring clarity to the role of different factors in determining RC-attachment, there is substantial agreement that none have succeeded in explaining the complete range of variation observed in the literature.

Chapter III introduces the discovery (Grillo, 2012) that the previous literature on RC-attachment was confounded by the asymmetric availability of Pseudo Relatives in the languages and structures tested. Pseudo Relatives (PRs) and RCs are string identical, but the two structures display very different structural and interpretive properties: PRs (2-a) are a kind of eventive Small Clauses (SCs), while RCs (2-b) are DP modifiers and introduce properties of entities. The chapter describes the structural and interpretive differences between Pseudo Relatives and Relative Clauses and introduces the PR-*first* Hypothesis, the main focus of this thesis.

(2) a. Juan ha [visto a [PR [DP la chica] [CP que corría]]]. PR
         J. has seen DOM the girl that ran.
         'Juan saw the girl running.'
     b. Juan ha visto a [DP la chica [CP que corría.]] RC
         J. has seen DOM the girl that ran.
         'Juan saw the girl that was running.'

The relevance of Pseudo Relatives (PRs) for the resolution of RC-attachment ambiguities arises from the fact that the attachment ambiguity disappears under the PR-parse (3-a).

(3) a. Juan ha [visto a   [PR [DP   la hija$_1$ del hombre$_2$] [CP que
         J. has seen DOM the daughter of the   man that   ran.
         pro$_{1/*2}$ corría]]]. PR

         'Juan saw [SC [DP the daughter$_1$ of the man][VP running$_{1/*}$].'

     b. Juan ha visto a   [DP la   hija$_1$ del hombre$_2$ [CP pro$_{1/2}$ que
         J. has seen DOM the daughter of   the man   that ran.
         corría.]] RC

         'Juan saw the daughter of the man that ran.'

Once the structural and interpretive differences between RCs and PRs are considered, it becomes clear that parsing sentences with RC-attachment ambiguities involves, first of all, making a choice between projecting a PR and an RC (i.e. a choice that belongs to the domain of minimal structure principles). Only at a second stage, if an RC-parse is chosen, will the parser have to resolve an attachment ambiguity (i.e. a problem falling within the domain of locality principles). Grillo (2012) and Grillo and Costa (2014) argued for a parsing preference for PRs over RCs due to their relative structural and interpretive simplicity. One consequence of this proposal (dubbed the *PR-first Hypothesis*) is that an apparent violation of locality principles will be observed for RC-attachment in languages and grammatical environments which license PRs. Grillo (2012) and Grillo and Costa (2014) argued that the superficial similarity between PRs and RCs might explain the reported non-local preference in the subset of Spanish and other so-called High Attachment languages. For these languages, apparent RCs modifying the complement of perceptual verbs are in fact ambiguous between an RC and a PR interpretation, whereas this ambiguity is non-existent in the subset of English and other Low-Attachment languages.

PR-*first* provides a valid framework to explain a number of questions that comprise the reported cross-linguistic variation, including questions such as why the differences between languages are observed exclusively with RC attachment ambiguities (and not in other structures), and why this happens only under certain conditions (e.g. when the RC is in object syntactic position).

This thesis contributes to this growing body of literature by investigating the complex interaction of these two types of economy principles: locality and minimal structure, in the domain of Relative Clause attachment ambiguities. The main aims of this work are:

1. To expand the empirical coverage of a principle of minimal structure (the PR-*first* Hypothesis) to include languages not previously tested (Chapter 4-7)

2. To establish the interaction of PR-preference with additional variables, in particular aspectual information, in the resolution of PR-RC ambiguities (Chapter 4 & 7)

3. To expand the current research of PR-effects to the domain of generation/production (Chapter 5)

4. To investigate the detailed time course of the disambiguation process in PR/RC ambiguity resolution (Chapter 6 & 7).

This thesis addresses these issues through a number of offline and online experiments (two attachment questionnaires, two acceptability judgements, one sentence completion task and two eye-tracking while reading studies) testing the effects of PR-availability in comprehension and production in Spanish, the language that ignited the debate on the universality of parsing principles but in which, to date, these effects had not been thoroughly tested. A number of restrictions on PR-availability in Spanish as compared to Italian make these experiments all the more relevant.

Chapter 4 presents new evidence from Spanish in support of the claim (Grillo, 2012; Grillo & Costa, 2014) that apparent cross-linguistic variation in RC-attachment is epiphenomenal and tied in large measure to the selective PR-availability in different languages and grammatical environments. Moreover, the potential role of aspect is investigated as a potential factor modulating the parser's choice between PR and RC parse. PRs in fact obey strict aspectual restrictions not seen in RCs, one of these restrictions being incompatibility with habitual interpretations in Spanish. This chapter first presents evidence for lower complexity of sentences which allow an habitual reading over minimally different sentences with episodic readings, in line with what was observed in the literature on the processing of generics vs. definites in the nominal domain. We then test to what extent the advantage of the habitual reading interacts with PR-preference. We show that while the aspectual manipulation interacts with cumulative exposure, it does not cancel the overall effect of PR availability.

Chapter 5 is devoted to the study of production of PRs. We set out to test the scope of PR-*first* in a sentence completion task to see whether the PR-effect could also apply to the generation of PRs and RCs. The PR-*first* Hypothesis has primarily focused on comprehension, but it is reasonable to think that the same effects could be expanded to production as well, especially in light of recent theories that propose a united architecture of the human language system that integrates comprehension and production (Dell et al., 2014; MacDonald, 2013;

Momma et al., 2018; Pickering et al., 2013a; Pickering et al., 2013b). As a first approach to answer this question, we performed a completion task in a PR-language (Spanish) and a control non-PR language (English). The results of this study show a strong effect of PR-availability in Spanish but not in English. The data presented here may also be relevant for recent accounts that suggest a single model for comprehension and production and more generally for models of production, as it provides information about the level and kind of specification of the projected structure.

Chapter 6 presents the first eye-tracking study testing attachment preferences when reading PR/RC ambiguous contexts in Spanish. The goal is to unveil the timing of disambiguation of local PR/RC ambiguities using the classic [matrix verb + complex DP + que clause] in contexts where PRs are allowed and comparing with contexts where the RC is the only possible parse. The results we present show that attachment preferences are largely modulated by the availability of Pseudo Relatives, and that when this availability is controlled, Spanish is also ruled by principles of locality.

Chapter 7 aims to provide a more direct evidence of PR-preference while avoiding attachment ambiguity. This study exploits the PR-restriction on aspect to build PR-compatible and PR-incompatible contexts, while imperfective aspect allows simultaneous construal between main and embedded predicates, Perfective forces a shifted reading only compatible with RCs. The preliminary data we provide are just provisional, and despite high skipping rates, the results already hint at a tendency toward selective costs of integration when a shifted reading is forced.

Chapter 8 summarizes main findings and contributions of this work, acknowledges limitations and proposes future avenues for research.

The case of variation in Relative Clause attachment

This chapter introduces one of the most long-lasting debates in the psycholinguistics literature: the apparent cross-linguistic variation in RC attachment preferences. The finding that speakers of different languages appeared to be guided by different parsing strategies when attaching RCs (Cuetos et al., 1988) questioned the universality of principles of locality and raised a number of issues for learnability and acquisition. Variation in parsing preferences of the same grammatical structures is highly problematic given the assumption that parsing preferences are grounded in universal principles of economy of computation. This problem affects in turn any theory of language acquisition as it challenges these theories to explain how children can acquire a language while simultaneously also having to acquire language specific parsing strategies (J. D. Fodor, 1998).

The exceptionality and specificity of the apparent variation in parsing, limited to the realm of RC attachment ambiguity under specific contextual properties, have made it difficult for theories of sentence processing and syntactic ambiguities to provide a valid framework able to explain the observed differences across and within languages.

Across the board, two broad families of accounts of these findings can be identified: a first set of accounts defends parsing preferences are grounded in universal principles of economy of computation and, from this perspective, cross-linguistic variation is reducible to grammatical differences. A second set of accounts defends parsing preferences are modulated in function of distributional differences in High versus Low Attachment of RCs across languages.

This chapter introduces the main findings in this literature together with the different approaches developed to solve the theoretical issues they raise. We will see that, while each of these approaches successfully capture some aspect of the variation and brings clarity to the role of different factors in determining RC-attachment, there is substantial agreement in the literature that none of them succeeded in explaining the whole range of variation observed in the literature. We can anticipate that, as discussed in the following Chapter 3, this is partly due to lack of awareness until relatively recently (Grillo, 2012) about the existence of an additional dimension of variation at the grammatical level in the languages and structures tested.

2.1 Relative Clauses do not obey locality principles

An important research program in psycholinguistics builds on the observation that the human language processor is designed to take quick decisions incrementally, choosing the simplest or most optimal structure to minimise cognitive resources cost. Based on this observation, Psycholinguists formulated the existence of parsing principles that guide parsing decisions. The goal of identifying these principles was initiated by the work of Kimball (1973), reformulated by Frazier (1978) in the Sausage Machine model, and extended in consecutive works (De Vincenzi, 1991; Frazier, 1990; Frazier et al., 1996). The set of universal parsing principles described and tested within this program (e.g. *Minimal Attachment*, *Active Filler Strategy*) correctly predicted parsing decisions across different structures and languages. Minimal Attachment, for instance, prompts each incoming word to be attached to the developing phrase structure such that the fewest possible additional nodes are constructed. The predictions of this principle have been widely supported by the research in this field, including results from reduced relative clause versus main clause analysis (Clifton Jr et al. 2003; Ferreira et al. 1986; Trueswell et al. 1994, among many other). Active Filler Strategy (*avoid postulating any chain members at S-structure, but do not delay required chain members*) also correctly predicts the avoidance of RCs in the cases just mentioned earlier.

There was, however, one exception: the Late Closure principle. Late Closure prompts the parser to *attach incoming material into the phrase or clause currently being processed*. The rationale is to avoid the maintenance of unattached items in working memory and fasten parsing attaching new material locally. Hence, Late Closure is, by definition, a principle of locality. Locality is a central concept in theories of ambiguity resolution and sentence complexity.

The principle of locality states that a cost of integrating two elements that hold a dependency relation (e.g. pronominal-antecedent relation, or filler-gap

dependency holding between the head noun and the subject/object gap position within a relative clause) is proportional to the distance between these elements: the longer the distance, the harder it is to parse (see *Dependency Locality Theory* Gibson 1998, 2000). The preference for building structural relations with the closest possible element capable to carry that relation stems from an economic strategy of the parser to minimize efforts and save cognitive resources such as working memory. A classic example with structural complexity is depicted in (1).

(1)   a.   CENTRE-EMBEDDED RC
        The administrator who the nurse supervised scolded the patient.
   b.   RIGHT-BRANCHING RC
        The administrator scolded the patient who the nurse supervised.

These structures are not structurally ambiguous, but the difficulty in (1-b) lies in the lexical material intervening between the subject DP *the administrator* and the verb *scolded*. The longer the distance between these two elements, the harder it is to integrate the verb, to the extent that in some cases a sentence can be considered 'unprocessable' (e.g. The reporter who the senator who John met attacked disliked the editor) (Chomsky, 1957; Miller et al., 1963; Miller et al., 1964).

While locality effects have been mainly studied in cases of linguistic complexity, Late Closure is the implementation of this principle to resolve syntactic ambiguities. In the case of interest in this thesis, the attachment preferences of RCs with double antecedent (DP1 of DP2 CP), Late Closure prompts a local attachment to DP2.

(2)   Maria played tennis with the brother$_1$ of the professor$_2$ who is bold$_{*1/2}$.

Attachment to DP2 (i.e. professor) should be easier for at least two reasons. First, it avoids to have an intervening DP between the RC and its head. If the RC modifies the first DP (i.e. brother), the second DP (i.e. professor) intervening between both could cause disruption. The second reason has to do with memory load: the second DP is more recent in working memory, and thus more accessible.

However, attachment preferences have been found to diverge depending on the language at stake, with some languages preferring a non local attachment to DP1, and others a local attachment to DP2. This finding challenged the universality of Late Closure. Next section will introduce the literature on this topic, and the reasons why it became one of the most controversial findings in psycholinguistics.

2.2   The Late Closure principle

One central question asked in the field of sentence processing is how the parser deals with syntactic ambiguity as the linguistic signal unfolds over time, and the mechanisms, rules, or sources of information consulted to disambiguate the input string. An answer to this question should also explain when do people *misparse* a sentence (also called 'garden-pathing'), and how the parsing process goes from there to the right interpretation.

The term *Garden Path* was coined by Hockett ([1961]) to refer to ambiguous sentences with an unexpected resolution that gives rise to a feeling of being metaphorically led up the garden path to a wrong interpretation of the sentence. The most famous example in English is 'The horse raced past the barn fell' (Bever, [1970]), in which initially the horse is supposed to race, but in fact the meaning is equivalent to 'The horse [that was raced past the barn] fell'. This concept gives name to a classic theory of syntactic disambiguation: the Garden-path model (Frazier et al., [1987]; Frazier, [1978]; Frazier et al., [1982]; Rayner et al., [1983]).

The Garden-path model assumes that parse choices are strictly serial (one single analysis at a time), with restricted access to certain sources of information. The origins of serial parsing stem from modularity in the sense of J. A. Fodor ([1983]). A modular serial parsing implies that knowledge sources are formally separated in a way that parsing is encapsulated, with restricted access to just one source of information, and the assignment of syntactic structure is initially guided solely by abstract principles. The Garden-path model was highly influenced by the seminal work of Kimball ([1973]) and the set of principles proposed in his work.

The Garden-path Model proposed a two-stage process where the first stage is modular (only syntactic information is accessed), and the second stage, not modular, is open to other sources of information, such as thematic roles, discourse context, semantic plausibility or lexical/syntactic frequency. For the first stage, the model proposes a parser that constructs a single syntactic representation on the basis of two phrase structure rules:

a. The principle of Minimal Attachment, which directs the parser to construct the simplest syntactic structure consistent with the input (Rayner et al., [1983]).

b. The principle of Late Closure, which directs the parser to attach new material into the phrase currently being processed rather than to a more distant attachment site (Frazier et al., [1982]).

These two principles are the responsible for the rapid building of syntactic structures relying solely on access to structural information. If the initial analysis of an ambiguous syntactic structure is incorrect, this causes processing disruption, frequently called a garden-path effect. When this happens, a reanalysis takes place in the second stage where plenty access to other sources of information help to reconstruct the sentence.

Minimal Attachment correctly predicted garden-path effects in [VP DP PP] sentences such as the example in (3), where VP-attachment should be preferred since it involves fewer nodes/a simpler structure than DP -attachment (Rayner et al., 1983). Garden-path effects should not happen if *with revolver* is replaced by *with binoculars*

(3)   The spy saw the cop with a revolver.

Minimal Attachment is also liable to explain the observed processing difficulty in other structures such as the case of reduced relatives (4) or object/complement ambiguities (5)

(4)   The boy sent the parcel seemed very pleased.

(5)   The woman realised her goals could be reached.

The second principle, Late Closure, predicts that an incoming phrase would preferably be attached locally, i.e. as part of the constituent currently being processed by the parser. In the case in (6), 'the sock' should preferably be integrated as the object of knitting, which can be transitive or intransitive.

(6)   When Mary was knitting the sock fell to the floor.

Frazier et al. (1982), in fact, found that readers had difficulties to integrate the verb 'fell' into the parse. Late Closure also predicts that *yesterday* should preferably modify *left* rather than *said* in the following example:

(7)   John said that Sue left yesterday.

Minimal Attachment and Late Closure capture the idea that in the presence of ambiguity the parser will select the first available analysis, grounded on basic principles of economy of computation and as a consequence they are naturally conceived as universal principles, part of the human mental architecture. While these postulates indeed correctly predicted the parser's decisions in most cases
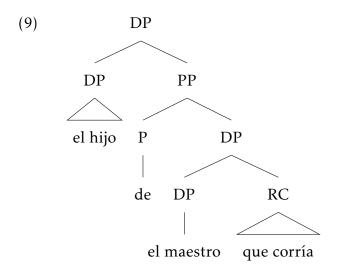
of syntactic ambiguity in a uniform fashion across languages, there appeared
to be one case that challenged its postulates: the processing of RC attachment
ambiguity.

Sentences with a complex DP followed by an RC [DP1 of DP2 + RC] have
two possible interpretations: one where the RC modifies the first DP (also called
high attachment for the hierarchical position in the tree) and one where the RC
modifies the second DP (low attachment).

(8)   Someone shot the servant$_1$ of the actress$_2$ that was$_{1/2}$ on the balcony.
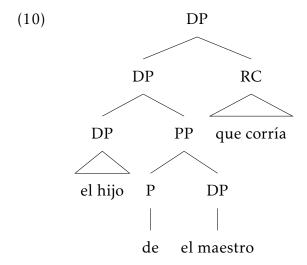
Attachment to the second DP has also been called local attachment, as the
RC is attached locally to the last DP (9), while attachment to DP1 is non local as
it requires to shift up the RC to modify the first DP (10).

Low Attachment

(9)

Alguien disparó[$_{DP}$ al hijo$_1$ [$_{PP}$de [el maestro$_2$ [$_{CP}$ que corría$_2$]]]].

HIGH ATTACHMENT

(10)

```
                        DP
                   ┌─────┴─────┐
                  DP           RC
              ┌────┴────┐      /\
             DP         PP   que corría
             /\      ┌───┴───┐
          el hijo    P       DP
                     │        │
                     de    el maestro
```

Alguien disparó [$_{DP}$ [$_{DP}$ al hijo$_1$ del maestro$_2$] [$_{CP}$ que corría$_1$]].

The initial results from experiments investigating RC-attachment in English showed a low attachment preference, supporting Late Closure predictions. However, the replication of theses experiments in other languages failed to show a uniform application of the principle cross-linguistically. Spanish was the first language for which a high attachment preference for RCs was reported. Cuetos et al. (1988) tested the same set of sentences in English and Spanish, the results showed that English native speakers preferred low attachment, while Spanish speakers preferred high attachment. This contrast was replicated in offline and online experiments using different methodologies (Carreiras, 1992; Carreiras et al., 1993, 1999; Cuetos et al., 1996; Cuetos et al., 1988). Further studies in additional languages showed that this contrast was not specific to English and Spanish, and the results led to a classification of low attachment languages like English (Cuetos et al., 1988; Fernández, 2003; Frazier et al., 1996; Mitchell et al., 1991), Arabic (Abdelghany et al., 1999), Swedish (Ehrlich, 1999), Norwegian (Ehrlich, 1999), Romanian (Ehrlich, 1999), Basque (Gutierrez-Ziardegi et al., 2004), and Chinese (Shen, 2006), and high attachment languages like Spanish (Carreiras, 1992; Carreiras et al., 2004; Cuetos et al., 1988; Fernández, 2003), Italian (De Vincenzi et al., 1995; De Vincenzi et al., 1993), French (Mitchell et al., 1990; Zagar et al., 1997), Galician (Fraga et al., 2005), Greek (Papadopoulou et al., 2003), Dutch (Brysbaert et al., 1996a; Mitchell et al., 2000a; Mitchell et al., 1990), Afrikaans (Mitchell et al., 2000a), Serbo-croatian (Lovric, 2004), including some swing languages whose results appeared to vary with specific properties of the experimental items and/or the experimental design, and to some extent also across participants (see Grillo & Costa, 2014, for discussion).

This cross-linguistic variation challenged the universality of Late Closure
and by extension, the Garden-path Model. Attachment of RCs constitutes one
of the most researched topics in the psycholinguistics literature on sentence pro-
cessing. To understand why such great amount of psycholinguistics research was
dedicated to this issue, it is important to understand three reasons why these
findings are puzzling. First and foremost, variation in parsing preferences in
what appeared to be the same grammatical structures is highly unexpected given
the natural assumption that parsing preferences are grounded in simple, inde-
pendently motivated and universal principles of economy of computation. The
second related, but independent issue is that the apparent variation in parsing
preferences is problematic for any theory of language acquisition: the challenge
here is to explain how children can acquire a language while simultaneously also
having to acquire language specific parsing strategies (J. D. Fodor, 1998). A third
issue relates to the specificity of the effect: the exceptional behaviour of the ill-
behaved languages with respect to locality appeared to be limited to the realm
of RC attachment ambiguity. In fact, further research showed that speakers of
"high-attachment languages" demonstrated a preference for local resolution of RC
attachment ambiguities in a number of well-defined environments. In Spanish,
for example, high attachment is only observed in right-branching RCs (Hemforth
et al., 2015), with a complementizer 'que' heading the CP. When the relative
pronoun 'el cual' (which/who) is placed instead of 'que', low attachment is the
preferred outcome (Fernández, 2003).

(11)   Alguien disparó contra el criado$_a$ del actor$_2$ el cual estaba$_2$ en el balcón.
         'Someone shot the servant of the actor who was on the balcony.'

Furthermore, beyond RCs, Igoa et al. (1998) showed that Spanish speakers
show a clear preference for local attachment for a variety of phrases, including
Prepositional Phrases (PPs) (12) and temporal modifiers (13).

(12)   a.   LOW ATTACHMENT
              Pedro [$_{VP}$ vendió [$_{DP}$ el libro [$_{CP}$ que había robado a su amigo]]]
        b.   HIGH ATTACHMENT
              Pedro [$_{VP}$ vendió [$_{DP}$ el libro [$_{CP}$ que había robado]] a su amigo]
              'Pedro sold the book that he had stolen from/to his friend.'

The PP *a su amigo* in sentences like (12) can receive both source interpretation (*P.
stole the book from his friend and then sold it*, Low Attachment to the local VP) or a
recipient oriented interpretation (*P. sold the book to his friend*, High Attachment to
the non-local VP). Igoa et al. showed that in these and other type of PP attachment

ambiguities (e.g. El físico dedujo las conclusiones del experimento/The physicist deduced the conclusions of/from the experiment), Spanish is not an exception and local attachment is preferred.

The exception to Late Closure seems to be fairly specific and reducible to just one particular structure: RC attachment in the presence of two potential antecedents. Even on the RC attachment grounds, non-locality effects are reducible to specific contexts. For instance, where the RC is positioned in right-branching instead of centre-embedded position (Hemforth et al., 2015), as in example (13):

(13)   a.   CENTRE-EMBEDDED RC
           El hijo del coronel que murió de apoplejía escribió cinco libros sobre enfermedades tropicales.
           'The son of the colonel who died of a stroke wrote five books on tropical disease.'
       b.   RIGHT-BRANCHING RC
           El doctor conoció al hijo de lcoronel que murió de apopleja.
           'The doctor met the son of the colonel who died of a stroke.'

In the environment of thematic prepositions when the preposition 'with' mediates between the two DP s (Gilboy et al., 1995) (see example (14))

(14)   Al millonario se le mostró una casa con una piscina que era tan grande como medio campo de fútbol.
       The millionaire was shown a house with a pool that was as big as half a football field.

Given the specificity of the problem, reducible to RCs in the specific context described earlier (i.e. right-branching RCs, preposition 'of' connecting the DPs, complementizer 'que' heading the embedded clause), it is difficult to state these differences as rooted at the fundamental level of parsing mechanisms. Such an assertion would imply the existence of different parsing principles for different languages, and also different within-language mechanisms sensitive to syntactic and lexical information, which would apply selectively in fine-grained contexts, or simply no parsing principles at all (which as mentioned earlier, would be problematic not only for parsing but also for theories of acquisition). We will further delve into this question in chapter 3, after the presentation of a proposal that could provide a valid framework for these results, the problem of the specificity, and the cross-linguistic variability.

A proliferation of new models and theories emerged in the field in an attempt to explain the observed cross-linguistic variation. The literature on this topic is vast and it would exceed the boundaries of this chapter to discuss it all. The next section will introduce some of the most influential models and proposals on the basis of their relevance to the specific issue of RC attachment variation.

2.3 Construal and other syntax first models

Frazier et al. (1996) reformulated the Garden-path model and proposed that late closure and minimal attachment are indeed universal, but apply only to the processing of primary relations, that is, the relation between the verb and its arguments. This way, primary phrases are parsed as in garden-path theory, but by contrast, adjuncts (non-primary relations) are simply loosely *associated* into the current thematic processing domain. Non-primary phrases receive initial underspecified syntactic analysis, allowing all non-structural sources of information (e.g. prosodic, semantic, pragmatic) to determine the final analysis.

In Construal theory, the parser will preferably analyse the incoming input instantiating a primary relation. When that is not possible, as is the case of RCs, the parser will integrate them within the current thematic domain using structural, pragmatic and discourse principles.

In fact, the case of classic RCs with complex DPs is a good test case for Construal. For example, in the cases where 'with' is the preposition linking the two DPs, the domain to which a non-primary item will be associated contains only the PP (*with the actress*) because 'with' is a theta-assigning preposition. Therefore, DP2 is the only available host. Alternatively, if the preposition 'of' mediates between the two DPs, the extended projection of the last theta-assigner is the highest VP which dominates the two potential heads of the RC, DP1 and DP2.

(15)   Someone shot the servant with/of the actress that was on the balcony.

In effect, research provided evidence in favour of these assumptions (De Vincenzi et al., 1995; De Vincenzi et al., 1993; Gilboy et al., 1995). Gilboy et al. (1995) tested Construal's predictions in English and Spanish in a series of questionnaires on RC attachment preference. Their work showed that preference for DP2 attachment was 53% in English versus 49% in Spanish when the non-theta-assigning preposition 'of' mediated between DP1 and DP2. The numbers increased to 69% in English versus 83% in Spanish with theta-assigning preposition 'with'. Gilboy and colleagues also tested the influence of the referential properties of the

DPs, and showed that within-language variability can be greater than between-languages variability. When a non-referential DP was made more referential by adding a determiner (e.g. *the sweater of wool* versus *the sweater of* the *wool*), DP2 attachment increased considerably. The presence of an adjective modifying an DP also increased attachment to the (already) modified DP. The interpretation of the data showed that nonstructural information such as thematic and referential properties of the DPs determined attachment preferences.

The study also found the usual differences between English and Spanish. Significant differences were found, particularly, in the condition with kinship relation type (e.g. the relative of the boy) commonly used in previous experiments, showing 57% high attachment in Spanish and 39% high attachment in English for the same sentences. The authors formulated an explanation based on an alternative genitive existing only in English, called the Saxon genitive (e.g. the actor's servant), whose meaning is identical to that with the Norman form (e.g. the servant of the actress). The difference between both relies on the possibility the Norman form offers to unambiguously refer to DP1 (e.g. the actor's servant was on the balcony vs. the servant of the actor). Since an easier and unambiguous structure is existent in English to refer to DP1, the use of the Norman form, following the Gricean maxim of clarity, might be preferably taken to refer to DP2. This would explain DP2 preference in English. Nevertheless, the Saxon genitive alternative must not be the only reason underlying cross-linguistic variation as in the Gilboy et al. (1995) study, when the type of relation was functional (e.g. the assistant of the inspector) the results were very similar in both languages. Moreover, Mitchell et al. (2000b) tested the Gricean account in two languages with frequently-used Saxon genitive as an alternative form, and their results diverged from those found in English.

2.3.1 Recency Preference vs Predicate Proximity

This theory proposed by Gibson and colleagues (Gibson, Pearlmutter, et al., 1999; Gibson et al., 1996) resembles in many aspects Construal theory, with the inclusion of a parameter-setting factor.

Recency Preference vs Predicate Proximity claims that preferences are ranked on the basis of two factors.

- Recency Preference: Preferentially attach structures for incoming lexical items to structures built more recently.

- Predicate Proximity: Attach as close as possible to the head of a predicate phrase.

Recency is a variant of Late Closure, with the difference that Late Closure only chooses one attachment site over all the alternatives, while Recency ranks all potential attachment sites and can interact with other factors to determine attachment preferences.

Predicate Proximity is an extension of Relativized Relevance, which postulates preferential attachment to the head of a predicate phrase (Frazier, 1990).

The two factors compete with each other, Recency prompts high attachment, while Predicate Proximity the contrary, low attachment. The final choice of preferred host falls to the one that entails the lowest processing-load cost. The theory assumes that Recency is an universal factor since it matches the general properties of the working memory, while Predicate Proximity is parameterised.

The theory predicts that languages with strict SVO word order like English will be dominated by Recency, whereas a language with a freer word order, such as Spanish, is more affected by Predicate Proximity. The reason for this is that the longer the average distance from the head of a predicate (verb) to its arguments in a language, the stronger the activation of the predicate needs to be in order to permit long distance attachments. The preference of attachment to a certain predicate is directly proportional to its degree of activation. A language like English, with a mostly rigid SVO word order, has a relatively weak Predicate Proximity strength because of the low average distance from verbal heads to their arguments. Spanish is principally an SVO language, but frequently also admits other orders such as VSO.

Gibson et al. (1996) tested fragments of sentences with three potential hosts such as that in (16) in two languages, Spanish and English, using a self-paced reading task.

(16)   . . . the lamp $_1$ near the painting $_2$ of the house $_3$ that was damaged$_{1,2,3}$ in the flood

Cumulative ungrammatically judgements (number of times an item is considered ungrammatical after reading the disambiguation), and reading times at the disambiguating region showed that in Spanish low attachment was judged ungrammatical less often than high or middle attachment, and high attachment was judged ungrammatical less often than middle attachment. Similarly, reading times were faster when the RC was attached to DP3, and slower when attached to DP2. Therefore, results from both dependent variables went in the same direction (DP3<DP1<DP2). The data showed the same results in English for reading times and ungrammatical judgements, with the only difference that there was no difference between middle and high attachment in ungrammatical reports.

Recency Preference vs Predicate Proximity satisfactorily explains the U-shape preference (DP3, DP1, DP2) found when the three hosts are available. The results in Spanish are not compatible with a single-factor (or principle) explanation, as there seem to be two different forces, one that predominantly prompts DP3 attachment, and a different one pulling toward DP1 attachment. Apart from Spanish and English, other languages replicated the findings in German (Hemforth et al., 1998) and Japanese (Miyamoto et al., 1999). There has also been some theoretical criticism to the theory. For instance, Mitchell et al. (1998) criticised it for making no commitment to a specific definition of verb/ argument distance.

2.3.2 The Linguistic Tuning Hypothesis: an experience-based, syntax first proposal

Cuetos et al. (1996), Mitchell et al. (1995) proposed an experience-based parsing mechanism predominantly governed by individual exposure to frequency distributions of structural possibilities. According to Tuning Hypothesis, the parser tuning occurs at a purely structural level, on the basis of syntactic information. Structural processing preferences are thus determined by the frequency with which they occur in a particular language.

In the general case of syntactic ambiguities, and the particular case of RC attachment with complex DP, the parser will choose the resolution of the ambiguity to which it has been most frequently exposed in the past, be it high attachment or low attachment. Along these lines, cross-linguistic variation is explained by variable frequency distributions in different languages. For example, Spanish preference for high attachment should correlate with a larger frequency of this structural resolution in Spanish, and vice versa in the case of English.

Given the impossibility to control individual exposure to different types of structures, one way to test Tuning predictions is to use corpus analysis. Although psycholinguistic work has generated some evidence that frequency of exposure can influence parsing (Cuetos et al., 1996; Mitchell et al., 1995), other studies do not report a straightforward mapping between frequency and the results obtained in the lab (see Mitchell et al. 1998 for problematic results from Dutch, Gibson and Schütze 1999 for problematic results in sentences with three DP sites in English, but also see Desmet et al. 2003). Furthermore, some common theoretical criticism address the lack of clear consensus as to the size of the elements over which exposure should have an effect (the grain size problem), and the lack of theoretical power to provide an answer to the question of whether a structure is more difficult to parse because it is less frequent, or if, on the contrary, it is the complexity of the structure which makes it less frequent and difficult to parse.

2.3.3 The emergence of Constraint-based Approaches

Constraint-based theories descended from interactive theories (Marslen-Wilson, 1975; Taraban et al., 1988; Tyler et al., 1977) and began to be an important account of sentence processing since the early 1990s. The different existent constraint-based theories differ in detail, but the common denominator is that ambiguity resolution is a continuous process, a single stage with immediate availability and influence of all sources of information. These multiple sources of information are called 'constraints', which include syntactic biases, probabilistic lexically-specific syntactic information, word meaning, verbs subcategorisation, events-knowledge, contextual pragmatic biases, prosodic cues, and other types of information gleaned from the linguistic and non-linguistic context. Another common property of constraint-based models is that multiple potential alternative interpretations are activated probabilistically in parallel. Therefore, sentence processing is achieved through the parallel simultaneous activation of different possible analyses of an ambiguous string, which are weighted probabilistically. Some constraint-based models also include anticipation or expectation of structure and content.

The development of these models have extended over the years, with an eventual contribution of computational modelling. The challenge these models face embrace the difficulty to predict the performance or output of a fully interacting nonlinear system that changes over time, which led to an initial under-specification or vagueness, rendering these theories unfalsifiable (Frazier, 1995). Criticism also came from supporters of the model as concerning the lack of specification about the range of probabilistic constraints that affect ambiguity resolution, the relative strength of these constraints, how they interact with one another (MacDonald et al., 1994; Tanenhaus et al., 1995).

An important effort has been made in the past years to identify important constraints. For instance, some studies showed verbal subcategorization restrictions such as transitivity can be used rapidly to resolve ambiguity during reading (Garnsey et al., 1997; Staub, 2007; Trueswell et al., 1993). Thematic role assignment and general world knowledge have also been shown to play an immediate role in the resolution of the main clause/reduced relative ambiguity(McRae et al., 1998), as well as contextual and referential factors (Altmann et al., 1988; Crain et al., 1985), among many other.

The first implementation of a constraint-based model was the Competition-integration model (McRae et al., 1998; Spivey et al., 1998; Spivey-Knowlton,

1994). Spivey and colleagues developed a model that simulates online reading
latency data. To do so, the model specifies and quantifies the relevant constraints,
describes an integration mechanism, and specifies a mapping onto reading times
that generates quantitative predictions. The model has been implemented in a
number of studies (Binder et al., 2001; Ferretti et al., 1999; Green et al., 2006;
McRae et al., 1998; Tanenhaus et al., 2000), studying different type of ambiguities
such as the main clause/reduced relative ambiguity, direct object/sentential com-
plement ambiguity, agentive versus locative prepositional phrase ambiguity, and
relative clause attachment. Other relevant implementations are the dynamical
systems model (Tabor et al., 1997), or the coordinated interplay account network
that has been used to simulate visual world eye-tracking data (Mayberry et al.,
2009).

Constraint-based models have evolved from a general statement (*all sources
of information are used immediately*), to the specification of measured constraints
in implemented models, which reduced theoretical degrees of freedom and have
made the theory falsifiable. Simulations have been advantageous to enable ex-
plicit testing of hypothesis about the relevant constraints and their relative strengths,
how they are weighted, and how they interact. Limitations with current imple-
mentations include the fact that models do not compute actual meaning of the
input, or also that they only allow a limited number of given alternatives, but do
not construct potential interpretations.

2.3.4 A hybrid model: Unrestricted race model

Van Gompel et al. (2000) reviewed a series of studies on syntactic ambigu-
ities, most of them employing eye-tracking technique, and observed that neither
two-stage theories, nor constraint-based approaches, account for the resolution
of structurally ambiguous sentences. Based on these general findings on syn-
tactic ambiguity resolution, Van Gompel et al. (2000) put forward an alternative
model which combines properties of both constraint-based and serial models. The
Unrestricted race model is a two-stage model that assumes only one analysis is
constructed at a time on strictly word by word incremental parsing. When the syn-
tactic structure built so far is inconsistent with the new information provided by
upcoming words, reanalysis takes place. The model is unrestricted because, like
constraint-based theories, there is no restriction on the sources of information ac-
cessible to build the analysis of an ambiguous structure. Therefore, non-syntactic
information is accessible to initially build an analysis as long as the information
is available before the point where the ambiguity arises. If non-syntactic infor-
mation becomes available at or after the ambiguous point, it cannot be employed
immediately during the initial parse.

The model assumes that different sources of information engage in a race to build the structure, with only one final structure being constructed: the one built the fastest. In some cases, the sources of information strongly support a particular analysis, which will be constructed first. In other cases the sources of information will support different analysis, with equal support for each. That means each analysis will be preferred half of the times, or in some cases perhaps a weak bias happens toward one analysis.

The main difference between both models is that constraint satisfaction model relates to competition. Different analyses compete with each other (very much like in lexical access models), thus ambiguous sentences should lead to higher costs due to competition of multiple analysis that are equally activated. Ambiguity advantage is the main argument against competition: ambiguous sentences in fact appear to be easier to parse than disambiguated alternatives, contrary to the predictions of a competition model.

If a certain analysis is inconsistent with incoming information, reanalysis takes place, which should be measurable as longer reading times, or more frequent regressions. The model predicts that globally ambiguous sentences should not imply any processing difficulty, or reanalysis, as the parser simply opts for the initially preferred structure. A crucial and novel aspect of this model involves cases of balanced ambiguity, where there is not a clear bias toward one analysis. In such cases the unrestricted race model predicts that the degree of processing difficulty depends on how often the initial analysis has to be revised. The more often reanalysis is required, the greater the processing difficulty. Along these lines, the model doesn't necessarily predict differences between ambiguous structures and strongly biased structures with subsequent consistent information, since reanalysis doesn't take place. In brief, the model only predicts processing costs when strongly biased structures need to be reanalysed, or in cases of balanced ambiguities where each analysis is taken roughly half of the times.

The predictions of this model, different from those from constraint-based and two-stage models, have been supported by a number of studies. Traxler et al. (1998) tested RC attachment ambiguity using ambiguous and disambiguated sentences toward DP1 or DP2 as illustrated in (17).

(17)   a.   The son of the driver that had the moustache was pretty cool.(ambiguous)

        b.   The car of the driver that had the moustache was pretty cool. (DP2 disambiguated)

        c.   The driver of the car that had the moustache was pretty cool. (DP1 disambiguated)

The offline preferred resolution for the ambiguous condition (17-a) in a forced-choice attachment questionnaire was DP2 attachment in 68% of the cases. The online results in an eye-tracking experiment using the three conditions indicated in (17) showed an ambiguity advantage in terms of faster reading times, with no difference between (17-b) and (17-c) (even though DP2 was preferred in the offline questionnaire).

The results were compared with those from a second study (18) employing the same methodology, where the preposition 'of' was replaced by the preposition 'with', which makes DP2 the only available host in the active theta domain.

(18)   a.   The steak with the sauce that was tasty didn't win a prize.(ambiguous)
           b.   The steak with the sauce that was runny didn't win a prize. (DP2 disambiguated)
           c.   The steak with the sauce that was tough didn't win a prize. (DP1 disambiguated)

The offline results in the ambiguous condition indicated a 81% of preference to low attachment (DP2). The online reading data showed, this time, longer reading times in the dispreferred reading (18-c) in comparison to both the preferred reading (18-b), and the ambiguous reading (18-a). Crucially, no difference was found between the ambiguous condition and the strongly preferred reading.

The authors claimed that constraint-based models, which claim that processing difficulty results from competition between alternative syntactic analysis activated in parallel, can't explain the results as they predict ambiguous sentences would show longer times than the disambiguated ones.

They concluded that the results provided evidence in favour of the Unrestricted race model, which correctly predicts an advantage of the ambiguous condition, the lack of difference between the ambiguous condition and the strongly biased one, but a difference between the ambiguous condition and the preferred interpretation when the preference is not strong. A potential problem with this conclusion is that the 'online' effect was only found in the late measure of total times.

Van Gompel et al. (2000) replicated and expanded the results in two eye-tracking studies with balanced and unbalanced ambiguities. The first experiment used sentences with RCs disambiguated by gender of a reflexive pronoun (himself/herself). This was considered the unbalanced condition as the offline pretest showed a DP2 attachment bias (70%).

(19) a. The brother of the colonel who shot himself on the balcony had been
very depressed. (ambiguous)
    b. The daughter of the colonel who shot himself on the balcony had
been very depressed. (DP2 attachment)
    c. The daughter of the colonel who shot herself on the balcony had been
very depressed. (DP1 attachment)

Data from eye movements showed an increased number of regressions
and longer total times when attachment was forced to DP1 in comparison to
the ambiguous condition. Although the number of regressions when the RC
modified DP2 was also greater than in the ambiguous condition, the results were
only significant by items.

The second experiment tests a more balanced ambiguity (49% preference
of DP2 attachment).

(20) a. The advisor of the mayor that had been driven to the meeting had a
lot of problems. (ambiguous)
    b. The village of the mayor that had been driven to the meeting had a
lot of problems. (DP2 attachment)
    c. The mayor of the village that had been driven to the meeting had
been a lot of problems. (DP1 attachment)

The proportion of regressions out in the ambiguous condition was numericaly
lower than both disambiguated conditions, and the disambiguated conditions did
not differ from each other.

Similar results have been replicated in other kind of syntactic ambiguities,
such as VP/DP ambiguity where the prepositional phrases could be interpreted
as modifier of the sentential object or instrument of the verb (Van Gompel et al.,
2001). The results show up most of the times as a late effect in total times in the
critical region and/or in first-pass regressions and regression path times in the
spillover region.

Swets et al. (2008) challenged the Unrestricted Race model by indicating
that an alternative explanation for the ambiguity advantage could be underspecifi-
cation. Readers might underspecify ambiguous sentences as an economy strategy,
unless the experimental task demands disambiguation. To test their hypothesis,
the authors employed sentences similar to those used in Van Gompel et al. (2001).
The key difference between both studies stands in the comprehension question
asked after the sentences. Swets et al. (2008) manipulated the focus of the ques-
tions in a way that one group was asked questions about RC attachments (e.g. Did

the maid / princess / son scratch in public?) whereas another group was asked superficial questions (e.g. Was anyone humiliated / proud?).

The results indicated that the type of questions indeed affected the reading of ambiguous sentences. When the questions were superficial, ambiguous sentences were read faster than the disambiguated ones, but in contrast, when the questions focused on attachment, ambiguous sentences did not show any advantage. Swets et al. (2008) concluded that the ambiguity advantage is just explained by shallow processing, which can turn to detailed/specific processing if the task so demands.

2.3.5   Factoring in *underspecification*: the Good enough approach

The Good enough approach is based on Ferreira and colleagues observation that representations are only *good enough* for the purpose at hand, and incorrect interpretations of ambiguous or complex sentences appear to linger even after a complete syntactic analysis should have ruled them out (Christianson et al., 2001; Ferreira et al., 2002a; Ferreira et al., 2016; Slattery et al., 2013; Sturt et al., 2004).

Ferreira and colleagues have provided evidence in a series of experiments that misinterpretations are ubiquitous in language comprehension, and questioned the reliability of online measures such as reading time to reflect the actual content of the representations generated during processing. Christianson et al. (2001) for example, reported misinterpretations of garden-path sentences. They studied participant's comprehension of sentences like the example in (21) by examining their answers to comprehension questions presented after the sentences had been read.

(21)   While Mary bathed the baby played in the crib.

They found that participants spent more time than in control conditions reading the disambiguating word "played", and often reread the preceding material as a result of a significant tendency to misinterpret these sentences to mean that Mary bathed the baby, when in fact the sentence specifies that Mary is bathing herself and not the baby, and the baby is playing in the crib. When participants were asked to answer questions such as: *Did the baby play in the crib?*, their accuracy was equally good in the garden-path and in the control condition. Now, when the question focused on the disambiguating region (Did Anna bath the baby?), participants wrongly answered affirmatively. Although participants restructured the sentence to make "the baby" the subject of "played", they do not seem to

have restructured the sentence to make the bathing event reflexive, and so they persisted in the interpretation that the baby was being dressed. In other words, the offline data showed that the initial misinterpretation lingered and caused participants to hold a representation in which "the baby" was both the subject of "played" and the object of "dressed". Importantly here, that happened despite the evidence from reading measures that these participants analysed and revised the syntactic structure.

Similarly, misinterpretations were also reported in passive sentences (Ferreira et al., 2000) like that in (22), which is often misinterpreted to mean that the dog bit the man. The data seems to indicate that people's beliefs and knowledge of the world are used to derive a semantic meaning of the sentences blind to the actual compositional, syntactically derived meaning.

(22)   The dog was bitten by the man.

A possible explanation for these results is the formation of "good enough representations" that are incoherent as a whole, but good enough to satisfy the demands of the task (Ferreira et al., 2002b; Ferreira et al., 2007; Sturt et al., 2004). The syntactic structure might be sometimes underspecified and semantic representations incomplete unless task's demands require a deeper processing. The supporters of this approach encourage the use comprehension measures such as question-answering accuracy and text recall in studies of sentence comprehension to examine the mapping between online measures and the content of the representations generated during processing, and also to know to which extent comprehension tasks could affect comprehension.

It is not clear why misinterpretations take place. There is more than one line of explanation to account for this observation. One possible explanation suggests that the syntactic misinterpretation lingers in memory, which fails to clean up the initial misinterpretation (Slattery et al., 2013). Similar results were observed in text processing literature, where data showed readers fail to update their representations when initial information was later contradicted (Albrecht et al., 1993; O'Brien et al., 1998). Yet a different line of explanation suggests that the parser skips over words whose integration challenge working memory capacity, and this preference overrides the need for grammatical well-formedness. Similar explanations have been proposed to explain linguistic illusions (e.g. *More people have been to Russia than I have*) (Wellwood et al., 2018).

The ideal research design would combine the two types of measures: Offline measures such as question-answering accuracy or recall to enquire the content of the representation participants generated, and online measures such as

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reading times or probability of regressions to know how these representations are built in real time. The only drawback of this is that questions unavoidably drive participant's attention to certain aspects of the structure. In the case of RC attachment ambiguities, an explicit question about attachment could make the participant aware of the ambiguity, or also of the purposes of the experiment. Comprehension tasks are often considered "metalinguistic", that is, they do not reflect the operation of the language processing system itself but instead unveil what participants think they have comprehended. In a lab context situation readers flexibly adjust their reading strategies depending on the task and the goals. Participants economise their attentional effort, and although many aspects of language comprehension are automatic, others demand attentional resources.

This approach raises the awareness that the measures obtained in the lab from participants are goal-oriented, and thus highly influenced by the specific task or goal at stake. As Schotter et al. (2014) pointed out: "Our findings imply that, in the future, researchers should anticipate the way in which the instructions they give to subjects and the types of questions they ask of them might change the way they approach the task of reading and subsequently the way in which they process words and sentences".

2.3.6   The role of prosody: the Implicit Prosody Hypothesis

Prosody could be defined as the level of linguistic representation at which the acoustic-phonetic properties of an utterance vary independently of its lexical items (Wagner et al., 2010). The acoustic-phonetic properties include emphasis, pitch excursion, intonational breaks, rhythm, and intonation, which combined serve the purpose of marking prosodic phrasing and prosodic prominence, among other. These two aspects of prosody have been key in the research of the relation between prosody and sentence processing. One central question was whether listeners can take advantage of the close mapping between syntax and prosodic boundaries to resolve syntactic ambiguities at the initial stages of processing. More than two decades of research strongly suggests that prosody can be rapidly integrated into the linguistic representation (Kjelgaard et al., 1999; Warren et al., 1995; Watson et al., 2005) to help disambiguate a structure.

A related question is whether the prosody can influence language comprehension in reading. Although there is no explicit prosodic information available when reading (apart from punctuation marks) it has been proposed that readers project a prosodic representation called implicit prosody (Bader, 1998; J. D. Fodor, 2002).

J. D. Fodor (1998, 2002)'s Implicit Prosody Hypothesis claims that a default

prosodic contour is constructed in silent reading, which is decisive in resolving syntactic ambiguities in general, and to solve the cross-linguistic differences in RC attachment preferences in particular. In cases of ambiguity, the parser would favour the syntactic analysis that better maps into the natural (default) prosodic contour for that construction.

For example, a general tendency to place an intonational boundaries before longer phrases might lead to positing a prosodic break before longer RCs, leading to the projection of an independent intonational phrase containing the RC itself, thus separating it from the closest DP which in turn would have consequences on RC attachment, leading to a higher proportion of High Attachment resolution for longer RCs. Shorter RCs, on the other hand, are less likely to be preceded by an intonational boundary. The absence of a boundary creates a bias towards low attachment. Similarly, a preference to attach new constituents to constituents of the same length (*Balanced Sister Hypothesis*, J. D. Fodor, 1998) leads long RCs to attach high, since this would lead to a long RC being attached to a long DP (the high DP modified by the low DP) and short RCs to preferentially attach locally, as this would lead to them being attached to a short DP.

Numerous experiments on sentence processing have shown an offline tend to low attachment when the RC is short but high when the RC is long (see among others Fernández et al. 1999 on English; Quinn et al. 2000 on French, English, and Arabic; Lovric 2004 on Croatian; Pynte et al. 2000 on French; Fernández 2003 on Spanish; Jun et al. 2003 on Japanese; Vasishth et al. 2004 on Hindi, Wijnen 2004 on Jabberbocky).

J. D. Fodor (2002) suggested that cross-linguistic variation in RC attachment might also be accounted for in terms of variation in prosodic constraints of each particular language. For example, high attachment languages might be more likely to place prosodic breaks at the beginning of constituents, and viceversa, low attachment languages might be less likely to place a prosodic boundary before the RC. However, no explanation has been offered in terms of what factors make some languages more prone to place prosodic breaks at a certain position. A number of studies have investigated alleged cross-linguistic differences in prosodic phrasing in overt prosody, to assess the tendency in high attachment languages to place a bigger prosodic break between an RC and the adjacent complex DP, than the break between the two head nouns, while the opposite relation would be true for speakers of low attachment languages.

Despite the confluence of cross-linguistic findings supporting a role of implicit prosody in sentence processing, experimental results (Bergmann et al.,

2008; Jun, 2010) suggest that implicit prosodic phrasing may not be fully consistent with explicit phrasing. Jun (2010) found that, counter to the predictions made by the Implicit Prosody Hypothesis, English speakers preferred a prosodic phrasing expected to occur with high attachment languages, that is, a bigger break between the RC ad the complex DP (DP1 DP2)//(RC), in comparison to the break between DP1 and DP2. The results are not the expected ones if implicit prosody is equal to explicit or overt prosody, and/or the prosodic boundary is the responsible for attachment choices. Bergmann et al. (2008) also found no correlation between phrasing prosodic pattern and attachment preferences in English and Spanish. In both cases, the strongest break was placed after DP2 when reading the sentences aloud, while attachment preferences were high attachment in Spanish and low attachment in English.

2.4 Summary

This chapter has introduced the challenge the cross-linguistic variation reported in RC attachment preferences posed to principles of parsing based on locality effects such as the Late Closure. The crisis of the Late Closure caused in turn the crisis of one of the most influential models of sentence processing, the Garden-Path model, leading to the subsequent proliferation of different theories of ambiguity resolution.

Some of these theories, just like the Garden-Path Model, defend parsing preferences are grounded in universal principles of economy of computation and cross-linguistic variation is reducible to grammatical distinctions (Construal, Recency/Predicate Proximity), including prosody (Implicit Prosody Hypothesis). Others focused on factors such as frequency distributions (Tuning), or a (Constraint-based approaches) as decesive for parsing preferences.

The contribution of each of these theories has helped to delve into the nature of human sentence processing to some extent and open new avenues of research. However, none of them provide a framework able to fully explain the specificity of variation across languages.

The next chapter introduces a new development in this literature, i.e. the discovery that an additional structural ambiguity has been this far neglected: the selective availability of Pseudo Relatives. Previous materials tested in the so-called High Attachment languages could have leaked a structure called Pseudo Relative, which superficially looks like Relative Clauses, but (among other fundamental differences) forces a reading compatible with High Attachment only.

3

A CONFOUNDING VARIABLE: THE PSEUDO RELATIVE

This chapter describes a recent proposal that will be central in this thesis: the PR-*first* Hypothesis. This proposal stems from the discovery (Grillo, 2012) that the previous literature on RC-attachment was confounded by the asymmetric availability of Pseudo Relatives in the languages and structures tested. Pseudo Relatives (PRs) and RCs are string identical, but the two structures display very different structural and interpretive properties: PRs are a kind of eventive SCs, while RCs are DP modifiers and introduce properties of entities. Grillo (2012) and Grillo and Costa (2014) argued that the superficial similarity between PRs and RCs might be the responsible of the reported non-local preference in the subset of Spanish and other so-called High Attachment languages. For these languages, apparent RCs modifying the complement of perceptual verbs are in fact ambiguous between an RC and a PR interpretation, whereas this ambiguity is non-existent in the subset of English and other Low-Attachment languages.

Crucially, the attachment ambiguity present under the RC reading disappears under the PR reading, where the highest DP is the only accessible subject for the embedded predicate. *PR-first* suggests that PRs are simpler at the structural and interpretive level than RCs and are thus preferred by the parser and that the problematic preference for High Attachment reported in the literature is largely a consequence of PR-availability. When PRs are not available, it is claimed, a uniform preference for Low Attachment is observed across languages.

PR-*first* provides a valid framework to explain a number of questions that include the reported cross-linguistic variation, including questions such as why the differences between languages are observed exclusively with RC attachment

ambiguities (and not in other structures), and why only under certain conditions (e.g. when the RC is in object syntactic position). Importantly, it also makes concrete predictions on the distribution of languages into the High Attachment or Low Attachment category in function of their grammar. The first section of this chapter describes some basic structural and interpretive properties of PRs together with some arguments to distinguish them from restrictive and non-restrictive RCs. Next, the PR-*first* Hypothesis is described together with its implications in the research of RC attachment preferences. The last section reviews current empirical support for this hypothesis.

3.1   The not-so unknown Pseudo Relatives

PRs are a type of clausal complement formed by a DP and a clause headed by a complementizer (*que* in Spanish), which contains a finite verb which agrees in person and number with that DP. In spite of their superficial similarity to RCs, PRs display clear differences at the structural, interpretive and prosodic levels.[1] .
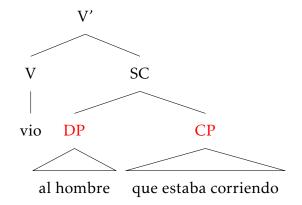
(1)   a.   María vio [$_{PR}$ [$_{DP}$ al   hombre] [$_{CP}$que   estaba corriendo.]]
             M.   saw the man that was   running.
             'Maria saw the man running.'
      b.   María vio [$_{DP}$ al   [$_{NP}$ hombre [$_{RC}$que   estaba corriendo.]]].
             M.   saw the man that was   running.
             'Maria saw the man that was running.'
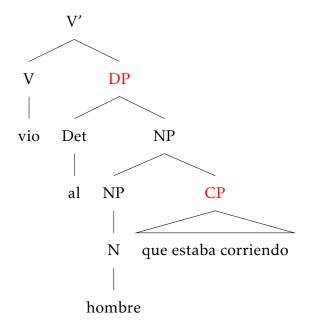
At a structural level, PRs have a DP subject and CP standing in a sisterhood relation (2), contrary to RCs, where the same CP is embedded within the DP they modify (3). Like English eventive SCs, PRs are projected as complements of perception verbs, while RCs are adjuncts.

---

[1]Whereas PRs have just landed in the field of psycholinguistics, there is a significant literature on them in theoretical linguistics (Brito 1995; Burzio 1986; Casalicchio 2013; Cinque 1992, 1995; Graffi 1980; Grillo et al. 2015, 2016b; Guasti 1988; Kayne 1975; Koenig et al. 1999; Koopman et al. 2008; Labelle 1996; Radford 1975b; Rafel 1999; Rizzi 1992 among many other). Linguists have primarily focused on PRs in Romance languages although PRs are also available in other language families (e.g. Serbo-Croatian), see below for more details.

(2) PSEUDO RELATIVE

```
                    V'
          ┌─────────┴─────────┐
          V                   SC
          │            ┌───────┴───────┐
         vio          DP              CP
                    ╱    ╲          ╱      ╲
                 al hombre     que estaba corriendo
```

(3) RELATIVE CLAUSE

```
                    V'
          ┌─────────┴─────────┐
          V                   DP
          │            ┌───────┴───────┐
         vio          Det              NP
                       │         ┌──────┴──────┐
                       al        NP            CP
                                  │         ╱     ╲
                                  N    que estaba corriendo
                                  │
                               hombre
```

(Adapted from Grillo and Costa, 2014, p. 162)

This structural difference is mapped into a different interpretation as PRs complements of perceptual verbs involve (direct) perceptual reports of situations, whereas RCs denote properties of entities. One of several consequences of this distinction is that the embedded event needs to be directly perceived in PRs but not in RCs.

(4) PSEUDO RELATIVE

$\exists e \exists e'[see(e)$ & EXPERIENCER(e) (Maria) & STIMULUS(e')(e) & RUN(e') & AGENT(e')(the man)]

There exists an event of *seeing* and the experiencer of that event is *Maria* and the stimulus is *an event of running* and *the man* is the agent.

(5) RELATIVE CLAUSE

$\exists e$ [see(e) & EXPERIENCER(e) Maria) & STIMULUS(the unique man that

was running)(e)]

There exists an event of *seeing* and the experiencer of that event is *Maria* and the stimulus is the *the unique man that ran*.

A clear indication that PRs refer to inanimate situations comes from sentences like (6), where the masculine pronoun *lo* cannot refer to the embedded subject *the girl*, but only to the whole situation *the girl running*.

(6) Lo   que vi   fué a   la chica que corría.
     What that I.saw was DOM the girl that ran.
     'What I saw was the girl running.'

The list in (7) contains a sample of PRs in different Romance languages.

The translation into English of these sentences corresponds to the eventive SCs of the Acc-ing type

(7) **Spanish**: He visto a Juan que corría. (Rafel, 1999)

Catalan: He vist en Joan que corria.(Rafel, 1999)

Galician: Eu vin eu Xoán que corría.(Rafel, 1999)

Portuguese: Eu vejo o João que corre[2].(Brito, 1995)

French: J'ai vu Jean qui courait. (Kayne, 1975; Koenig et al., 1999; Koopman et al., 2008; Labelle, 1996)

Italian: Ho visto Gianni che correva. (Burzio, 1986; Casalicchio, 2013; Cinque, 1992, 1995; Graffi, 1980; Guasti, 1988; Radford, 1975b; Rizzi, 1992)

English-SC: I saw Gianni running

Examples of PRs in other type of languages are the following:

(8) **Greek**: Idha ton Yani pu etreche.
     'I saw Gianni running.' (Angelopoulos, 2015)

Serbo-croatian: Video sam Jovana koji je ljubio devojku.
     'I saw Jovana kissing he girl.' (Grillo & Costa, 2014)

Dutch: Ik zag Jan die naar huis rende.
     'I saw Jan running home.' (Grillo & Costa, 2014)

---

[2]The status of PRs in Portuguese will be discussed in the next section, but for now just say that most speakers of European Portuguese do not accept PRs as presented here and that the structure called Prepositional Infinitival Clause (PIC) is more widely accepted as the correlate to PRs

3.2 Featuring Pseudo Relatives

Evidence for distinct analyses of PRs and RCs comes from multiple sources, some of which are reviewed in this section. One primary indication that PRs and RCs comes from the type of DP allowed to precede the embedded clause in the two constructions. Whereas RCs are only allowed with common names, PRs are perfectly acceptable with proper names even in the absence of an intonational break typical of non-restrictive RCs:

(9)   He   visto a   Juan que corría.
      I.have seen DOM J.   that ran.IMPF.
      'I saw Juan running.'

An even clearer diagnostic to distinguish PRs from both restrictive and non-restrictive RCs come from the availability of PRs with pronouns (10).

(10)   a.   Maria ha visto a   la candidata que pintaba.
            Maria has seen DOM the candidate that painted.
            'Maria saw the candidate that was painting.'
       b.   Maria la   ha visto que pintaba. PR-only
            Maria her has seen that painted.
            'Maria saw her painting.'

Contrary to PRs, neither restrictive or non-restrictive RCs are licensed with pronouns.

(11)   a.   Maria ha votado a   la candidata que pintaba. RC-only
            Maria has voted DOM the candidate that painted
            'Maria voted for the candidate that painted.'
       b.   *Maria la   ha votado que pintaba.
            Maria her has voted that painted.
            '*Maria voted for her that painted.'

Notice that the example in (10-b) corresponds to a two constituent PR, where the DP can move outside the PR, whereas the examples provided in exampl(1) and (2) constitute a single constituent PR. In fact, in line with the observations made by Cinque (1992, 1995), PRs allow for multiple parses which are subject to cross-linguistic variation. The three possible analyses discussed by Cinque (1995) are:

(a) A single CP constituent analysis: *visto* [$_{CP}$ DP *que* ...].

(b) A two constituent analysis where the matrix verb takes only the DP as complement and the CP function as an adjunct: *visto* [DP] [$_{CP}$ *que* ...].

(c) A single DP constituent where the 'que' clause is a modifier of the DP: *visto* [$_{DP}$ DP *que* ...].

Most recently Grillo et al. (2017) argued for the reduction of the number of possible analyses to two: single DP constituents, and two DP + CP predicate constituents. The first type corresponds to PRs which are situation-denoting DPs (we return to this in subsection 3.2.3). This analysis is available in Spanish as shown by different tests:

(12) He visto [$_{PR}$ al chico que subía al coche]
       I saw DOM.the boy that got.into the car
       'I have seen the boy getting into the car.'

Pseudo-clefts

(13) Lo que he visto es a María que subía al coche.
       'What I saw is Mary getting into the car.'

Pronominalization

(14) Lo he visto.
       'I have seen it.'

Anaphoric interpretation (Brito, 1995)

(15) Desde aquí vi a María que subía al coche, pero desde allí no debías de
       poder verlo.
       'From here, I saw Maria getting into the car, but from there you must not
       have been able to see it.'

The three tests show that the pronoun 'lo' makes reference to the whole event of 'Mary getting into the car'.

Adjunct insertion

The insertion of adjuncts between the head and the predicate renders the structure ungrammatical, or only grammatical if interpreted as an appositive.

(16)   *He fotografiado a Juan in fraganti que robaba muestras de perfume.
        'I took pictures of Juan in the act of stealing perfume samples.'

On the other hand, two-constituent PRs are more restricted in Spanish. Although movement of DPs is allowed, as shown by cliticization in the above example repeated in (17), PRs are not allowed for instance following predicates that only take two-constituent PRs such as *incontrare*/meet or *sorprendere*/surprise, that is, predicates that only take entities as objects and not situations.

(17)   a. Maria ha visto a   la   candidata que   pintaba.
            Maria has seen DOM.the candidate that   painted.
            'Maria saw the candidate that was painting.'
        b. Maria la   ha visto que pintaba. PR-only
            Maria her has seen that painted.
            'Maria saw her painting.'

The structural and interpretive differences between PRs and RCs also explain a number of restrictions observed with PRs that do not apply to RCs, including constraints on licensing environment, Tense, Aspect and properties of the embedded predicate. Some of these restrictions apply uniformly across all PR-licensing languages, other are language specific, with some languages, e.g. Italian, allowing for more PR-licensing environments than e.g. Spanish. Next subsection focuses on PR-restrictions in Spanish, which will be useful to later understand the manipulations carried out to create PR-licensing and non-licensing contexts in the experiments presented in this thesis.

3.2.1   Restrictions on PRs in Spanish

(i) **Restrictions on matrix verb**

While RCs are free to modify a DP independently from the context in which it appears, PRs are only available under a restricted set of predicates. This set contains most typically verbs of perception (18-a), but also quasi-perceptual verbs (such as e.g. *film*, *record*), as these can freely introduce situations.[3] Contrary to RCs, however, PRs are not allowed under predicates that only take entities as complements, including epistemic, stative, and relational verbs (18-b).

---

[3]Some languages, like Italian, also allow PRs under a few non-perceptual verbs, roughly corresponding to the set of predicates licensing Acc-ing constructions in English, including e.g.: *incontrare*, meet, *beccare*, catch, *sopportare*, stand, as in *I can't stand Boris*. As mentioned before, this is due to the fact that PRs, like English eventive SCs, allow multiple analyses.

(18)   a.   María ha visto a   Claudia que corría.
                M.   has seen DOM Claudia that ran.IMPF.
                'Maria saw Claudia running.'

         b. *María ha conocido a   Claudia que corría.
                M.   has met   DOM Claudia that ran.IMPF.
                '*Maria met Claudia that ran.'

         c. *María ha querido a   Claudia que corría.
                M.   has loved   DOM Claudia that ran.IMPF.
                '*Maria loved Claudia that ran.'

         d. *María está casada   con Claudia que corría.
                M.   is   married with Claudia that ran.IMPF.
                '*Maria met Claudia that ran.'

As mentioned, clear prosodic differences distinguish PRs from appositive RCs. Beside prosody, pronominal reference can also be used to rule out the appositive reading in (19-b) (which unlike restrictive RCs can take proper names as heads).[4] The example in (19-a) further shows that PRs denote events, here the object of seeing, i.e. event of 'Claudia running', can naturally be referred back to using the neuter clitic *lo* 'it'. On the contrary, as the appositive in (19-b) modifies the DP *Claudia*, only the feminine clitic *la* 'her' can be used to refer back to it.

(19)   a.   María ha visto a   Claudia que corría.   Yo también
                M.   has seen DOM Claudia that ran.IMPF. I   too
                lo   he   visto.
                it.ACC have.I seen
                'Maria saw Claudia running. I saw it too.'

         b.   María ha visto a   Claudia, que corría.   Yo también
                M.   has seen DOM Claudia, that ran.IMPF. I   too
                la/*lo   he   visto.
                her/it.ACC have.I seen
                'Maria saw Claudia, that ran. I saw her too.'

(ii) **PRs only allow the complementizer *que*:**

Relative pronouns such as *el cual* (who/which) cannot introduce PRs, only restrictive or appostive RCs.

---

[4]Grillo and Turco (2016) provide preliminary evidence that PRs and restrictive RCs are also prosodically distinct: Italian speakers make use of temporal and melodic cues to disambiguate between PRs and RCs, with longer production duration (and more tonal movement) for both the DP and the following CP in PRs than in RCs, which they take to indicate presence of a major prosodic boundary between the DP and CP in PRs, related to the difference of attachment height of the CP in the two structures.

(20)   a.   *He   visto a   Juan el   cual estaba sonriendo.
                I.have seen DOM Juan the who was   smiling
                'I saw Juan smiling.'

        b.   He   saludado al   chico el   cual estaba sonriendo.
                I.have waived   the boy   the who was   smiling
                'I waived the boy who was smiling.'

(iii) **Tense restrictions**

PRs obey Tense restrictions not found with RCs. While Tense in RCs displays clear referential properties, Tense in PRs is anaphoric and typically matches (or depends on) the tense specification of the main clause (Pozniak et al., 2019). The restriction naturally stems from the direct perception interpretation triggered by PRs: the *seeing*-event and the perceived event should overlap in time. Simultaneity is thus a requisite in PRs (21-a), but just an option in RCs (21-b).

(21)   a.   *María vio a   Alejandro que corre.
                M.   saw DOM Alejando that runs.IMPF
                '*Maria saw Alejandro that runs.'

        b.   María trabaja con el   chico que corre/correrá/había
                M.   works with the boy   that runs/will.run/had
                corrido.
                run.
                'Maria works with the boy that runs/will run/had run.'

(iv) **Restrictions to viewpoint/outer aspect**

Also for the sake of simultaneity, the aspectual form of the embedded verb should be Progressive/Imperfective, for the reported event needs to be perceived as it unfolds. That is an essential condition to guarantee the simultaneity of both events, one expressed by the main predicate and another by the embedded predicate. Perfective aspect, which is associated with terminated events, would not be compatible with the ongoing interpretation, and would force a shifted reading.[5] (4)

(22)   *María vio a   Alejandro que había corrido.
         M.   saw DOM Alejando that had   ran.
         '*Maria saw Alejandro that had run.'

---

[5]See Casalicchio (2013) for discussion of exceptional cases in which terminated events are allowed in PRs, these typically denote a situation with some directly perceivable consequent state of an event, importantly the auxiliary still appears in its Imperfective form, as in e.g.: *Ho visto Maria che aveva appena rotto il vetro*/I saw M. that had just broken the glass.

Importantly, in languages which allow both a Progressive and habitual interpretation of Imperfectives (like Italian or Spanish) only the Progressive interpretation survives in PRs. Ban on habitual interpretation is easily diagnosed e.g. using bare plural objects whose meaning cannot fit in the boundaries of a single event (23-c).[6]

(23)   a.   María vio al   chico que corría.
            M.   saw DOM.the boy   that ran.
            'Maria saw the boy running/that was running.'
       b.   María vio a   Alejandro que corría.
            M.   saw DOM Alejandro that ran.
            'Maria saw Alejandro running/*that was running.'
       c.   *María vio a   Alejandro que corría maratones.
            M.   saw DOM Alejandro that ran   marathons.
            'Maria saw Alejandro running marathons.'

(v) **Restrictions to Inner Aspect**

Again in sharp contract to RCs, which can contain any type of predicate, and in line with what was observed with Acc-ing constructions, PRs can only contain eventive predicates and disallow non-perceptual predicates.[7]

(25)   a.   He   visto a   Juan que hablaba en   Inglés.
            I.have seen DOM J.   that spoke   English.
            'I saw G. speaking English.'
       b.   *He   visto a Juan que   conocía el Inglés.
            I.have seen J. that knew English.
            '*I saw knowing English.'

The list of restrictions does not end here, a more thorough description of PR-restrictions can be found in chapter 5. The restrictions on tense and aspect exposed here will be of importance to understand the manipulation carried out in chapter 4.

---

[6]Naturally, bare plurals are allowed in PRs as long as their presence still allows for an episodic reading of the event, e.g. *Juan vio al chico que comia patatas*/John saw the boy eating potatoes.

[7]In specific cases, stage-level predicates might be allowed (24-a), but not individual level predicates (11-b):

(24)   a.   Ho   visto Gianni che aveva gli occhi rossi.
            I.have seen G.   that had   the eyes red.
            'I saw G. with red eyes.'
       b.   *Ho   visto Gianni che aveva gli occhi blu.
            I.have seen G.   that had   the eyes blue.
            '*I saw G. with blue eyes.' (Casalicchio, 2013)[p.117][ex.160]

3.2.2 PRs semantic features

(i) **PRs are transparent**: Moulton et al. (2015a) and Grillo and Moulton (2016a) claim that PRs, despite the fact that they involve fully inflected clauses, are semantically transparent and denote direct perception of events. Following Barwise (1981) and Barwise et al. (1983) description of direct or epistemically neutral (26-a) and indirect or epistemically positive (26-b) perceptual reports, Moulton et al. (2014) defend that beyond bare infinitives, the property of transparency can also be ascribed to PRs, in spite of being finite clauses.

(26)   a.   Rita saw Max leave early.
         b.   Rita saw that Max left early.

Moulton et al. (2014) defend that in contrast to full complement clauses (which display indirect or epistemically positive perception, as in (27-b)), PRs are direct or epistemically neutral (27-a) as they do not presuppose any intellectual belief. The perceiver sees the event (*Juan making coffee*, as in (27-a)) by means of the senses. In contrast, what the perceiver sees in (27-b) is not necessarily the event per se, but evidence showing that Juan made coffee that morning, maybe by the sound of the coffee pot or the smell of coffee.

(27)   a.   Vi   a   Juan que hacía el café.
              I.saw DOM Juan that made the coffee.
              'I saw Juan making coffee.'
         b.   Vi   que Juan hacía el café.
              I.saw that Juan made the coffee.
              'I saw that Juan made coffee.'

PRs, just like infinitives, establish a direct relation between a perceiver and an individual situation. Substitution of extensionally equivalent descriptions of an individual situation preserves truth, like the example in (28) since they are epistemically neutral.

(28)   Vi   a   Juan   llorar/ que   lloraba, pero pensaba que
         saw.I Juan cry.INF/ that   cried. IMPF, but thought that
         estaba riendo.
         was.he laughing.
         I saw Juan cry/crying, but thought he was laughing.

Indirect perception complements are epistemically non-neutral, hence substitution is not allowed here.

(29) Vi   que Juan lloraba (por   las lágrimas), #   pero
      saw.I that Juan cried. ɪᴍᴘꜰ (by the   teardrops), but
      pensaba que estaba riendo.
      thought that was.he laughing.
      I saw that Juan cried (from the tears on his eyes), but thought he
      was laughing.

(ii) **PRs are referential**: Grillo et al. (2017) claim that PRs refer to specific
events located in time and space. As such, PRs do not display quantifier-
scope ambiguities under universal quantifiers and they block distributive
readings (30).

(30) Todo el   mundo ha visto a   Jorge que bailaba.
      All   the world   has seen ᴅᴏᴍ Jorge that danced
      'Everyone has seen Jorge dancing.'

Only a cumulative reading holds in example (30), that is, a single event of
dancing for everyone, instead of a distributive reading where there is one
different event of dancing for each person.

In contrast, infinitival complements allow both cumulative and distributive
readings, because the universal quantifier can either take scope over the
existential quantifier in the multiple events of dancing, or either the existen-
tial quantifier can take scope over the universal quantifier in a single event
of dancing.

(31) a. Todo el   mundo ha visto a Jorge bailar ayer   por la
          All   the world   has seen to Jorge dance yesterday by   the
          noche.
          night.
          'Everyone saw Jorge dance yesterday night.'
      b. Todo el   mundo ha visto a Jorge bailar alguna vez.
          All   the world   has seen to Jorge dance some   time.
          'Everyone saw Jorge dance sometime.'

Further evidence for PR referentiality comes from the fact that PRs cannot
scope under negation (32-a)(Grillo et al., 2015), in contrast to infinitives
(32-b).

(32) a. *María no vio a   Pedro que corría en la   carrera.
          M.   not saw ᴅᴏᴍ Pedro that ran   in the race.

           'Maria didn't see Pedro that ran in the race.'

    b.   María no vio al   hombre correr en la carrera.
        M.   not saw DOM.the man   run in the race.
        'Maria didn't see the man run in the race.'

PRs do not scope under negation because they refer to individual situations and presuppose the existence of such event. For the same rationale, narrow scope under conditional of the event described in the PRs is not available:

(33)   #Si Carla hubiera   visto a Alejandro que bailaba se habría
        If Carla had.COND seen a Alejandro that danced SE would.have
        enfadado, pero por   suerte no   bailó.
        got.angry, but luckily not   he.dance
        'If Carla had.COND seen Alejandro dancing, she would have got angry, but luckily he didn't dance.'

Conversely, infinitival clauses, which are not referential can take narrow scope under conditionals:

(34)   Si Carla hubiera visto a   Alejandro bailar, se habría
        If Carla had   seen DOM Alejandro dance, SE would.have
        enfadado, pero por suerte no bailó.
        got.angry, but for luck not he.dance
        'If Carla had seen Alejandro dance, she would have got angry, but luckily he didn't dance'

3.2.3 PRs internal structure

This section outlines three different candidates for the PR internal structure existent in the literature, with special focus on the recent proposal made by Grillo and Moulton (2016a).

Cinque (1992), Guasti (1988), Radford (1975a), Rafel (1999) claimed a SC status of PRs on the basis of similar distributional properties of PRs and SCs (35), and coordination between these two structures (36).

(35)   He visto a Juan que corría / con María/ saltando la valla / borracho.
        'I saw Juan running/ with María/jumping the fence/ drunk.' (Rafel, 1999, p. 171)

(36)   Vi [SC al sospechoso dentro de un coche negro] y [PR a una mujer que salía del banco.]
        'I saw the suspect inside a black car and a woman leaving the bank'

Cinque (1995) also argued that PRs are CPs because the type of proform used for the substitution test (*il che*) typically refers to propositional CPs and not individual DPs.

(37)   a.   Ho   visto Mario che scriveva nel   sonno, il   che mi pareva
              Have.I seen Mario that write   in.the sleep, the that me seem
              cosí strano.
              so   strange
              'I saw Mario writing while asleep, which did not seem that strange.'
        b.   Ho   visto che Mario scriveva nel   sonno, il   che mi pareva
              Have.I seen that Mario write   in.the sleep, the that me seem
              cosí strano.
              so   strange
              'I saw that Mario writes in his sleep, which did not seem that strange.'

Cinque argues that since the proform *il che* can refer back to both PRs and CPs, PRs must be CPs. This argument was criticized by Grillo et al. (2015) who pointed out that the pronominalization by *il che* also works for infinitives (38-a), SCs (38-b) or DPs, so CP status does not seem to be a necessary condition.

(38)   a.   Ho   visto Mario scrivere   nel   sonno, il   che mi pareva cosí
              Have.I seen Mario write.INF in.the sleep, the that me seem   so
              strano.
              strange
              'I saw Mario write in his asleep, which did not seem so strange to me.'
        b.   Ho   visto Mario ammalato, il   che mi pareva cosí strano.
              Have.I seen Mario sick,   the that me seem   so   strange
              'I saw Mario sick, which did not seem so strange to me.'

In fact, as the examples in (39) show, CP status is not even a sufficient condition for the licensing of "*il che*":

(39)   a.   Gianni mi ha detto che l'esercito ha bombardato la   città,
              Gianni me has told   that the.army has bombed   the city,   the
              il   che ha   fatto molte   vittime.
              that has made many   victims.
              'G. told me that army bombed the city, which made many victims.'
        b.   Ho   visto l'esercito che bombardava la   città, il   che ha
              Have.1sg seen the.army that bombed   the city, the that has
              fatto   molte vittime
              made   many victims.
              'I saw the army bombing the city, which made many victims.'

These observations void the argument for CP status of PRs from *il che* pronominalization.

3.2.4 DP analysis of single constitent PRs

Grillo and Moulton ([2016a](#)) highlighted that PRs have the same distribution as DPs. For example PRs and DPs (unlike CPs) can complement propositions.

(40) a. La   vista di Carlo è da non perdere.
          The sight of Carlo is to not miss
          'The sight of Carlo is not to be missed.'

      b. La   vista di Carlo che balla il   tango è da non perdere.
          The sight of Carlo that dance the tango is to not miss
          'The sight of Carlo dancing the tango is not to be missed.'

      c. La   storia (*di) che Carlo ha sconfitto il   drago   non è vera.
          The story (*of) that Carlo has defied   the dragon not is true
          'The story that Carlo defied the dragon is not true.'

      (Grillo & Moulton, [2016a](#), p. 5)

They also argue that PRs are allowed in environments that exclusively select for situations (41-a), and not entities (41-b) or propositions (41-c):

(41) a. La   scena di Carlo che balla   il   tango è da non perdere.
          The scene of Carlo that dances the tango is to not miss
          'The scene of Carlo that dances the tango is not to be missed.'

(42) a. *La   scena di Carlo è da non perdere.
          The scene of Carlo is to not miss
          'The scene of Carlo that dances the tango is to not missed.

      b. *Maria crede/ritiene Carlo che balla.
          Maria believes   Carlo that dances.
          '*Mary believes Carlo dancing.' (Grillo & Moulton, [2016a](#), p. 6)

Moreover, PRs can be pronominalized by *qué*, which commonly only substitutes DPs.

(43) Vi a Mario que corría la maratón.
      'I saw Maria running the merathon.'
      Qué has visto? A Mario que corría la maratón.
      'What did you see?' 'Mario running the marathon.'

Finally, only DPs (and not CPs) can be coordinated with PRs.

(44)   a.   Desde aquí ya   veo a   Carlos y   a   su hijo Pablo que
            From here already I.see DOM Carlos and DOM his son Pablo that
            corren a nuestro encuentro.
            runs   to our   finding
            'From here, I see Carlos and his son Pablo running to meet us.'

       b.   *Desde aquí ya   veo a   Carlos y   que su hijo Pablo corren
            From here already I.see DOM Carlos and that his son Pablo runs
            a nuestro encuentro.
            to our   finding
            'From here, I see Carlos and his son Pablo running to meet us.'

The evidence Grillo et al. (2017) and Moulton et al. (2015b) present from both
syntax and semantics for a DP-analysis of PRs and Grillo and Moulton (2016a) sug-
gest that one dimension of cross-linguistic variation in PR-availability is largely
dependent on the availability of both *kind* and *token* interpretation of definite DPs
in PR-licensing environments. A full discussion of Grillo and Moulton's analysis
would take us too far astray from the present goals. Suffices here to say that, in
their analysis, while PRs typically introduce event tokens/individual situations,
PRs in subject position in Italian denote event kinds/types of situations (Gehrke,
2019; Portner, 1991). The intended meaning in e.g. Maria che balla è uno spetta-
colo./'Mary dancing is quite a sight.', thus, is that any instantiation or token of the
event-kind of *Maria dancing* is a sight. PRs in these contexts obey restrictions typ-
ical of kind-denoting expressions, including incompatibility with unique event
modifiers (among many others). One advantage of this analysis is that it provides
a straightforward account of cross-linguistic differences in the availability of PRs
with kind-taking predicates such as e.g. *sopportare* 'can't stand' and *being com-
mon/widespread*, as well as absolute with constructions and existentials. See Grillo
and Moulton (2016a) for details and analysis.

3.2.5   Differences between Spanish PRs, Italian PRs and European Portuguese PRs/PICs

It is important to point out that PR-availability is not a unitary phenomenon
across languages, in fact a great deal of variation in PR-licensing environment is
often also found within a given language. This is in part due to the fact that, as
argued by Cinque (1992, 1995), PRs (at least in some languages) allow multiple
structural analyses. For instance, European Portuguese licensing contexts for PRs
vary greatly across speakers (Brito, 1995).

Brito (1995) argued that PRs are available in a restricted set of contexts,
such as contexts introduced by the adverb *eis*:

(45)   Eis   o   comboio que chega.
         Here's the train   that arrives
         'Here's the train arriving.'

Or PRs under perceptual reports:

(46)   Vejo o   teu   filho que está a chorar.
         see.I the your soon that is   P cry.
         'I see your soon crying.'

Although this example passes the following single constituency tests (examples from Brito 1995):

   Pseudo-cleft

(47)   O que eu vi foi o teu filho que está a chorar.
         'What I saw was your son crying.'

Anaphoric interpretation

(48)   Daqui eu vejo o teu filho que chora mas tu não deves ver daí/vê-lo daí.
         'From here I see your son crying but you could not see it from there.'

It fails to meet other PR basic properties which are nevertheless observed in PICs, such as modification of proper names (49) or modification of clitics (50) (examples from Costa et al. 2016; B. Fernandes 2012:

(49)   *Eu vi o Pedro que chorava. (PR)
         Eu vi o Pedro a chorar. (PIC)
         ' I saw him crying.'

(50)   *Eu vi-o que corria. (PR)
         Eu vi-o a correr.   PIC
         'I saw him running.'

Furthermore, PIC have similar SC distributional properties:

(51)   a.   O Gianni deixou a sala embriagado. (SC)
            'Gianni left the room drunk.'

        b. *O Gianni deixou a sala que estava ainda sob o efeito do álcool. (PR)
            'Gianni left the room that was still under the effect of the alcohol.'

        c.   O Gianni deixou a sala ainda a beber. (PIC)
            'Gianni left the room still drinking.'

Rafel (1999), B. Fernandes (2012) and Costa et al. (2016) suggested a structure called Prepositional Infinitival Constructions (PIC) (52) to be a better correlate as it shares most of the properties assigned to PRs.

(52)   Vejo o   teu   filho a chorar.
        see.I the your soon P cry.
        'I see your soon crying.'

Although Spanish PRs are somewhat closer to Italian PRs, a striking difference between both is the wider distribution of PRs in structural contexts beyond perceptual reports in Italian, which cover absolute-with constructions (53-a), locative and existential constructions (53-b,c), complement of verbs like 'to remember' (53-d), *sopportare* (53-e), and nominals (53-f), among others. Spanish does not allow PRs in any of these contexts. [8]

(53)   a.   Con Gianni che parla, non faremo niente. (Italian)
            *Con Juan que habla, no haremos nada. (Spanish)
            'With John speaking, we will never do anything.'

        b.   In cucina c'è una pentona (d'acqua) che bolle. (Italian)
            *En la cocina hay una olla (de agua) que hierve.(Spanish)
            'In the kitchen there is a pot of water boiling.'

        c.   Il giovedí c'è Gianni che suona.(Italian)
            *El Jueves hay Juan que toca.(Spanish)
            'On Thursdays there is John playing.

        d.   Ricordo Gianni che partiva. (Italian)
            *Recuerdo a Juan que partía. (Spanish)
            'I remember Juan leaving.'

        e.   Non sopporto Gianni che fuma in casa mia.(Italian)
            *No aguanto a Juan que fuma en mi casa. (Spanish)
            'I can't stand John smoking in my house.'

---

[8]In turn, most of these sentences are accepted when the PR is replaced by the present participle. e.g. *En la cocina hay una olla (de agua) hirviendo*/ 'In the kitchen there is a pot of water boiling.' On this point see more below.

f. La fotografia di Gianni che balla il tango è stata la più venduta. (Italian)

*La fotografía de Juan que baila el tango ha sido la más vendida. (Spanish)

The picture of John dancing tango was the one that sold the most.'
(Examples from Rafel 1999, pp. 56–57)

Another crucial difference between Italian and Spanish is that Italian allows kind-denoting PRs, whereas Spanish does not. In some languages, Spanish being one of them, PRs are not allowed in subject position (example adapted from Grillo and Moulton (2016a)):

(54) a. *Carlos y María que bailan el tango son un espectáculo para no perdérselo.(Spanish)
      b. Carlo e Maria che ballano il tango sono uno spettacolo da non perdere.(Italian)
          'Carlos and Maria that are dancing tango are a sight not to be missed'

Kind-referring PRs are not allowed in Spanish and for extension, PRs are not allowed in subject position, only in object position under an episodic reading of *Maria dancing* as a single event.

The lack of kind-PRs in Spanish is assumed by Grillo and Moulton (2016a) to explain why PRs are not allowed in subject position (e). The same rationale is used by the authors to explain why tense match in PRs displays episodic direct perception in both languages, but conversely, tense mismatch delivers generic direct perception (event kind) in Italian, and forces an RC reading in Spanish.

(55) a. Carlo ha visto   Maria che balla.
          Carlo has seen.PAST Maria that dances.PRES
          Carlo has seen Maria dancing.
      b. *Carlos ha visto   a   María que baila.
          Carlos has seen.PAST DOM Maria that dances.PRES
          Carlos has seen Maria dancing.

Evidence for the existence of multiple parses for PRs provides a rationale to explain away at least some of the observed variation: the distribution of PRs across languages should be tied to the availability of a given PR parse in that language. Thus if a language only allows PRs in the environment of perceptual verbs (or more broadly in the context of predicates that can select situations), it would be reasonable to conclude that only single constituent/situation denoting PRs are allowed in that language.

As mentioned in the previous section, Grillo et al. (2017), Moulton et al. (2015b) present evidence from both syntax and semantics for a DP-analysis of PRs and Grillo and Moulton (2016a) suggest that one dimension of cross-linguistic variation in PR-availability is largely dependent on the availability of both *kind* and *token* interpretation of definite DPs in PR-licensing environments. One advantage of this analysis is that it provides a straightforward account of cross-linguistic differences in the availability of PRs with kind-taking predicates such as e.g. *sopportare* 'can't stand' and *being common/widespread*, as well as absolute with constructions and existentials Grillo and Moulton (2016a)

Another important dimension of variation, is the availability of alternative structures to introduce events/situations in PR-licensing environments. In Spanish, but not in standard Italian, there exists an unambiguous option for introducing event descriptions in PR-environments: the *gerundive verb form* (56-a), which in English corresponds to the present participle (e.g. smoking).

(56)   a.   María bailando flamenco es todo un espectáculo.
             Maria dancing flamenco is all   a   spectacle.
             '*Maria dancing flamenco is something to see.'
       b.   *Maria ballando flamenco è uno spettacolo.

The present participle allow both a token (57-a) and a kind (57-b) reading in some contexts.

(57)   a.   El jueves   pasado todos vimos a   Juan bailando el tango.
             The Thursday last   all   saw.we DOM Juan dancing the tango.
             'Last Thursday all saw Juan dancing tango.'
       b.   Todos han visto alguna vez a   Juan bailando el tango.
             All   have seen some   time DOM Juan dancing the tango.
             'Everyone has seen one day or another Juan dancing tango.'

The *gerundio* is also allowed in the contexts presented previously where PRs were not allowed:

  (a) Complement of a noun:
       La fotografía de Juan bailando el tango ha sido la más vendida.
       'The picture of John dancing the tango was the one which sold the most.'

  (b) In absolute with constructions:
       Con Juan hablando como una cotorra, no haremos nada.(Spanish)
       'With John speaking like a parrot, we will never do anything.'

(c) In locative contexts:

En la cocina hay una olla (de agua) hierviendo.(Spanish)

'In the kitchen there is a pot of water boiling.'

(d) With verbs like to remember:

Recuerdo a Luca cocinando ñoquis.

'I remember Luca cooking gnocchi.'

(e) PRs in subject position:

Carlos y María bailando el tango son un espectáculo para no perdérselo.

'Carlos and Maria that are dancing tango are a sight not to be missed'

The presence of an unambiguous form in Spanish is bound to have important repercussions in the processing and interpretation of embedded clauses as we will see more in depth in chapter 4.

Finally, a particularity that Spanish grammar presents is the presence of the Differential Object Marking (DOM) preceding the direct object in selective contexts. The phenomenon of DOM has been widely studied in this language (Brugè et al., 1996; Laca, 1995; Leonetti, 2004; Ormazabal et al., 2013; Salcedo, 1999) (for an overview see Fábregas 2013). In spite of the considerable variation across dialects and individual preferences, the general observation is that the phenomenon is determined by the interaction of two types of information. The first one is the properties of the direct object defined in terms of animacy, definiteness, specificity and topicality. As a rule of thumb, the greater the degree of individuation and referentiality, the more likely the compulsory of DOM is. The second factor is the type of main verb, as certain verbs require DOM, while others present some degrees of freedom. Verbs of perception fall in the latter category. Generally, DOM follows verbs of perception when the object is animate, but there is some tolerance to the lack of DOM when the direct object is headed by an indefinite article with an animate object.

(58)   Vi   (a)   un perro.
        saw.I (DOM) a   dog.
        'I saw a dog.'

The same applies to animate indefinite objects in PR contexts.

(59)   a. Vi   (a)   un perro que   nadaba.
            Saw.I (DOM) a   dog   swimming.
            'I saw a dog swimming.'

    b.   Vi   (a) unos niños   que   saltaban la   valla.
        Saw.I ᴅᴏᴍ a   children jumping the   fence.
        'I saw some children jumping the fence.'

There seems to be, at the intuitive level, a difference between both. The a-marking in this context might increase the exceptionality of the object. Somewhat related, Fábregas (2013) indicates that the a-marking seems to be associated to contexts where the a-marked DP is the intended agent of some implicit event. For example, in a context where something has happened in the kitchen (there is a mess, a ruined cake, or something broken), the a-marking such as in (60-a) might indicate the intention of the speaker to convey that the dog is likely to be responsible for that.

(60)   a.   Vi a un perro en la cocina.
            I.saw A a dog in the kitchen
      b.   Vi un perro en la cocina.
            I.saw a dog in the kitchen

In contrast, definite animates in PR contexts require DOM (at least with the verb 'to see'):

(61)   a.   *Vi   el   perro que nadaba.
          Saw.I the dog   that swam.
          'I saw a dog swimming.'
      b.   *Vi   los niños   que saltaban la   valla.
          Saw.I the children that jump   the fence.
          'I saw the children jumping the fence.'

                ´

In the next section we will see the relation between the availability of PRs in a certain language and the parsing of RCs. The hypothesis that will be presented, the PR-*first* Hypothesis, is central for the work of this thesis.

3.3 The PR-*first* Hypothesis

Based on the observation of the asymmetric distribution of PRs across languages, and the syntactic and semantic properties of both structures, Grillo (2012) put forward the *PR-first Hypothesis* to explain the cross-linguistic RC attachment variability, further developed in Grillo and Costa (2014).

PR-first Hypothesis: *When PRs are available, everything else being equal, they will be preferred over RCs.*[9]

The rationale for PR-*first* is that PRs are less complex than RCs at the syntactic, semantic and discourse levels. In the first place, PRs have simpler syntax and semantics than RCs. First of all, PRs (at least in the case of single constituent analysis) are arguments, while RCs are adjuncts. Preference for arguments over adjuncts is well documented in the psycholinguistics literature, together with a general tendency of the parser to avoid restrictive interpretations whenever possible, at least out of a licensing context (see e.g. Staub et al. 2018, a.o.). Furthermore, as the discussion above has shown, while RCs are fully specified clauses, PRs are SCs, with greatly impoverished structures despite their appearances (see also Grillo and Moulton 2016a; Moulton et al. 2015b on PRs being semantically transparent despite being finite clauses). One illustration of this comes from the observation that Tense is anaphoric in PRs, but referential in RCs. The anaphoric tense in PRs establishes a dependence between the embedded and the matrix tense, in a way that simultaneity between embedded and main verbs should be met. Just like with reflexive pronouns, embedded tense must be bound (by the matrix tense). In the case of RCs, the dependence is not established with the matrix tense, but rather with the context. Referential tense in RCs functions in a way similar to free pronouns. The referential domain of PRs is comprised within the sentence level, thus the dependence is resolved structurally, which arguably should contribute to the PR advantage.

As seen above, PRs are also impoverished in terms of both inner and outer aspect. These impoverishment are readily translated into processing advantages, as the levels of uncertainty associated with each of these categories is greatly reduced in PRs when compared with RCs. This means that once a PR is projected, the set of choices available to the parser (for Tense and Aspect) is greatly reduced.

A third argument comes from discourse: the discourse licensing conditions of RCs, in fact, are more complex than those of PRs. RCs introduce properties of individuals which contribute to the identification of a unique individual from a set of alternatives. This set of alternatives must be either present in the current discourse or it must be presupposed. This rich contextual representation is not needed in the case of PRs, which simply introduce directly perceived situations. Since PRs carry fewer unsupported presuppositions than RCs, they will be preferably adopted by the parser also from a discourse perspective (Altmann et al., 1988; Crain et al., 1985).

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[9]Preference is understood in terms of overall preference across subjects and items.

Finally, PRs should also be preferred from a pragmatic perspective because of the principle of *Relativized Relevance* (Frazier, 1990). Frazier proposed that in the presence of ambiguities, the parser privileges interpretations that contribute to the main assertion of the clause. PRs, being arguments of the main predicate, are more relevant than RCs, which are being modifiers provide information which might be tangential to the main assertion of an utterance.

3.3.1   PR-*first* and attachment preferences

The *PR-first Hypothesis* has important consequences for RC attachment with complex DP (62). This is because under the PR-parse there is no ambiguity of attachment, as only the highest DP is an accessible subject for the embedded predicate (i.e. only the higher DP c-commands the subject gap in the CP). If the *PR-first Hypothesis* is sound, i.e. if PR-parse is preferred, a preference for High Attachment should be observed in languages and contexts which license PRs.

(62)   María vio [$_{PR}$ [$_{DP}$ al hijo$_i$ [$_{PP}$ del maestro$_j$]]] [que corría$_{i,*j}$].
         Maria saw the son of the teacher that ran.$_{IMP}$.

         'Maria saw the son of the teacher running.'

Support for *PR-first* comes from both review of previous results from the literature on RC-attachment and from a number of recent studies which directly manipulated PR-availability. The list of languages traditionally classified as *High Attachment* is composed mostly of languages that license PRs (including e.g. Dutch, Italian, Serbo-Croatian, Greek), while languages that do not license PRs have been classified as *Low Attachment* based on previous results (e.g. English, Basque, Chinese).

In table 3.1 we see that the subset of languages which generally prefers High Attachment coincides with the subset of languages with PR availability, with some exceptions[10] .

PR-*first* predictions align with predictions from classic models and theories of parsing presented in Chapter 2, Construal and Referential Theory. Construal theory assumes that the parser will preferably analize the incoming input instantiating a primary relation, therefore a complement will be favoured to an adjunct.

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[10]Notice once more that PR-availability is not the only factor involved in RC-attachment disambiguation. Therefore a perfect mapping between PR-availability and attachment preference is not necessarily predicted. Russian, German and Bulgarian, for example, have been traditionally classified as High Attachment languages, while none of the three allows PRs. RCs in the three languages, however, are introduced by relative pronouns (and not complementizers) and are preceded by a comma in writing. See Grillo and Costa 2014; Hemforth et al. 2000 for discussion of how both variables have important effects on RC attachment for independent reasons.

Table 3.1: Attachment preferences and PR availability (adapted from Grillo and Costa (2014))

Language	Attach.	PR availability
Afrikaans	HA	?
Serbo-croatian	HA	✓
Spanish	HA	✓
Dutch	HA	✓
French	HA	✓
Galician	HA	✓
Greek	HA	✓
Italian	HA	✓
Russian	HA	X
Japanese	HA	✓
Korean	HA	✓
Arabic	LA	?
Basque	LA	X
Chinese	LA	X
English	LA	X
Norwegian	LA	✓
Romanian	LA	X
Swedish	LA	✓
Bulgarian	HA/LA	X
Portuguese	HA/LA	✓
German	HA/LA	X

If minimal attachment applies to the parser's decision between these two structures, the PR syntactic tree obtains a fewer number of nodes. In the case of RCs, as a non-primary structure, language-specific grammatical properties and higher level information, such as contextual information and semantic plausibility, will modulate attachment, but when these factors are controlled locality principles such as late closure should apply. In the case of Referential Theory, when PRs are at stake there is no need to presuppose a pre-established entity or set of entities in the discourse model as it's the case with RCs (Altmann et al., 1988; Crain et al., 1985).

Previous studies on RC-attachment can be hard to evaluate in light of the confound raised by selective PR-availability; to fully evaluate the impact of this factor is essential to provide a direct test of PR-availability in different languages and environments. A number of recent studies directly manipulating PR-availability have consistently reported High Attachment in globally ambiguous PR/RC environments (e.g. under perception verbs) and Low Attachment in unambiguous RC environments (e.g. under non-perceptual/relational predicates) in a number of PR-languages. Next section reviews and discusses results from

these studies.

3.4   PR-*first* Hypothesis: State of the art

This section presents the empirical evidence gathered to date in the PR/RC ambiguity literature. Two main different research methods have been frequently used to test PR-*first* Hypothesis: offline attachment preferences using forced-choice attachment questionnaires, and online parsing of locally ambiguous PR/RC contexts in eye-tracking experiments.

3.4.1   Grillo & Costa (2014)

Grillo and Costa (2014) tested the PR-*first* Hypothesis in two experiments. The first experiment compared PR-compatible contexts (right-branching 'che' clauses with subject gap), and PR non-licensing contexts (which included right-branching with object gap, centre-embedded with subject gap, and centre-embedded with object gap) as the example in (63) shows.

(63)   a.   **Right-branching/ Subject gap (56.5% HA)**
                  Il barista ha guardato l'amico del cliente che <> veniva sorpreso dai colleghi.
                  'The barman watched the friend of the client (that was) being surprised by his colleagues.'

         b.   **Right-branching/ Object gap (44% HA)**
                  Il barista ha guardato l'amico del cliente che i colleghi avevano sorpreso <>.
                  'The barman watched the friend of the client that his colleagues had surprised.'

         c.   **Center-embedded/ Subject gap (32.8% HA)**
                  L'amico del cliente che <> veniva sopreso dai colleghi é molto buono.
                  'The friend of the client that was surprised by his colleagues is very nice.'

         d.   **Center-embedded/ Object gap (40.1% HA)**
                  L'amico del cliente che i colleghi avevano sopreso <> é molto buono.
                  'The friend of the client that his colleagues had suprised is very nice.'

To replicate previous findings, the authors used a selection of entity-taking and event-taking verbs in each condition. The final percentages of attachment preferences showed a High Attachment preference only in the condition where PRs are available, that is, right-branching with subject gap, and Low Attachment for the

rest. The analysis showed a significant difference between subject and object gap only in the right-branching condition, and an effect of position in the condition with subject gap.

All in all, the results go in line with the predictions from PR-*first*, but in order to fully test the hypothesis, a direct comparison between entity-taking and event-taking verbs was carried out in the second experiment. In order to prove that the difference between right-branching with subject gap and the rest of conditions is due to the availability of PRs (even if just in one part of the target items), ambiguous PR/RC contexts created with perception verbs were compared with genuine RCs in environments that exclusively select entities (e.g. under stative/relational verbs like *work with/ be married to*).

(64)   a.   **PR/RC context**
            Gianni ha visto il figlio del medico che correva.
            'Gianni saw the son of the doctor running/ that ran.'
    b.   **RC context**
            Gianni vive con il figlio del medico che correva..
            'Gianni lives with the son of the doctor that ran.'

The results showed 78.6% of High Attachment in PR/RC contexts and 24.2% in genuine RCs, the difference between both being statistically significant. Even though PRs were available in every item in the condition with perception verbs, 100% is not observed because the effect of PR-availability covaries with other relevant factors. In this case, for instance, other factors such as referentiality or plausibility were not controlled. It is an empirical question how much does PR-effect interact with other effects, and to which extend would PR-*first* be observed in extremely biased materials. This study strongly supports PR-*first* Hypothesis in Italian, but other PR-languages should be tested to prove the robustness of the hypothesis. Non-PR languages should be studied as well to fully test the hypothesis and rule out alternative explanations.

3.4.2 Studies in Portuguese

B. Fernandes (2012) tested PR/RCs (65-a) and PICs (65-c) in European Portuguese in a series of attachment questionnaires. The use of event-taking predicates and entity-taking predicates created PR and PIC compatible or incompatible environments.

(65)   a.   PR/RC - Perceptual
           Alguém viu o filho do médico que estava jantar.

        'Someone saw the son of the doctor that was having dinner.'

    b.   PR/RC - Non-perceptual

        Alguém divide a casa com o filho do médico que estava a jantar.

        'Someone shares the house with the son of the doctor that was having dinner.'

    c.   PIC - Perceptual

        Alguém viu o filho do médico a jantar.

        'Someone saw the son of the doctor having dinner'.

    d.   PIC - Non-perceptual

        Alguém divide a casa com o filho do médico a jantar.

        'Someone shares the house with the son of the doctor having dinner'.

In addtion, Fernandes also tested these constructions in nominal sentences (e.g. A fotografia do filho do médico (que estava) a jantar é velha/ The picture of the doctor's son having dinner is old.)

The results with PICs showed 78% of High Attachment preference with perceptuals and 20% with non-perceptuals. Similar results were obtained in nominal environments (71% versus 38%). The results with PR/RCs also showed a main effect of verb type and High Attachment preference was increased in PR-compatible contexts (61%) in comparison to genuine RCs (33%), although the contrast is less marked. The author concluded that although PICs are the closer structure to PRs in European Portuguese, the temporal availability of PICs until the complementizer 'que' and the limited availability of PRs in European Portuguese might explain the higher percentage of High Attachment in this language.

Tomaz et al. (2014) also examined the influence of the availability of PRs in European Portuguese in a forced-choice questionnaire and a self-paced reading task.

The attachment questionnaire served the purpose of exploring offline preferences of attachment in ambiguous PR/RC (66-a) and genuine RC contexts (66-b).

(66)   a.   O Eduardo ouviu o irmão do jovem que estava a cantar no largo.

        'Eduardo heard the brother of the young man (that was)/ singing in the square.'

    b.   O Eduardo vive com o irmão do jovem que estava a cantar no largo.

        'Eduardo lives with the brother of the young man (that was)/ singing in the square.'

The data showed a stronger preference for High Attachment in PR-compatible

contexts (70% of High Attachment) than in contexts of genuine RCs (50%). These numbers slightly differed from those found by B. Fernandes (2012), for the same comparison between PR-compatible contexts (61%) and genuine RCs (33%), but the differences might be due to the employment of different materials in both experiments.

The same materials disambiguated toward DP1 or DP2 by means of number agreement, crossing all possible combinations of number of the DPs with number of the embedded verb, were used for the self-paced reading task.

No significant effects were found in reading times in the critical region (*estava/estavam*), but there was a significant interaction in the spillover region (*a*), although further analysis is not reported. Response times to the question when sentences were disambiguated toward DP1 under perception verbs were significantly faster than in non-perceptual verbs. Furthermore, there were higher error rates and slower response times when Low Attachment was forced in PR-compatible contexts in comparison to High Attachment.

The results show an effect of PR-availability in attachment preferences. This effect does not emerge in reading measures in self-paced reading task. However, low accuracy rates when initial PR-compatible sentences are forced to RC-disambiguation hints at a possible override of disambiguating information (in fact, similar outcome will be reported in further research which will be presented below).

One interesting data this study provides which is otherwise difficult to obtain with other methods, was the reading times at the complementizer region 'que'. The reading times were faster in PR-compatible environments suggesting that readers build a preference for a PR reading at the verb level, facilitating the integration of 'que' clause in this context.

Costa et al. (2016) constitutes the first paper on children's preferences of attachment of PR/RCs and PICs in European Portuguese.

Costa et al. (2016) performed a picture selection task conducted with children of four and five years old, and a control group of adults, where sentences with PR/RCs (67-a) or PICs (67-b) were presented under perceptual reports to participants who had to choose the picture that best matched the sentences.

(67)   a.   Mostra-me o   amigo do caçador   que está   a saltar.
               Show.me   the friend of the.hunter that jumps.
               'Show me the friend of the hunter that jumps.'

        b.   Mostra-me o   amigo do caçador   a saltar.
               Show.me   the friend of the.hunter P jumpINF
               'Show me the friend of the hunter jumping.'

In one of the pictures, only DP1 (e.g. the friend) is performing the action described in the sentence, and vice versa, in the other picture is only DP2 (e.g. the hunter) who performed the action. The adult control group showed a 90.6% of High Attachment preference in sentences with PICs and 62% in sentences with PR/RCs. The High Attachment found in PR/RCs is explained by the authors as the result of the residual effect of PR availability has on attachment. The results in the group of 5-year-old children are fairly similar to the group of adults (69.6% High Attachment in PR/RCs and 82.3% in PICs), but in contrast, the group of 4-year-old display a different tendency (57.8% High Attachment in PR/RCs and 66.3% in PICs). Differences between both groups are explained by effects of (linear) intervention which are overcome by the age of 5. Although the acceptability of PRs in European Portuguese seems very limited with great variability between speakers, its effects (albeit more modest than the effects observed in PICs) are still notable in this language, as shown in Tomaz et al. (2014) and Costa et al. (2016). A post-test questionnaire about PRs acceptability judgements could have been beneficial for checking the mapping with attachment preferences.

Another study in Portuguese, this time comparing Brazilian and European Portuguese PRs (E. Fernandes et al., 2016) in PR/RC ambiguous contexts in a forced-choice attachment questionnaire. In line with Costa et al. (2016) and Tomaz et al. (2014), there is an increased percentage of High Attachment choices in the condition combining perceptual main verb with tense match (68-a) (although the interaction is only marginally significant).

(68)　　a.　Mário viu a filha da doutora que corria a maratona. 'Mario saw the daughter of the doctor that ran the marathon.'

　　　　b.　O Mário vê a filha da doutora que corria a maratona. 'Mario sees the daughter of the doctor that ran the marathon.'

　　　　c.　O Mário viveu com a filha da doutora que corria a maratona. 'Mario lived with the daughter of the doctor that ran the marathon.'

　　　　d.　O Mário vive com a filha da doutora que corria a maratona. 'Mario lives with the daughter of the doctor that ran the marathon.'

In spite of the general boost in High Attachment in PR-compatible contexts, the preferences in European and Brazilian differed. The overall preference in Brazilian Portuguese was Law Attachment, whereas the overall preference in European Portuguese switched from High Attachment preference under perceptual verbs (including when it was followed by tense mismatch, showing again an override of disambiguating information in PR-compatible contexts) to Low Attachment under non-perceptual verbs.

Given the yet unknown state of Brazilian PRs, it is difficult to interpret the results but it is reasonable to think that PRs are not available in this variety of Portuguese. As for European Portuguese, it seems that the residual acceptance of PRs in some contexts in this language might be enough to explain the High Attachment preference in PR-compatible contexts, in line with what has been observed in previous studies in European Portuguese Costa et al. (2016), B. Fernandes (2012), Tomaz et al. (2014).

3.4.3   Study in English

Grillo et al. (2015a) put the emphasis on the need to test the PR-*first* Hypothesis not only in PR-languages but also in languages where this structure is not available in order to rule out potential alternative explanations rooted on predicate semantic (Rohde et al., 2011).

Grillo et al. (2015a) tested English (a non-PR language) in PR-licensing (using event-taking verbs) and PR-non licensing (using entity-taking verbs) environments. The results showed an overall preference for Low Attachment, although PR-licensing environments enhanced the percentage of High Attachment.

(69)   a.   **Event-taking, Verbal**
             Mark observed the friend of the politician that was cooking.
       b.   **Event-taking, Nominal**
             The scene of the friend of the politician that was cooking is long.
       c.   **Entity-taking, Verbal**
             Mark is engaged to the friend of the politician that was cooking.
       d.   **Entity-taking, Nominal**
             The boat of the friend of the politician that was cooking is long.

Type of verb had a modulatory role, with significantly more High Attachment for event-taking predicates (mean of 34.85% High Attachment) than entity-taking predicates (mean of 33.7%). The effect was found in both environments.

In a second experiment, the authors showed that English can shift to a High Attachment preference when SCs are at stake. English SCs were tested in SC/reduced RC environments with results similar to those found in PR-*first* Hypothesis. The authors concluded that a combination of semantic/pragmatic effects and the temporal availability of a SC interpretation can explain results in the first experiment. The second experiment extends PR-*first* to SC-first, supported by the results in English. A globally ambiguous SC/reduced RC constructions (event-taking) and unambiguous reduced RCs (entity-taking) in nominal and verbal environments

(70)   a.   **Event-taking, Verbal**
Mark observed the friend of the politician cooking.

          b.   **Event-taking, Nominal**
EVENT-TAKING, NOMINAL
The scene of the friend of the politician cooking is long.

          c.   **Entity-taking, Verbal**
Mark is engaged to the friend of the politician cooking.

          d.   **Event-taking, Nominal**
The boat of the friend of the politician cooking is long.

The results showed that English can switch its traditional low-attachment preference to High Attachment when SCs are available. Mean of High Attachment was 55.8% in event-taking predicates, and 17.45% in entity-taking predicates. The experiment served the purpose of demonstrating that, while there is an effect of predicate semantics, the effect is limited and cannot explain High Attachment per se. In English, High Attachment is only obtained when SCs are made available. The results thus support a grammatical factor as the source of cross-linguistic variation, and expands previous findings on PRs to SCs.

English was also used as a control language in Pozniak et al. (2019), finding relevant differences with French in the parsing of PR/RC ambiguities.

3.4.4   Studies in French

Pozniak et al. (2019) constitutes the first online evidence of the advantage of PRs. Two offline methods (attachment questionnaire and acceptability judgements) and one online study (eye-tracking) were designed to test the PR-*first* Hypothesis in French while comparing the results with English.

In the attachment questionnaire in French, High Attachment was preferred in PR-compatible environments (i.e. perceptual main predicate) (61%) whereas Low Attachment was widely preferred in PR-incompatible environments (i.e. non-perceptual main predicate) (28% of High Attachment).

For the acceptability of tense (mis)match in French and English the authors created PR-compatible environments employing tense match, and PR-incompatible environments using tense mismatch (see section 3.2.1 for tense restrictions on PRs).

(71)   a.   PERCEPTUAL, MATCH
Jean a vu la fille qui poussait la femme.
John saw the girl that pushed the lady.

b.   PERCEPTUAL, MISMATCH

Jean voit la fille qui poussait la femme.

John sees the girl that pushed the lady.

c.   NON-PERCEPTUAL, MATCH

Jean était marié à la fille qui poussait la femme.

John was married to the girl that pushed the lady.

d.   NON-PERCEPTUAL, MISMATCH

Jean était marié à la fille qui poussait la femme.

John is married to the girl that pushed the lady.

The results showed selective integration costs in French when tense mismatch followed perceptual verbs. No other differences were found under non-perceptuals in French, or in any condition in English.

The experimental design in the eye-tracking experiment, however, led to adaptation effects. Given that past tense was always found in the embedded verb, participants anticipated that a matrix verb in present tense would lead to a tense mismatch, and thus a consequent RC parse. Pozniak et al. decided that only the first half of the trials was included in the analysis because learning/adaptation effects attenuated the PR effect over the experiment, reducing the difference between tense match and tense mismatch initially observed for French under perceptuals.

The results delivered a three-way interaction between tense, verb type, and language. Further analysis in French showed that PR-compatible conditions with tense mismatch generated longer regression path duration and higher proportion of regressions out of the region under perceptual verbs. No effect is found in the condition with non-perceptual verbs. In English, there was a main effect of tense (mismatch was harder than match), but no effect of verb type or interaction in regression path duration and proportion of regressions-out.

This study attested the offline and online PR-*first* effect in French, and the lack of such effect in English in an eye-tracking study.

The work of B. Fernandes et al. (2018) also reported adaptation effects (in line with Pozniak et al.) and a solution to neutralise it in the study of acceptability judgements in PR/RC ambiguities in Italian. The experimental design in both studies are similar, and in this case, the adaptation effects were measurable as an increase of acceptability rates in the condition of RCs under perceptual verbs. B. Fernandes et al. (2018) managed to neutralize or reduce adaptation effects

making the cue less reliable by adding unambiguous PRs with a main perception verb in present tense followed by an embedded verb in present tense.

Grillo et al. (2015b) tested subject RCs and object RCs in PR-compatible environments (i.e. perceptual matrix predicate) and PR-incompatible environments (i.e. non-perceptual matrix predicate) in two languages: French and English. Although reading times were not very informative (just showing an expected advantage of subject RC over object RCs), their results on percentage of correct answers to questions presented after the sentences were relevant: their data showed lower accuracy for object RCs in PR-compatible than in RC-only environments, which might indicate some shallow processing or overriding of disambiguating information when in PR-compatible contexts the RC-parse id forced.

3.4.5 Other studies

Apart from French, European Portuguese and Italian, the effects of PR-*first* were also tested in Greek. Grillo and Spathas (2014) tested this language in a forced-choice questionnaire combining class of verb (perceptual vs non-perceptual) and tense (match vs mismatch). Their results displayed a High Attachment preference in 62.4% of the cases in globally ambiguous sentences with perceptual verbs with tense match, and 48.5% High Attachment preference with tense mismatch. The results with non-perceptuals go in the opposite direction, 30.7% High Attachment with tense match, and 36.1% with tense mismatch. The statistical analysis confirmed that a significant effect of tense was obtained in perceptual verbs but not in non-perceptuals. The authors concluded the results were in line with predictions of PR-*first*, and the effect of PR availability might take place early in the sentence because the effects are still observable in conditions with perception verbs but tense mismatch.

On the production side, Grillo and Turco (2016) performed the first and only planned production study to date in which PR and RC prosodic cues were examined and compared. Italian native speakers productions when reading ambiguous PR/RC sentences presented after an RC-inducing context (72) or after a PR-inducing context (73) were analyzed to see whether structural differences are encoded at a prosodic level.

(72)   RC–CONTEXT : During the weekend, we only had two patients in the clinic, one of them was calm, the other one didn't stop fidgeting for a second.

(73)   PR–CONTEXT : We have a patient who's constantly moving. At the hospital we have clear rules as to where to keep everything. This is especially

for safety reasons and to avoid hindering in case of emergency.

The results from a pilot study with 8 participants already delivered significant results. The data showed that Temporal melodic cues are used to disambiguate between RCs and PRs starting immediately after the matrix verb (at the DP head object). The analysis showed that more tonal movements occurred in PR/RC contexts in comparison to genuine RCs. The analysis also showed that the duration of the DP matrix object and CP in PR-contexts was longer than in RC-contexts. The results are controversial as, on the one side, the comparison is not just between two concrete structures (PRs versus RCs), but rather between an ambiguous context (compatible with both structures), and an unambiguous context (RC-only compatible context). On the other side, the finding of the longer duration in PRs clashes with the traditional prediction in comprehension studies of faster reading in easier/preferred structures, in this case the PR. This opens up the gate to questions such as whether temporal properties observed in production can be projected by implicit prosody when reading.

3.4.6 Summary

The empirical evidence gathered so far in the following languages: Italian (B. Fernandes et al., 2018; Grillo & Costa, 2014; Grillo & Turco, 2016), Greek (Grillo & Spathas, 2014), European Portuguese (Costa et al., 2016; B. Fernandes, 2012; E. Fernandes et al., 2016; Tomaz et al., 2014), Brazilian Portuguese (E. Fernandes et al., 2016), English (Grillo et al., 2015a) and French (Grillo et al., 2015b; Pozniak et al., 2019), comprehending studies on acquisition (Costa et al., 2016), planned production (Grillo & Turco, 2016), attachment questionnaires, acceptability judgements, picture selection task and eye-tracking studies, begins to provide a robust support to PR-*first* Hypothesis. Although the same materials have not always been used across these languages, this factor might add to the robustness of the effect as its replication is not limited to a determined set of sentences, overcoming potential confounds linked to these sentences.

Importantly, whenever a PR parse is made unavailable, speakers of each of these languages (previously classified as High Attachment) consistently show a strong preference to attach RCs locally. The availability of PRs in these languages is one of the key factors to explain their previous classification as High Attachment languages.

Conversely, the same contextual manipulation (of e.g. perceptual vs. non-perceptual predicates) does not lead to High Attachment in languages, such as

English, where PRs are not allowed (Grillo et al., 2015a). This excludes the possibility that PR-availability effects are reducible to independent effects of plausibility or predicate semantics. Grillo et al. (2015a) also observed that the PR-*first* can be generalised to the ambiguity between SCs and reduced RCs (e.g. *John saw the boy running the marathon*). The availability of SCs in English triggers High Attachment of reduced RCs in a language that otherwise prefers Low Attachment.

This evidence renders the classic High Attachment vs Low Attachment languages division somewhat obsolete, and strongly suggests that the availability of a PRs/SCs parse is a decisive factor determining RC attachment, it certainly constitute a potential confound not to be ignored when investigating RC-attachment.

Future steps to solidify the empirical evidence of PR-*first* includes to expand the research to other PR languages and non PR languages. Moreover, future research should focus on two main aspects: the interaction of PR effects with other relevant factors to weigh its explanatory power, and the exploration in greater detail of the online effects to see at which stage the PR-parse is projected.

This thesis attempts to provide an answer to these questions. First, it tests the validity of the predictions drawn by the PR-*first* Hypothesis in both offline and online studies in Spanish, a language that has not been tested yet in spite of being the language that lit the debate on the universality of parsing principles. Second, the effects of PR-*first* are weighed against other potential factors that might favour the RC parse. Third, it presents a novel study on the effects of PR-availability on generation. Next chapter presents novel results in Spanish in support of the PR-first Hypothesis from two experiments, where we also explore the interaction of PR-availability effects with aspectual properties of the embedded clause (PRs are incompatible with habituals).

4

TESTING PR-*first* IN SPANISH AND THE EFFECTS OF ASPECT

4.1 Introduction[1]

This chapter presents new evidence from Spanish in support of the claim (Grillo, 2012; Grillo & Costa, 2014) that apparent cross-linguistic variation in RC-attachment is epiphenomenal and tied in large measure to the selective PR-availability in different languages and grammatical environments.

We also investigate the potential role of aspect in modulating the parser's choice between PR and RC parse. PRs in fact obey strict aspectual restrictions not seen in RCs and are not compatible with habitual interpretations. We first present evidence for higher acceptability of sentences which allow an habitual reading over minimally different sentences with episodic readings, in line with what was observed in the literature on the processing of generics vs. definites in the nominal domain. We then test to what extent the advantage of habitual readings interacts with PR-preference. We show that while there is an aspectual effect (only observed in interaction with cumulative exposure), it does not cancel the overall effect of PR availability.

This chapter is organized as follows. Section 4.2 presents a summary of the relevant literature on RC attachment in Spanish. Section 4.4 test the hypothesis that sentences which allow habitual interpretations should be easier to parse than episodic sentence. We presents results from an acceptability study in which we manipulated the availability of habitual reading in Spanish, comparing minimally

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[1]This chapter is based on: Aguilar & Grillo (2020). Spanish is not different: On the universality of minimal structure and locality principles. Under review in *Glossa*.

different sentences with Imperfective (compatible with habitual) and Progressive (incompatible with habitual) aspect. In line with genericity effects observed in the nominal domain, we expect to observe higher acceptability for Imperfective than Progressive aspect. Finally, section 4.5 and 4.6 presents two RC-attachment studies which manipulate both PR-availability and Aspect. The results support the idea that RC-attachment in Spanish does not constitute an exception to locality principles. Two important conclusions will be drawn: RC-attachment appears to be strongly governed by locality principles and PR-availability is largely responsible for apparent cross-linguistic variation in RC-attachment. Aspect appears to play a small modulatory role, primarily observable as a selective adaptation to RC reading effect over the course of the experiment, which nevertheless does not reverse the strong effect of PR-availability.

4.2   Previous research on RC-attachment in Spanish

Spanish has been key in the literature of RC attachment ambiguities since it was the first language found to contradict principles of locality and show preference for non-local attachment. Different offline and online studies attested an across the board preference for high attachment in Spanish in an assorted number of tasks and techniques. This section presents a review of previous work on RC attachment in Spanish, where different factors, argued to affect RC attachment, were manipulated (including sentence segmentation, relation between the DPs, referentiality, prosodic breaks, length, position of the RC). Some studies that made an important contribution to the development of new models and theories already discussed in 2, will be described here in more detail.

Cuetos et al. (1988) were the first to investigate RC attachment preferences in Spanish in order to test the Late Closure principle. In total, they ran two questionnaires (in English and Spanish) and three online experiments (only in Spanish). The two forced-choice attachment questionnaire presented ambiguous sentences of the type DP+V+DP1 of DP2+RC. Spanish speakers preferred to attach the RC to the first DP in 62.5% of cases, and to the second DP in 36.8% of cases. The results in Spanish contrasted with those in English where the percentages were 36% high attachment and 58% low attachment. Next, they ran three self-paced reading tasks in Spanish employing pragmatic and prototypical gender information as a means of disambiguation. An example of pragmatic disambiguation is offered in example (1) and prototypical gender information in example (2)

(1)   Lewis ran over the dog of the fruiterer that comes to this district to sell oranges.

(2)   This afternoon I saw the nurse of the doctor who was at home with his wife.

Sentences were presented region-by-region. The first display showed the main subject, main verb and object (DP+V-DP1 of DP2), the second display started at the beginning of the RC, and the third display showed the last part of the RC which contains the disambiguating information. Example (3) shows the displays separated by slashes.

(3)   Someone shot the servant of the actress/ who was on the balcony/ with her husband.

Sentences were always disambiguated towards DP2, and reading times were compared with those in control sentences identical to the target sentence without the first DP (DP+V+DP/ RC/ final disambiguating clause), and therefore without local ambiguity. Reading times for the final display were significantly longer in locally ambiguous sentences. Cuetos et al. (1988) concluded that longer times revealed participant's preference for non-local attachment and reanalysis costs when the final disambiguating clause forces low attachment. Nevertheless, the authors acknowledge that an alternative interpretation is plausible because, they argued, differences in length in the previous region could have confounded the results, as longer sentences increase the reading times of the final display.

The second self-paced reading task was meant to overcome the length asymmetry. To do so this experiment includes a second type of control sentences identical to target sentences but the possessive 'of' (*de* in Spanish) intervening between DPs is replaced by the connector 'and'.

(4)   Peter was looking at the book and the girl that was in the living room watching tv.

The results did not differed from the previous experiment, proving that length of previous region did not affect reading times in the critical region. A final experiment compared exactly the same structure, disambiguated towards DP2 in the experimental items and globally ambiguous in the control. In the control sentence (5) both DPs were of the same gender.

(5)   Someone shot the servant$_{\text{FEM}}$ of the actress who was on the balcony.

The results again showed longer reading times in the final display in the exper-
imental condition in comparison to the control condition. In conclusion, the
results in Cuetos et al. (1988) do not support Late Closure as a universal pars-
ing strategy. In spite of the many limitations of their experimental design (e.g.
they compare ambiguous with unambiguous sentences, and RC is systematically
disambiguated toward low attachment, so their measures do not compare high
attachment with low attachment, but rather low attachment in ambiguous versus
unambiguous contexts) their results have been replicated several times in Spanish
and extended to other languages in subsequent experiments.

The results of Cuetos et al. (1988) seminal work were problematic for the
universality of parsing principles, as exposed in Chapter 2. The global attempt to
solve this problem has been extended for decades leading to the development of
a significant literature testing the status of the Late Closure strategy across a vari-
ety of languages, finding that some languages behave like Spanish and other like
English. There was also a great deal of new studies testing Spanish attachment
preferences with different materials, paradigms and techniques. Carreiras (1992)
replicated the preference for high attachment in Spanish using offline (question-
naire) and online (self-paced reading task) technique. Offline results showed that
the use of a comma before the RC favours attachment to DP1:

(6)   Someone shot the servant of the actress, who was on the balcony.

The results also seemed to be influenced by plausibility of attachment of
the RC. Using the same materials as Cuetos et al. (1988), the results for sentences
with comma after DP2 lead to 82.5% high attachment, and it dropped to 58%
for the same sentences with biased content toward DP2 attachment. Without the
use of commas the attachment preferences were 67% high attachment (similar
to results found by Cuetos et al. 1988) and 35% high attachment for DP2 biased
materials. Online attachment was not affected by punctuation or plausibility,
therefore the author concluded that syntactic strategies guide initial preferences
and punctuation or plausibility influence final interpretation.

Carreiras et al. (1993) further confirmed the non-local preference in Span-
ish not only in reading times, but also in accuracy and response latency. Partic-
ipants were asked questions about the content and host of the RC, and answers
were more accurate and quicker when the RC was disambiguated to the first DP1.
Same materials tested in English showed no difference in accuracy and speed. Car-
reiras et al. (1993) also showed that the two types of disambiguation previously

used in Spanish, pragmatic/gender role (e.g. who gave birth, who used to be a Catholic priest) and morphological gender-marking delivered the same results.

Gilboy et al. (1996) criticised the standard segmentation in the presentation of sentences in self-paced reading tasks used in previous experiments, which typically consisted in a long segmentation with just a division between the main and the embedded clause, that is, right before the RC. The authors argued that high attachment is an experimental artefact influenced by this type of segmentation. The interruption before the RC induced participants to create an intonational contour which determined attachment (similar to the effect of commas). This idea was initially supported by the results they obtained, as ambiguity resolution with sentences segmented in larger units, with the complex DP as a whole unit (e.g. Alguien disparó al criado de la actriz/que estaba en el balcón) delivered a bias to DP1 attachment and sentences with smaller units (e.g. Alguien disparó al criado/ de la actriz/que estaba en el balcón) showed no preference.

Nevertheless, Carreiras et al. (1999) argued that non-local attachment could not just be a by-product of the segmentation of materials since it is still observed when sentences are presented without segmentation when using eye-tracking technique. In the two eye-tracking experiments the authors ran, the advantage for high attachment in Spanish was found in total reading times, although analysis with pooled data from the two experiments in Spanish, showed the advantage was also significant in first-pass reading times by subjects but not by items.

The materials used in Carreiras et al. (1993) and Carreiras et al. (1999) were adapted and tested in the first and only ERP (Event Related Potentials) study performed in this literature in Spanish. Carreiras et al. (2004) reported a larger amplitude of the P600 effect when RC was forced to attach low. The distribution of P600 was biphasic, with a first window (500–700 ms) widely distributed, and a second window (700–900 ms) with a posterior distribution. The authors concluded that local attachment was the non-preferred continuation and its computation implied a higher cost of integration and probably revision/ reanalysis. At this point, high attachment preference has been systematically attested in Spanish in a number of experiments using different methodologies (questionnaire, self-paced reading task, eye-tracking, ERPs). However, the picture has not always been as clear-cut and variation occurred when different factors were manipulated.

Gilboy et al. (1995)'s work put the emphasis on the noun's argument structure and referential properties of the DPs, and showed that within-language variability can be greater than between-languages variability. This chapter was key to validate some tenets of Construal theory, and has been largely cited in the field

of psycholinguistics. Their data showed that in Spanish, attachment to DP1 was preferred only in 12% of cases when the restrictive (non-comitative) preposition 'con'/with (a theta role assigner) intervened between the two DPs (7).

(7)   En la estantería guardo una caja con una tapa que barnizó Pedro.
        'On the shelves I keep a box with a lid that Pedro varnished.'

The numbers increased to 51% when the non-theta-assigning preposition 'of' mediated between DP1 and DP2, and the number went up to 83% of attachment to DP1 when the second DP was non-referential. The results supported Construal predictions that when a non-primary relation is at stake, the parser will integrate them within the current thematic domain using structural, pragmatic and discourse principles. The data with 'with' confirmed that *the parser will integrate the non-primay relation within the current thematic domain*. The second part, which postulates the effects of structural, pragmatic and discourse principles, was also confirmed. When DP2 took DP1 as an argument and both were within the same thematic domain, DP1 attachment increased considerably, and when a non-referential DP was made more referential by adding a determiner (e.g. the sweater of the wool), DP2 attachment increased. Moreover, the presence of an adjective modifying DP2 increased (51% low attachment, compared to 48% when DP1 included an adjective or 43% when neither did). The definite or indefinite status of the determiner did not seem to play a role in attachment. In sum, the results showed the influence of thematic processing domains, referentiality, adjectival modification, and focus, and more generally, gave support to Construal and referentiality principles.

Another study that questioned the invariability of high attachment in Spanish was the work of Gibson et al. (1996). These authors tested fragments of sentences, with three potential hosts such as [DP1 prep DP2 prep DP3 RC] (e.g. the lamp near the painting of the house that was damaged in the flood) in Spanish and English using self-paced reading task. Cumulative ungrammaticality judgements (number of times an item is considered ungrammatical after reading the disambiguation) and reading times at the critical region showed that low attachment was judged ungrammatical less often than high or middle attachment, and high attachment was judged ungrammatical less often than middle attachment. In this line, reading times were fastest when RC was attached to DP3, and slowest when attached to DP2, therefore results from both dependent variables went in the same direction (DP3<DP1<DP2). The results in Spanish and English were the same for reading times and ungrammatical judgements, with the only difference

that there was no difference between middle and high attachment in ungrammatical reports. Therefore, when three sites are available Spanish shows a low attachment preference just as English does. These results highlighted the need to postulate two factors influencing attachment decisions, rather than one, as the results cannot be explained monotonically. The two factors are Recency and Predicate proximity (see chapter 2).

Differences between offline and online tests have been reported by Fernández (2003). For the same materials Fernández (2003) reported offline preference for high attachment (57% high attachment) and online preference for low attachment in a self-paced reading task. Number morphology was used as a means of disambiguation, including conditions where an DP2 plural intervened between an DP1 singular and the RC. It is not clear whether these effects are due to plural attraction effects, given that low attachment could be triggered by a plural DP intervening between the embedded verb and the first DP as in the following configuration [DP1$_{SING}$ of DP2$_{PLURAL}$ that V$_{SING}$]. The same claim was made for Portuguese in Maia et al. (2007), Miyamoto (2005), and for English in Deevy (2000).

As regards differences between online and offline studies, Maia et al. (2007) made the claim that cross-linguistic differences are limited to offline studies, whereas online preferences are generally aligned across languages in showing local preferences. This claim can in fact explain some results found in the RC attachment literature, for instance in in Brazilian Portuguese (see Maia et al. 2007 for thorough discussion), however, reported online preferences for high attachment in other languages (Spanish Carreiras et al. 2004, French Zagar et al. 1997, Dutch Brysbaert et al. 1996b, among others), or low attachment for centre-embedded RCs but high attachment for the same RCs placed in right-branching position (Hemforth et al., 2015), remain unexplained under this view.

A few studies focused on lexico-semantic properties and their influence on attachment preferences. Acuña-Fariña et al. (2009) tested animacy effects on RC attachment, finding faster readings when RC is attached high on the configuration: animate DP1 and inanimate DP2. However, there was no preference in the DP1 inanimate and DP2 animate condition. Therefore, it seems that animacy just reinforced a high attachment preference, which was neutralised but not reversed when DP2 is animate. The study also highlighted that, while most studies in RC attachment use animate DPs, corpus studies show that in 70% of the cases, the structure comes with inanimate nouns in both DP1 and DP2, and that the configuration with animacy in both positions seems to be the least frequent. In both cases there is a bias to DP1 attachment. As for the cases of combined

configuration (Inanimate (DP1) - Animate (DP2), and Animate (DP1) - Inanimate (DP2)), high attachment is more frequent in the latter and low attachment in the former. The results of the self-paced reading task only partly match the patterns found in the corpus study. Another study tested the influence of the emotional content of the words on attachment. Fraga et al. (2012) manipulated valence (pleasant-unpleasant) and arousal (calm-excited) of DP1 and DP2 in a series of sentence completion tasks. Participant's completions showed that DP1 was mainly chosen for attachment when both DPs were neutral, but when DP2 contained an emotional charged word, DP2 was preferred regardless of the emotional content of DP1. Furthermore, when arousal is neutral, high attachment is the default preference, but when DP1 or DP2 contained a high arousal word (e.g. triumph, champion) completions were biased towards that DP. Similar results were obtained in a self-paced reading task (García-Orza et al., 2017).

The influence of prosodic cues on attachment preferences has also been the focus of study. For instance, in Teira et al. (2007) work showed that participants tend to place a break after DP2 in sentences disambiguated to attach high. In auditory comprehension of RCs, a break after DP1 led to more local attachment preference, and vice versa, a break after DP2 favoured high attachment. Length of the RC also played a role in triggering more high attachment (although the effect was only significant by subjects and not by items). The relation between length and prosodic break was also attested by de la Cruz-Pavia et al. (2015). Participant's utterances reading sentences that contained RCs of different lengths, revealed that 82.15% of the prosodic breaks made within the critical region were placed after DP2, and that the longer the RC was, the greater the frequency of occurrence of a prosodic break after DP2. A break insertion after DP2 seems to be the default phrasing in Spanish, however this study does not provide with further information about the relation of prosodic breaks and attachment.

Fromont et al. (2017) further replicated the interplay between prosodic breaks and syntax. Baseline preference in the absence of breaks or conflicting cues was to attach low (60% low attachment), but in the presence of prosodic breaks, attachment preferences were reversed with a shift from low attachment preference when a prosodic break was placed after DP1 (12% high attachment), to high attachment when DP2 was followed by a break (70% high attachment). Nevertheless, not all studies report an alignment between prosodic breaks and attachment. Bergmann et al. (2008) planned production study with English and Spanish native speakers showed that interpretation of the sentence was not correlated with prosodic patterns: whereas there was a general tendency to prosodically separate the complex DP from the RC, attachment preferences were not correlated with prosodic breaks (English preferred low attachment and Spanish high attachment).

More recent work on RC attachment focused on the interaction between clause-length and the role of information structure. Hemforth et al. (2015) tested short and long RCs in Spanish (among other languages: German, English, and French) placed in object or subject position (8) in an offline attachment questionnaire. There was an effect of length in Spanish modulated by position, as low attachment was preferred in subject-modifying RCs irrespective of length, but long RCs showed more high attachment in object-modifying RCs. The authors conclude that discourse and prosody jointly influence attachment preferences.

(8) a. El hijo del   coronel que murió escribió cinco libros sobre
         The son of.the colonel that died   wrote   five books on
         enfermedades tropicales.
         tropical   disease.'
         'The son of the colonel who died wrote five books on tropical disease.'
     b. El   doctor conoció al hijo del   coronel que murió.
         The doctor met   the son of.the colonel that died.'
         'The doctor met the son of the colonel who died.'

The bulk of these studies seem to show that there are a number of factors that modulate attachment preferences when it comes to RCs. However, the complex pattern of results cannot be explained by the sum of these variables, and moreover, they can't explain the cross-linguistic differences as their effect is supposed to be the same across languages.

4.3   Testing PR-*first* and aspectual effects in Spanish

The main goal of this work is to test PR-*first* Hypothesis in Spanish in RC-attachment ambiguities. Spanish grammar presents some particularities which differentiate it from other PR-languages such as Italian. The distributional properties of PRs are considerably more restricted in Spanish than in Italian, and furthermore, there exists in this language an unambiguous alternative structure which conveys similar meaning: the gerundive form (corresponding to the present participle in English). These factors, as well as the central role Spanish played in the RC-attachment literature, make Spanish an important language to test the predictions of PR-*first*.

The second goal of this work is to investigate factors that might weaken the parser's preference for PRs, or if you prefer, reduce the parser's dislike for RCs. We argue that aspect manipulation could, at least in principle, achieve this.

As discussed in chapter 3, only Imperfective/Progressive aspect is licensed in PRs. Perfectives, and crucially habituals are banned from these constructions, arguably because of their incompatibility with the semantics of PRs, which involves direct perception of ongoing situations:[2]

(9)   *Ana vio a María que solía correr.
       Ana saw DOM Maria that used.to ran.
       '*Ana saw Maria that used to ran.'

RCs, on the other hand, do not impose any aspectual restriction and are fully compatible with Imperfective, Perfective, and habitual interpretations.

Importantly, in Spanish, the so-called *Simple Past* form is ambiguous between a Past Imperfective interpretation and a habitual interpretation (10). The aspectual interpretation of the past is therefore tightly linked to the PR/RC disambiguation, with the habitual reading only being available under the RC parse (but not vice-versa, i.e. the RC reading is still compatible with the Progressive interpretation).

(10)   La chica que corría.
        The girl that ran.IMPF

        'The girl that was running/used to run'.

This distinction is important as a wealth of psycholinguistics literature shows that, in the absence of a supporting discourse, generics are easier to parse than definites. Tanenhaus et al. (1980), for example, shows that definite expressions take longer to process when a referent has not been established in the preceding discourse. Similarly, a wealth of results supports *the Principle of Referential support* (Altmann et al., 1988), according to which an DP analysis which is referentially supported will be favoured over one that is not. For example, in the absence of a licensing context, i.e. a context which supports a referential analysis of the DP *bad workmen* in (11) a clear preference for a generic interpretation emerges. Thus, when the context does not offer the object of reference of the referring expression (11-b), parsing is predicted to be harder.

(11)   a.   Bad workmen blame their tools.
        b.   Bad workmen walked through the door.

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[2]See Grillo and Moulton (2016a) for discussion of the role of habitual in deriving a *kind* reading of PRs in Italian. Spanish does not allow kind PRs.

We test the hypothesis that episodic events, just like definite descriptions, make reference to particulars and need to be referentially supported by the context in a way that generic statements and habituals do not. To our knowledge, while an important literature exists on the processing of genericity in the nominal domain, the processing of habitual vs. token events constitutes a significant gap in the psycholinguistics literature.

In the following section, we first present the results of an acceptability study in which we manipulated the availability of habitual reading in Spanish, comparing minimally different sentences with Imperfective (compatible with habitual) and Progressive (incompatible with habitual) aspect. If our hypothesis is on the right track, we expect to observe higher acceptability for Imperfective than Progressive aspect. This would constitute an important result in itself, supporting a unified analysis of genericity effects across the verbal and nominal domain.[3] Importantly, given that PRs are not compatible with habits, it will also allow us to pit against each other the preference for habitual reading and the PR-preference discussed so far.[4]

4.4 Experiment 1: Acceptability Judgement task

4.4.1 Participants

Forty European Spanish native speakers (mean age=31.2, sd=5.02, 13 women) were recruited on Prolific Academic. Participants were monolinguals or late bilinguals, but not early bilinguals. All participants had normal or corrected-to-normal vision, and no history of language disorders. Each participant gave informed consent before taking part in the study and was paid a small fee for participation.

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[3]On generics and habitual aspect see e.g. Carlson (2012), Carlson (2019).

[4]There might be one additional reason why the Imperfective/habitual ambiguity might be of interest for the processing of RCs, which is tied to the semantics of RCs themselves. RCs denote properties of entities. Building an RC interpretation, therefore, requires first and foremost, to convert a proposition into a property. We hypothesize that habitual aspect might more readily lead to the property interpretation required by RCs, since (at least at an intuitive level) habits are easily converted into properties, while association with episodic events does not (at least out of the blue) provide such a strong grounding for property building. To illustrate, compare the sentence in (12-a) and (12-b) (where # marks pragmatic oddity):

(12)   a.   The boy used to run → the boy was a runner.
           b.   The boy was running → #the boy was a runner.

4.4.2 Materials and design

Twenty-four experimental sentences were built in 4 different versions in a 2 (Structure: simple active vs. right-branching RC) x 2 (Aspect: Past Imperfective vs Past Progressive) latin square design (full list of items available in Appendix I). The four resultant lists were assigned randomly to participants. Fillers (n=60) contained active and passive sentences, but never RCs or PRs, and we avoided as much as possible other type of syntactic ambiguities. Half of the filler items were not grammatical. Some of the ungrammatical fillers contained an error of agreement (13) other contained an inappropiate preposition (14).

(13)   El jugador podría anotar doce *gol* en el partido de fútbol.
        'The player could score 12 *goal* in the football game.'

(14)   El escritor pasó dos años en su chalet *con* los Alpes.
        'The writer spent two years in his cottage with the Alpes.'

Every sentence was followed by a comprehension question.

(15)   a.   **Simple active / Past Imperfective**
              El médico fumaba puros.
              'The doctor smoked/used to smoked cigars.'
        b.   **Simple active / Past Progressive**
              El médico estaba fumando puros.
              'The doctor was smoking cigars.'
        c.   **RC/ Past Imperfective**
              Isabel está casada con el médico que fumaba puros.
              'Isabel is married to the doctor that smoked cigars.'
        d.   **RC / Past Progressive**
              Isabel está casada con el médico que estaba fumando puros.
              'Isabel is married to the doctor that was smoking cigars.'

4.4.3 Procedure

The experiment was created and performed with the programming website GORILLA (https://gorilla.sc). Experimental sentences were presented one by one on the centre of the screen. Participants were instructed to read the sentences at their normal pace, and select a punctuation in a 7-point Likert scale, then press the space bar and a yes/no question was displayed in the centre of the screen.

Example of comprehension question:
Estaba el médico fumando puros? /Was the doctor smoking cigars?

Before the start, participants were presented with 6 practice sentences to become familiar with the procedure. The experiment lasted around 15-20 minutes.

4.4.4 Results and analysis

Data from two participants were excluded from analysis because their accuracy in comprehension questions was lower than 80%. Data from the remaining 38 participants was analysed with R (R Core Team, 2018) fitting Cumulative link models (CLM) for ordinal data using the package 'ordinal' (Christensen, 2019). Type of syntactic structure (RC vs simple actives) and Aspect (Imperfective vs Progressive) were introduced as fixed factors, with interaction term into the model, and participants and items as random effects.

The analysis showed a main effect of Aspect (*coefficient=-0.855, SE=0.224, z-value=-3.804, p<.001*), a main effect of syntactic structure (*coefficient=1.431, SE=0.223, z-value=6.40, p<.001*), and an interaction (*coefficient=-0.943, SE=0.435, z-value=-2.166, p=.030*).

Further analysis showed the effect of Aspect is significant in both RCs (*coefficient=-0.603, SE=0.250, z-value=-2.409, p=.016*), and Simple Active sentences (*coefficient=-1.394, SE=0.422, z-value=-3.299, p<.001*).
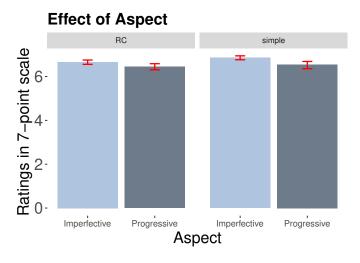
Figure 4.1: Effect of Aspect in Acceptability Judgements

Table 4.1: Average acceptability score by condition

Simple Active		RC	
Imperfective	Progressive	Imperfective	Progressive
6.86	6.54	6.66	6.45

4.4.5 Discussion

Acceptability ratings were very high for all conditions of this experiment. This is just expected given that all target sentences were perfectly grammatical and did not involve particularly complex structures. The analysis showed an effect of aspect with a clear preference for Imperfective aspect over Progressive in both simple actives and RC environments. This is in line with our hypothesis that the availability of an habitual reading eases processing load and indirectly supports the hypothesis that generic sentences are easier to parse than episodic ones, in line with parallel results from the literature on the processing of generics/definites in the nominal domain.

Higher overall acceptability of simple actives over RCs is not surprising in the context of the present discussion, but it was not one of the aims of this experiment to compare simple active sentences with sentences with RCs. This effect, as well as the interaction between Aspect and Type of Structure, is hard to interpret given that the sentence pairs vary across more than one dimension: the intro (e.g. *Isabel está casada con...*), absent from the simple active condition, might modulate acceptability for reasons independent from our manipulation. Furthermore, the length of simple active sentences is considerably shorter than that of sentences with RCs. As already mentioned, the aim of this experiment was not to compare the strength of the Aspectual manipulation across the two structural environments, but to test for effects of availability of habituals and determine whether these effects are also present in the environment of RCs, which is essential for our next set of experiments.

We now present two forced-choice attachment questionnaires to attest the effect of PR-availability in ambiguous PR/RC attachment contexts in Spanish and its interplay with aspectual make-up.

4.5   Experiment 2: Attachment questionnaire

We now present the results of a forced-choice attachment questionnaire designed to test the effect of PR-availability on the resolution of RC-attachment ambiguities in Spanish. The experiment also manipulates aspect of the embedded predicate, to determine whether availability of habituals modulates the effect of PR-availability.

Event-taking (perception verbs) and entity-taking (non-perceptual) verbs are employed to build PR-compatible and PR-incompatible environments in combination with Past Imperfective versus Past Progressive aspectual forms. The

PR-first Hypothesis predicts that the traditionally observed high attachment preference in Spanish will only be replicated in PR-licensing environments and that when PRs are not available, Spanish speakers will display a well-behaved preference for attaching RCs locally (i.e. more high attachment following perception verbs than non-perceptual verbs).

As for the effect of aspect, the results of Experiment 1 support the hypothesis that the parser will prefer an habitual reading of the Past Imperfective, incompatible with PRs. The Past Progressive form, however, resists the habitual interpretation, and naturally delivers the episodic reading involved in PRs. Potentially, under perceptual verbs, we could expect there to be a tension between PR-*first* on the one hand, which involves an episodic reading of the embedded predicate, and the alleged preference for habitual interpretation of Imperfectives. In other words, it is possible that the aspectual manipulation could contribute to disambiguate toward a PR or an RC parse (and thus towards high or low attachment) under perceptual verbs. The aspectual manipulation, however, is not expected to play a role in modulating RC attachment in the environment of non-perceptual verbs, as here RCs are the only possible parse. If the preference for PRs is built and projected by the time the parser encounters the perception verb, the PR-effect should overcome the effect of aspect. However, under the *Unrestricted race* model (Van Gompel et al., 2000), aspect will still play a role, by modulating the relative activation of the habitual interpretation, and thus by extension of the RC parse.

4.5.1 Participants

Forty Spanish native speakers (mean age=37, sd=9, 29 women) members of the staff of the Spanish school Instituto Giner de los Rios (Oeiras, Lisbon) participated in an offline questionnaire using Linger. All the participants gave their informed consent before taking part in the study and were naive as to the goals of the experiment.

4.5.2 Materials & Design

Twenty-four experimental sentences were generated in 4 different versions in a 2 Verb Type (PR-compatible vs. RC-only verbs[5]) x 2 Aspect (Past Imperfective vs Past Progressive) design (see example (16), full list of items available in Appendix II).

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[5]The type of PR-compatible verbs employed in this experiment include perceptual and pseudo-perceptual verbs: *ver* (see), *oir* (listen), *mirar* (look), *escuchar* (hear), *observar* (observe), *pillar* (catch), *fotografiar* (photograph), *imaginar* (imagine), *soñar* (dream), *dibujar* (draw) and *grabar* (record/film)

Sentences were organized in a latin square design and distributed into four
lists. Fillers (n=71) contained active (e.g. *La hija de la profesora luchará para ser la
capitana del equipo*/ The daughter of the teacher will fight to be the team captain)
and passive sentences (i.e. *El humilde aprendiz fue atacado por el alto ejecutivo*/
The humble apprentice was attacked by the senior executive), but never RCs or
PRs, or other type of syntactic ambiguities. Both target and fillers were translated
and adapted from the materials in Grillo and Costa (2014) with the correspon-
dent adjustments to Spanish and the aspectual manipulation. Every sentence
was followed by a comprehension question and the presentation of materials was
counterbalanced.

(16)   a.   **Ambiguous PR /RC – Past Imperfective**
          Juan vio al hijo del médico que pintaba.
          'John saw the son of the doctor painting/that painted'

    b.   **Ambiguous PR/RC – Past Progressive**
          Juan vio al hijo del médico que estaba pintando.
          'John saw the son of the doctor painting/that was painting.'

    c.   **Unambiguous RC- Past Imperfective**
          Juan trabaja con el hijo del médico que pintaba.
          'John works with the son of the doctor that painted.'

    d.   **Unambiguous RC – Past Progressive**
          Juan trabaja con el hijo del médico que estaba pintando.
          'John works with the son of the doctor that was painting.'

4.5.3 Procedure

Experimental sentences were presented one by one in the centre of the
screen. Participants were instructed to read the sentences at their normal pace,
and press the space bar as soon as they were done reading. Immediately after, a
question was displayed on a separate screen, together with two option answers
and participants were instructed to choose the correct one or, if uncertain, the
one that seemed the best option to them. For target sentences, the two options
referred to the two possible antecedents (i.e. DP1 or DP2). The order of presen-
tation of the two DPs was counterbalanced across participants and items. The
order of presentations of the items in each of the four versions was randomized.
Participants were instructed to press the "F"key on their keyboard to choose the
option presented on the left side of the screen and the "J"key to choose the option
presented on the right side.

(17)   Question:
         ¿Quién pintaba/estaba pintando?
         Who was painting?

A.   El hijo   B.   El médico
       The son   *The doctor*

Before the experiment started, participants were presented with six practice items to help them familiarize with the procedure. The experiment lasted around 30 minutes.

4.5.4   Data analysis

Data were analysed with R (R Core Team, 2018) fitting Generalized Linear Mixed-Effects Models with binomial distribution using the package lme4 (Bates et al., 2015). As fixed effects, we entered *Verb type* (Perceptual vs Non-perceptual) and *Aspect* (Imperfective vs Progressive), with interaction term into the model, and participants and items as random effects. All predictors were contrast coded. The results delivered a main effect of *Verb Type* (coefficient=-0.8827, SE=0.1621, z-score=-5.445, $p<.0001$) and a main effect of *Aspect* (coefficient=.3759, SE=0.1590, z-score=2.365, $p=.0180$). No interaction was found ($p>.05$).
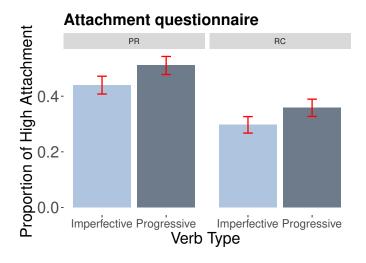
Figure 4.2: Mean proportion of high attachment across Aspect and Verb type.

Table 4.2: Average proportions of High Attachment

	PR		RC	
	Imperfective	Progressive	Imperfective	Progressive
	0.44	0.51	0.29	0.35

4.5.5 Intermediate discussion

The significant statistical difference in attachment preferences between
perceptuals and non-perceptuals shows an effect of PR-availability on attachment.
The low percentage of high attachment in the condition with imperfectives under
perceptual verbs might be explained by other reasons, potentially by the aspectual
manipulation and the consequent availability of habituals with imperfectives.

Importantly, low attachment preference is observed whenever PRs are not
available, supporting the hypothesis that previous results from Spanish were con-
founded by PR-availability and that cross-linguistic variation in RC attachment is
epiphenomenal. The results in PR-compatible environments match those found
in other PR-languages, although the percentages observed in this study are consid-
erably lower, especially when compared with Italian (78.6% high attachment in
perceptuals versus 24.2% non-perceptuals). The grammatical differences between
Spanish and Italian (introduced in chapter 3) might partly explain these results.
The Italian versatility in the distribution of PRs in a number of environments is
not observed in Spanish where availability is fairly more restricted, perhaps due
to the availability of a more frequent and unambiguous alternative, the present
participle. In this situation, a weaker effect of PR-availability in Spanish than in
Italian is to be expected under the *Unrestricted Race* model of sentence processing
(Van Gompel et al., 2000). More PR-parses ultimately means higher likelihood
that the winning structure will be a PR.

The main effect of aspect indicated that Progressives led to more high at-
tachment than Imperfectives, but the lack of interaction between aspect and verb
type ruled out the differential effect of aspect expected only in perception verbs.
The fact that the length of the RC in the Past Progressive condition was on av-
erage 7 characters/ 3 syllables longer than the Past Imperfective might (at least
partly) explain the observed effect of aspect. Length of the RC has been reported
to determine attachment in many languages, including Spanish (Fernández, 2003;
Fromont et al., 2017; Hemforth et al., 2015; Teira et al., 2007). Longer RCs in-
crease the likelihood of occurrence of a prosodic break after DP2, which leads
to more high attachment as explained by Fodor's *Balanced Sister Hypothesis* (J. D.
Fodor, 1998, 2002): *When the prosodic contour projected onto the stimulus contains
a prosodic break, a bias will be imposed to attach a phrase as a sister to a phrase of
similar size (or similar prosodic weight)*. That is, longer embedded clauses will pre-
fer to modify the head of the complex DP (DP1), and shorter RCs will preferably
modify the lower DP (DP2). In this experiment it is difficult to disentangle the
effect of aspect from the effect of length/prosody, as the condition with Progres-
sives is systematically the longer condition. Although the interaction was not
significant in our results, the magnitude of the aspectual effect was numerically

higher in PR/RC-environment (12.3%) than in RC-only environment (7.6%). One explanation might be that the effect of aspect encoded a combination of prosodic and aspectual effects in PR/RC condition, but only prosodic effects in the RC-only condition.

In the next experiment we aim to cancel the length confound using length-balanced materials.

4.6 Experiment 3: Attachment questionnaire with length control

In this experiment we further test the effects of PR-availability on the resolution of RC-attachment ambiguities in Spanish while also testing whether Aspectual manipulation (i.e. the availability of habituals) modulates these effects. To avoid the problems posed by differences in length in the previous experiment, we matched length across conditions, while ensuring that this did not interfere with the availability of the habitual reading.

While the basic design is the same as the previous experiment, modulo length manipulation, the present experiment also controlled for potential training effects triggered by exposure to a great number of unambiguous RCs within the experiment (half of the stimuli contain unambiguous RCs, while the other half are ambiguous between a PR and RC reading). A number of recent papers has investigated the effect of cumulative exposure to a dispreferred structure across an experimental setting, showing that repeated exposure leads to a reduction of their processing disadvantage over competing structures (Fine et al., 2013).

Of direct relevance for the present study, B. Fernandes et al. (2018) showed that lack of balance in the proportion of unambiguous RCs and PRs can lead to structural priming effects, generating a stronger preference for the RC reading over the course of the experiment. See also (Pozniak et al., 2019) for parallel results from French. Here we will test for learning effects across the verb type and the aspect manipulation.

4.6.1 Participants

Eighty European Spanish native speakers (mean age=30.09, sd=7.3, 43 women) were recruited on Prolific Academic with normal or corrected-to-normal vision and no history of language disorders. Participants were monolinguals or late bilinguals, but not early bilinguals. Each participant gave informed consent before taking part in the study and was paid a small fee for participation.

4.6.2   Materials & design

Target materials were translated and adapted from Tomaz et al. (2014) from Portuguese to Spanish. Materials had to also be adapted to the Imperfective/ Progressive manipulation of the present experiment. Additionally, a word following the embedded verb was inserted in the condition with Past Imperfective trying to preserve the neutrality toward a episodic or an habitual reading. For instance, a word like 'marathons' was avoided as it would trigger habitual reading, given that a man running marathons cannot be perceived in a single perception event. Full list of target items are available in Appendix III.

The experimental design was the same as in Experiment 4.5.
See an example of materials in (18)

(18)   a.   **Perception verb[6]/Imperfective**
            Juan vio al hijo del médico que pintaba caballos.
            'John saw the son of the doctor painting horses/ that painted horses.'
       b.   **Perception verb/ Progressive**
            Juan vio al hijo del médico que estaba pintando.
            'John saw the son of the doctor painting/that was painting.'
       c.   **RC-only verb/Imperfective**
            Juan trabaja con el hijo del médico que pintaba caballos.
            'John works with the son of the doctor that painted horses.'
       d.   **RC-only verb/Progressive**
            Juan trabaja con el hijo del médico que estaba pintando.
            'John works with the son of the doctor that was painting.'

4.6.3   Procedure

The procedure was similar as in Experiment 4.5, but this time the experiment was built in the programming website GORILLA (https://gorilla.sc). Furthermore, the presentation of items was pseudorandomized to make sure that each item number was presented the same number of times in the first half as in the second half of the experiment, and also that the presentation of items under a certain condition was balanced across experiments, that is, that conditions are equally distributed across the experiment, avoiding that a certain condition (say condition b) randomly fall in the first or second or final part of the experiment systematically. This manipulation will allow us to track potential effects of position of the item in the list reported in previous experiments. Data from one participant was excluded from analysis because accuracy was less than 80%.

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[6]The type of perception verbs employed in this experiment were: *ver* (see), *oir* (listen), *mirar* (look), *escuchar* (hear), *observar* (observe), *pillar* (catch) and *imaginar* (imagine).

4.6.4 Data analysis

In this analysis we decided to factor in the position of the item in the trial presentation to include potential effects of cumulative exposure [7]. Data were analysed with R (R Core Team, 2018) fitting Generalized Linear Mixed-Effects Models with binomial distribution using the package lme4 (Bates et al., 2015). As fixed effects, we entered *Verb type* (Perceptual vs Non-perceptual), *Aspect* (Imperfective vs Progressive) and *Trial Number* (order of presentation of the items), with interaction term into the model, and participants and items as random effects (full model with crossed random intercepts for Subjects and Items did not converge). All predictors were contrast coded. The results showed a main effect of *Verb type* (coefficient=-0.976444, SE=0.304540, z-value=-3.206, p=.00134), a main effect of *Trial Number* (coefficient=-0.011496, SE=0.002161, z-value=-5.321, p<.0001) and a marginal 3-way interaction between *Verb type*, *Aspect* and *Trial Number*, (coefficient=-0.015311, SE=0.008564, z-value=-1.788, p=.07381).

Table 4.3: Mean percentages of HA for the first half and second half of the experiment, and the average values

	PR Imp	RC Imp	PR Progr	RC Progr
First	64.9	43.6	56.7	42.4
Second	51.4	35.1	53.6	31.3
Average	58.2	39.4	55.2	37
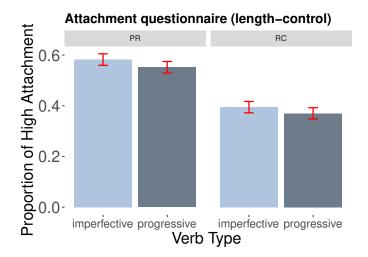
Figure 4.3: Mean proportion of High Attachment across Aspect and Verb type

[7]Some recent work have attested the effects of cumulative exposure in RC attachment ambiguities (Chun, 2018), and also in in PR/RC ambiguity research (B. Fernandes et al., 2018; Pozniak et al., 2019). Whereas some of these work employ the concept of adaptation, or sometimes syntactic priming, we use the theory-neutral term of cumulative exposure effects instead of adaption or syntactic priming to refer to a change in the participant's structural preferences influenced by previous exposure

The interaction is explained by the differential effect of position of the item
in the condition with perception verbs. There is a tendency to increased number of low attachment along the experiment, measurable here as a difference in
attachment between the first half and the second half of the experiment, which
is significant in all conditions with the exception of the condition with imperfectives under perceptual verbs. In the condition with perceptuals, the effect is
only observed in Imperfectives (coefficient=-0.015628, SE=0.004158, z-value=-3.759, p=.000171) but not in Progressives (coefficient=-0.003493, SE=0.004163,
z-value=-0.839, p=.401).
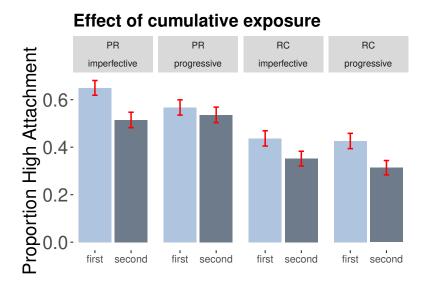
Figure 4.4: Mean proportion of High Attachment across Verb type and Aspect

To sum up, there is a general effect of Verb Type across both Progressives
and Imperfectives. There is not a main effect of Aspect, nor an interaction between
Verb Type and Aspect, but there is a main effect of Trial Number and a 3-way
interaction between Aspect, Verb Type and Trial Number. The interaction is
explained by the decreasing number of high attachment over the experiment in
all conditions with the exception of Past Progressive under perception verbs.

4.6.5 Collapsing data from Experiment 2 and 3

Collapsed data from both experiments were analysed with R (R Core Team,
2018) fitting Generalized Linear Mixed-Effects Models with binomial distribution
using the package lme4 (Bates et al., 2015). As fixed effects, we entered *Verb type*
(Perceptual vs Non-perceptual) *Aspect* (Imperfective vs Progressive) and *Experiment* (Experiment 2 and Experiment 3), with interaction term into the model, and
participants and items as random effects. All predictors were contrast coded.

The results show a main effect of Verb type (coefficient=-0.906, SE=0.094, z-value=-9.619, p<.0001) and a 2-way interaction between Aspect and Experiment (coefficient=-0.505, SE=0.185, z-value=-2.721, p<.006). We hypothesise the interaction is explained by the insertion of an additional word in the condition with Imperfectives in experiment 2. Planned comparisons in the subset of Imperfectives with Verb type (Perceptual vs Non-perceptual) and Experiment (Experiment2 vs. Experiment3) as fixed factors, with interaction term into the model, and participants and items as random effects confirmed that the effect is due to differences between both experiments in the condition with Imperfectives (coefficient=0.777, SE=0.295, z-value=2.630, p=.008526). There is no interaction and the contrast between experiments is not observed in the subset with Progressives (all p-values>.05).
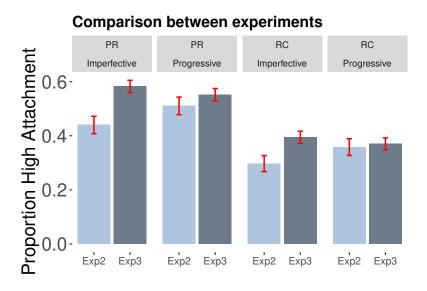
Figure 4.5: Attachment preferences across Experiment 2 and Experiment 3

4.6.6 Discussion

The final experiment replicated the main findings of the first attachment questionnaire, no straightforward interaction between the independent variables of Verb Type and Aspect was observed, but an exploratory analysis revealed an interaction between these variables and order of presentation. We address these in turn, focusing first on the main result and focus of this chapter: the effect of PR-availability on RC-attachment.

First and foremost, this study replicated the main results of the first attachment questionnaire: when PR-availability is controlled for, Spanish speakers display a preference for local attachment of RCs. This supports the claim that alleged cross-linguistic differences in RC-attachment are in fact epiphenomenal

and largely dependent on grammatical variation. Higher proportion of high attachment when PRs are available (57%) in comparison to RC-only environments (38%), supports the predictions of *PR-first Hypothesis*: PRs are preferred by the parser, and although the numbers are modest, this is observable in higher preference for interpreting the non-local DP (i.e. the only accessible subject of a PR) as the subject of the embedded CP under perceptual reports. These results are in line with previous findings from other PR-licensing languages, like Italian (Grillo & Costa, 2014), French (Pozniak et al., 2019), Greek (Grillo & Spathas, 2014) and Portuguese (Costa et al., 2016; B. Fernandes, 2012; Grillo et al., 2012a; Tomaz et al., 2014).

The strength of the effect of PR-availability on RC-attachment is also comparable with previous results from French, Greek and Portuguese, while a stronger effect was observed for Italian in Grillo and Costa (2014) (with percentages of high attachment over 70% on average under perceptual verbs). While the Italian results might be an effect of sampling, there are reasons to suggest that this might not be so and that they are rooted in more fundamental grammatical differences across the heterogeneous set of PR-languages. This is due to two important reasons: the first reason is that, contrary to these other languages, Italian does not license unambiguous alternatives to PRs, as e.g. Acc-ing constructions in Spanish (*Juan vio a María bailando/John saw Mary dancing* or Prepositional Infinitive Constructions in Portuguese (*O João viu a Maria a dançar*). We follow Frazier et al. (1996) and Gilboy et al. (1995) in suggesting that the availability of unambiguous alternatives to PRs will reduce the strength of the parser's preference for PR interpretation over the RC interpretation because of the application of the Gricean maxim of clarity (be clear, avoid ambiguity).[8] The present participle in Spanish conveys approximately the same meaning as the PR, potentially leading the reader/listener to infer that this option might have been chosen by the writer/speaker if the relevant meaning was intended, which may contribute to lower the PR-effect, at least in offline tests.

The second is that Italian (to our knowledge) is by far the most liberal language when it comes to PR-licensing. As discussed above, Italian licenses PRs in a variety of environments in which they are not available in other languages, including Spanish, suggesting that a number of structural possibilities to derive PR-like readings in Italian are not available in other languages. As discussed above, this is particularly relevant in *Unrestricted Race Models* of sentence processing. In these models, any increase in number of parses that lead to equivalent

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[8]*When interpreting sentences (with nonprimary phrases, at least), readers/listeners act as if they assume that writers/speakers tend to avoid using an ambiguous expression when an unambiguous one is available, obeying the maxim of clarity.*(p.156 Gilboy et al., 1995).

results in terms of interpretation (i.e. high attachment in the present case) will increase the proportion of disambiguation in favour of that interpretation.

Moving on to the aspectual manipulation, while there is not a *prima facie* effect of aspect, an effect seems to surface throughout the experiment in interaction with cumulative exposure effects, having a selective effect on Imperfectives but not Progressives under perception verbs (Figure 4.4).

In the case of perception verbs, the results seem to indicate that repetitive exposure to RCs have a cumulative effect only on the Past Imperfective condition. Our claim is that this is so because Past Imperfective more easily shifts from a PR to an RC parse (measurable here as a change in attachment preferences) because Past Imperfective has the possibility to shift from an eventive episodic reading to an habitual one to accommodate an RC parse. Cumulative effects are not observed in Past Progressives because the episodic reading is much more salient with Progressives and the habitual reading is either disallowed or hard to derive. We also speculate that compatibility with habituals might also play another role reducing complexity of RCs: habits are more easily turned into properties than token events. The additional cost involved in deriving the property needed for the RC reading out of a episodic event could make episodic sentences more resistant to this sort of cumulative effects.

Previous evidence of exposure effects to low-attached or high-attached RCs have been shown in Chun (2018). The authors reported exposure effects to prior attachment preferences in an eye-tracking study using visual world paradigm, where English native speakers moderately shifted their preferences to the more statistically frequent structural attachment, be it high or low attachment. Participants initial preference for low attachment was accentuated when previously exposed to low attachment resolution, and when they were next exposed to high attached RCs, the number of high attachment increased, although it did not reversed initial preference. In the PR/RC resolution research, B. Fernandes et al. (2018) and Pozniak et al. (2019) both report exposure effects in PR/RC disambiguation. In their respective works, they found that participants adapted to a complex combination of tense and verb type to predict forthcoming structure. In both studies a perceptual main verb in present tense would introduce ambiguous PR/RC structures, whereas a perceptual main verb in past tense verb would systematically lead to an RC parse as the embedded clause always had past tense, hence the initial preference for PR reading would be cancelled at that point. This case, however, seems different from the case presented in this experiment, as the participants used the combination of tenses as a clue to predict eventual resolution.

It is important to stress that, while the effect of PR-availability is robust
and in line with previous findings, the results showing a three-way interaction
between Verb Type, Aspect and order of presentation, can be only treated as
exploratory at present and more work is needed to further test the hypothesis
that habituals reduce RC complexity. While the results from the acceptability
task (experiment 4.4) are informative, further research needs to replicate these
findings in, for instance, a length-balanced set of materials.

One conclusion we can still draw from the present results is that while
the preference for a PR parse (measurable as high attachment preference), *might*
be partly overridden by cumulative exposure to RCs, the PR-preference does not
seem to be reversed or even cancelled. These preliminary results suggest that
effects of cumulative exposure seem to be limited to sentences including Past
Imperfective, i.e. an aspectual form compatible with the habitual reading.

Additionally, it should also be kept in mind that to control for length and
avoid confounds due to *implicit prosody*, the aspectual manipulation required the
addition of a word in the Imperfective condition. Despite our efforts to maintain
neutrality of readings, i.e. to select bare plural objects compatible with both
habitual and episodic readings, we can't exclude that this manipulation might
have facilitated access to the habitual reading in Past Imperfective condition,
as we cannot exclude that this manipulation might have triggered the effect for
independent reasons.

It could be argued, for example, that lengthening of the clause with a neu-
tral word (*caballos*, 'horses') might have increased the informational load from
the semantic and/or pragmatic point of view. Effects of load of information on
RC-attachment were investigated by Hemforth et al. (2013), who reported that
length effects observed in previous studies might covariate with the effect of in-
creasing load of information and pragmatic principles. The hypothesis they put
forward combined Almor (1999)'s Informational Load Hypothesis (*the function
of informational load should be to help identify the antecedent, add new information
about it, or both*) and the Principle of Relativized Relevance (Frazier, 1990) (*prefer-
entially construe a phrase as being relevant to the main assertion of the sentence*). The
implementation of these principles to the resolution of syntactic ambiguities lead
Hemforth et al. (2013) predict that informativeness influences attachment in a
way that the more informative the content of an RC is, the higher the chance to
attach it to a more central or relevant element of the utterance (which in this case
is DP1). Although there seems to be an initial effect of Informational load in the
first half of the experiment (see figure 4.4), the effect quickly disappears in the
second half of the experiment, and cannot explain the overall results, that is, Im-
perfectives show an increased number of local attachments to DP2 in comparison

to progressives, irrespective of verb condition.

4.7   Conclusion

We presented novel evidence from Spanish supporting the universality of principles of locality. Although there are a number of factors that determine attachment, PR-availability is a key one. When the availability of PR parse is controlled for, Spanish speakers show a clear preference for local attachment of RCs. We also demonstrated an effect of PR-availability on attachment: a preference for high attachment (in terms of overall preference across subjects and items) is observed whenever a PR reading is available, in line with previous results from Italian (Grillo & Costa, 2014), Portuguese (B. Fernandes, 2012; Grillo et al., 2012a, 2012b; Tomaz et al., 2014), Greek (Grillo & Spathas, 2014) and French (Pozniak et al., 2019).

The second important result of this study (Experiment 1) is that the availability of habitual aspect seems to increase acceptability of a sentence in comparison to a minimally different episodic sentence. Dealing with perfectly grammatical sentences, we take acceptability scores as a proxy for relative complexity, with higher acceptability correlating with lower complexity. This result echoes previous results in the nominal domain, and suggests that genericity plays a similar role at clausal level. In line with our predictions, sentences compatible with an habitual reading appear to be easier to parse (out of the blue) because they carry fewer unsupported presuppositions than episodic sentences. Just like definite DPs, episodic readings require a richer mental model/more presuppositions than generic DPs and habituals.

Given that PRs require an episodic reading and are not compatible with habituals (and under the reasonable assumption that habits make better properties/RCs), we could pit the PR-preference and the observed preference for habituals against each other (Experiment 2 and 3). The results of this double manipulation are more exploratory. While we did not observe a straightforward effect of Aspect, an exploratory analysis including order of presentation suggests that aspectual information seem to play a modulatory role in interaction with cumulative exposure to RCs. The tension between aspect and PR-availability, initially dominated by the latter, give way a little to the influence of aspect and cumulative exposure to RCs, which both go in the same direction. Thus, although the effect of PR-*first* is never reversed, it is partly overrode by the joint influence of aspect and PR-availability. The results, although just preliminary at this stage, outline a research program that brings the study of genericity from the DP level

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to the clausal level and investigates the potential role of aspect in moderating RC-avoidance.

GENERATION OF PSEUDO RELATIVES

5.1 Introduction

This chapter is devoted to the study of production of PRs. We set out to test the scope of PR-*first* in a sentence completion task to see whether the PR-effect could also apply to generation of PRs and RCs.

The PR-*first* Hypothesis has primarily focused in comprehension, but it is reasonable to think that the same effects could be expanded to production as well, especially in light of recent theories that propose a united architecture of the human language system that integrates comprehension and production (Dell et al., 2014; MacDonald, 2013; Momma et al., 2018; Pickering et al., 2013a; Pickering et al., 2013b).

The aim of most theories that suggest a comprehension/production alignment is not to completely equate both, but rather to describe what is shared across them. There are different views in that respect, from proposals based on embodied cognition (Pickering et al., 2013a) that postulate shared representations, to connectionist accounts to which comprehension and production share a single cognitive architecture and processes (Dell et al., 2014). Other interactionist accounts make the claim that what is shared is a distributional pattern of frequency, hence comprehension and production are different mechanisms but both are shaped by language experience and statistical distributions (MacDonald, 2013).

For Momma et al. (2018) there is a shared cognitive mechanism in charge of structure-building where comprehension, production and grammar are conflated. Their proposal is a version of the single-mechanism view that suggests the

parser and the generator are identical in at least three levels: the (grammatical) representations, the mechanisms to build those representations, and the procedures for building sentence structures (i.e. the steps and order followed to create the parts of the sentence representation).

The question this work raises is whether a principle of economy such as the PR-first exerts its influence on production as it has been observed in comprehension. While there are obvious differences between comprehension and production (see e.g. summary in Tooley et al. 2014), there are at least two reasons to think that PR-effects could also be observed in production. On the one hand the differences between comprehension and production are less critical than it was initially thought, and pressure of time, memory span limitation and incremental parsing/planning are factors that apply to both domains. On the other hand, any task purported to tap into comprehension, also covers production as the parser needs to generate the target representations to arrive at a correct interpretation, and viceversa, production tasks also involve to a certain extent comprehension (e.g. as self-monitoring).

In the remainder of this chapter, we first briefly introduce the reader to experimental methods in production before presenting the results of a novel sentence completion task tapping into the effect of PR-availability in production across and within languages. Besides the opportunity of increasing our understanding of shared mechanisms between comprehension and production, there is an additional reason to test PR-first in the context of production. We argue that the evidence from production, especially completion task, provides very direct support for hypotheses about structural preference. We claim that in the context of the PR/RC ambiguity, which can be particularly difficult to study in corpora because of the at times impossibility of deciding which structural analysis was in fact intended, sentence completion is a better option than corpora study. We argue that the careful analysis (based on subtle syntactic and semantic criteria distinguishing PRs and RCs) can in principle be extended to corpus studies.

5.1.1   The study of language production

In the field of psycholinguisitics there is a vast variety of techniques both offline (questionnaires, acceptability judgements) and online (self-paced reading, eye-tracking, event-related potentials) used in the study of language comprehension. The options for language production are, nevertheless, far more limited at present.

From the experimental point of view, there is full control of the input presented to participants in comprehension studies, whereas this control is more

limited in production, which makes the interpretation and analysis of results a more intricate process. Nevertheless, psycholinguists made their way to conceive creative ways to dive into production processes. Speech error analysis, naming tasks, elicited production, are some examples, to name a few.

The use of corpus data has proven useful to explore the frequency of particular linguistic structures, but when a suitable corpus is not available, or the frequency of the linguistic structure at stake is very low, generation of data using norming studies has been used as an alternative. Especially relevant for the present discussion is another limitation with corpus studies, which comes from the fact that in the case of e.g. the PR/RC ambiguity, it is far from easy to establish the relative proportion of both structures in a corpus. That is, while it is relatively easy (or at least possible) to univocally identify PRs when they are headed by pronouns or proper names (modulo prosody for the latter) for instance, it is far more complicated (if at all possible) to decide whether a given sentence containing a common noun, e.g. *Juan ha visto a la chica que corría*, should be classified as a PR or an RC. At least without taking into account larger portion of discourse and relying on subjective criteria.

In the late 20th century, one of the methods used to explore the probability of a certain structure consisted in asking participants to create sentences by completing simple phrases or by using particular verbs. Connine et al. (1984) asked participants to build a sentence using a verb from a given list of verbs, and a topic from a list of topics (e.g. animals, sports) or a setting (e.g. school, home). In other studies participants were given a pronoun followed by a verb (e.g. *They admitted...*) (Holmes et al., 1989), or a more constricted sentence meant to elicit RCs (e.g. *John babysits/detests the children of the musician who...*) (Rohde et al., 2011).

There are obvious differences between corpus studies and completion tasks, and their results oftentimes differed (Merlo, 1994; Roland et al., 2002). The divergence of results could be explained by the number of potential different factors between both, such as the lack of discourse context in the out-of-the-blue-sentences usually employed in completion tasks, or the experimental design. Another relevant factor distinguishing naturally occurring sentences and elicited production is the nature of the input. When talking or writing, the message we want to convey is the input that sets off a sequence of utterances or sentences (Levelt, 1989). Contrarily, in a completion task, the input is the words given by the experimenter to be used as the first building blocks of the sentence. There is no message to convey but participants use this information to project a structure and a meaning coherent with the initial interpretation of the given words. Production, studied this way, could be a gate to investigate parsing predictions. For its ability to tap

into both, prediction and generation, sentence completion task is the technique selected in this work to study generation of PRs.

5.1.2 Pseudo Relatives exclusive environment

The goal of exploring the generation of PRs has to inevitably face the problem that RCs and PRs are string identical, which complicates the process of telling them apart. As mentioned before, it is not trivial to decide whether a sequence is a PR or an RC, and the context is not always of assistance. One potential useful criterion for classifying PRs is the number of syntactic and semantic constraints they are subjected to in comparison to RCs. There are several constraints a PR-licensing environment must meet to guarantee, among other conditions, the simultaneity between embedded and main predicate, as both events have to (at least momentarily) overlap in time. In chapter 3 the principal differences between PRs and RCs have been outlined. In this section I will deepen in the constraints PRs impose and provide a detailed characterization of the restricted contexts that allow PRs. These constraints will allow us to establish objective criteria of analysis of our completion study and to adjudicate, for every utterance, whether it is PR-compatible or not. This is a less ambitious but much more realistic goal, and as we will see, it will still prove extremely useful in showing the existence of clear patterns in the outcome of the experiment.

Verb type constraint: As discussed amply thus far, PRs denote events, and thus they are only allowed in contexts which select events (e.g. perceptual verbs (1)), but not by non-perceptual predicates (2). As in previous experiments, this distinction will play an important role in our design.

(1)   Juan vio a   Ana   que corría.
      J.   saw DOM Anna that run.$_{\text{IMPF}}$
      'John saw Ana running.'

(2)   *Juan conocía a   Miguel que corría.
      J.   knew   DOM Miguel that run.IMPF
      '*John knew Miguel running.'

Tense match constraint: PRs require matching tense between matrix and embedded verb. While Tense in RCs displays clear referential properties, Tense in PRs is anaphoric and typically matches (or depends on) the tense specification of the main clause (Pozniak et al., 2019). The restriction naturally stems from the direct perception interpretation triggered by PRs: the *seeing*-event and the perceived event should overlap in time. Simultaneity is thus a requisite in PRs (3-a), but just an option in RCs (3-b).

(3)　　a.　*María vio a　　　Alejandro que corre.
　　　　　　M.　　saw DOM Alejando　that runs.IMP
　　　　　　'*Maria saw Alejandro running.'

　　　　b.　María trabaja con　el　chico que corre/correrá/había corrido.
　　　　　　M.　　works　with the boy　that runs/will.run/had　run.
　　　　　　'Maria works with the boy that runs/will run/had run.'

Tense mismatch forces a shifted reading and consequently an RC disambiguation, either in present under past, or past under present.

Restriction to Outer Aspect: Also for the sake of simultaneity, the aspectual form of the embedded verb should be progressive/imperfective. Aspect with reference to the internal structure of the situation is required in the embedded verb, for the reported event has to be perceived and reported from within, as it unfolds. Perfective aspect, which is associated with terminated events, would not be compatible with an ongoing interpretation.[1] (4)

(4)　　*María vio a　　　Alejandro que había corrido.
　　　　　M.　　saw DOM Alejando　that had　ran.
　　　　　'*Maria saw Alejandro that had run.'

Importantly, in languages which allow both a progressive and habitual interpretation of imperfectives (like Italian or Spanish) only the progressive interpretation survives in PRs. Ban on habitual interpretation is easily diagnosed, for instance, using bare plural objects whose meaning cannot fit in the boundaries of a single event[2], as in the example (5-c).

(5)　　a.　María vio al　　　chico que corría.
　　　　　　M.　　saw DOM.the boy　that ran.
　　　　　　'Maria saw the boy running/that was running.'

　　　　b.　María vio a　　　Alejandro que corría.
　　　　　　M.　　saw DOM Alejandro that ran.
　　　　　　'Maria saw Alejandro running/*that was running.'

　　　　c.　*María vio a　　　Alejandro que corría maratones.
　　　　　　M.　　saw DOM Alejandro that ran　　marathons.
　　　　　　'Maria saw Alejandro running marathons.'

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[1]As mentioned before, Casalicchio ([2013](#)) discussed that terminated events are allowed in PRs. These typically denote a situation with some directly perceivable consequent state of an event, importantly the auxiliary still appears in its imperfective form, as in e.g.: *Ho visto Maria che aveva appena rotto il vetro*/I saw M. that had just broken the glass.

[2]Naturally, bare plurals are allowed in PRs as long as their presence still allows for an episodic reading of the event, e.g. *Juan vio al chico que comía patatas/John saw the boy eating potatoes.*

In the Spanish past tense there is a clear distinction between perfective (e.g. Ana nadó) and imperfective (e.g. Ana nadaba) in the Simple form, whereas in English both of them are translated or correspond to Simple Past (e.g. Anna swam). There are aspectual forms to express imperfectivity in English, by means of the Habitual Aspect (e.g. Ana used to swim in the beach) and the Progressive form (e.g. Ana was swimming). Only the latter will be accepted here because habits do not make events, as exemplified in (6-b) where the only acceptable reading is an appositive.

(6)   a.   John saw the man that used to smoke.
       b.   *John saw Richard that used to smoked.

An effect of shifted reading takes place when embedded aspect is not imperfective.

(7)   María vio al   hombre que había estado corriendo.
       M.   saw the man   that had   been   running.
       'Maria saw the man that had been running.'

The criterion used to define which aspectual forms are accepted according to the Outer aspect constraint relies on whether the ongoing nature of the event is preserved. Accordingly, the options in past tense in Spanish are Past Imperfect (e.g. nadaba) and Imperfect Progressive (e.g estaba nadando). The options in present tense are: Present Indicative (e.g. nada) and Present Progressive (e.g. está nadando).

In English, Imperfect aspect is marked by the form be + V-ing, which corresponds to the Progressive (continuous) form, as it does not entail completion. Therefore, the option for past in English is Past Progressive (e.g. was swimming), and for present tense are: Simple Present (e.g. swim) and Present Progressive (e.g. is swimming).

Restrictions on adverbial modifiers: Temporal adverbs that force a past shifted reading (e.g. yesterday, the last year), or habitual reading (e.g. always, every day, regularly) are incompatible with simultaneity, and thus incompatible with PRs.

(8)   María vio al   hombre que corría ayer   en la   carrera.
       M.   saw the man   that ran   yesterday in the race.
       'Maria saw the man that ran yesterday in the race.'

Subject Relatives (SR)

PRs generally require subject gap, as the DP following the matrix verb is usually taken to be the subject of the embedded verb (although there are a few exceptions to this, on which see Aldama 2018; Casalicchio 2013; Graffi 1980; Grillo and Moulton 2016a, among others).

(9)   María vio al hombre que animaba   a la chica en la carrera.
        M.   saw the man   that encouraged to the girl   in the race.
        '*Maria saw the man encouraging the girl in the race.'

Object gap generally leads to ungrammaticality.[3]

(10)   *María vio al hombre que la chica animaba   en la carrera.
         M.   saw the man   that the girl encouraged in the race.
        'Maria saw the man that the girl encouraged in the race.'

Restrictions to Inner Aspect In sharp contrast to RCs, which can contain any type of predicate, and in line with what observed with Acc-ing constructions, PRs can only contain eventive predicates and disallow non-perceptual predicates. In specific cases, stage-level predicates might be allowed (13), but not individual level predicates (11-b):

(11)   a.   Ho   visto Gianni che aveva gli occhi rossi.
               I.have seen G.   that had   the eyes red.
               'I saw G. with red eyes.'
    b.   *Ho   visto Gianni che aveva gli occhi blu.
               I.have seen G.   that had   the eyes blue.
               '*I saw G. with blue eyes.' (Casalicchio, 2013)[p.117][ex.160]

(12)   a.   He   visto a   Juan que hablaba en   Inglés.
               I.have seen DOM J.   that spoke   English.
               'I saw G. speaking English.'
    b.   *He   visto a Juan que   conocía el Inglés.
               I.have seen J. that knew English.
               '*I saw knowing English.'

Stage-level predicates and states are allowed within the PR predicate (13), but individual-level predicates are not (14) as the latter do not denote transitory properties of the subject (e.g. the boy with brown hair, the boy from Tokyo).

(13)   He   visto a Juan que corría / esperaba el autobús.
        I.have seen a Juan that ran   / waited.for the bus

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[3]Nevertheless, Aldama, 2018 defends that in Spanish object gap PRs are accepted in Spanish in sentences whenever a DO clitic is coindexed with the head of the PR.

'I saw Juan running / waiting for the bus'

(14)   *He   visto a Juan que tenía 15 años/   los ojos azules.
        I.have seen a Juan that was   15 years.old the blue eyes
        'I saw Juan being 15 years old/having blue eyes.'

This restriction is not present in the case of RCs (15), nor in completive clauses (16), where both types of predicates are allowed.

(15)   He   conocido al chico que corría/ tiene los   ojos azules.
         I.have met   the boy that ran/   the   blue eyes
         'I have met the boy that (used to)ran/ have blue eyes.'

(16)   He visto que Juan corría /   tiene 15 años.
         I   have seen that Juan   ran /   has 15   years
         'I saw that Juan (used to) ran / is 15 years old.'

The same rationale applies to attitudinal embedded predicates or psychological predicates, they fail to fulfil this requirement. (17)

(17)   María vio al   hombre que ama las carreras.
         M.   saw the man   that loves the races.
         'Maria saw the man that loves races.'

DP object constraint: As mentioned before, in some cases PRs are not compatible with bare DPs. The eventive reading is available when the bare DP fits well within a single event.

(18)   María vio al   hombre que comía cerezas.
         M.   saw the man   that ate   cherries.
         'Maria saw the man eating cherries'

However, in other cases, the plurality of events denoted/coerced by the predicate surpasses the scope of a single perceptual event, cancelling the PR reading.

(19)   María vio al   hombre que corría maratones.
         M.   saw the man   that ran   marathons.
         'Maria saw the man that ran marathons.'

A summary of PR constraints can be found in table 5.1.

Constraints on PRs	
Verb type	Perceptuals
Tense match	Between matrix and embedded verb
Outer aspect	Imperfective (continuous), not habitual
Time adverbials	Disallowed if force past shifted
Subject relatives	Only subject gap is generally requested
Inner aspect	Embedded predicate should be eventive and perceivable
DP objects	Bare nouns generally disallowed

Table 5.1: Summary of PRs constraints

5.1.3 Current study

The central question of this chapter is whether PR preference also applies to generation as previously observed in parsing. We examined the generation of structural preferences in PR/RC ambiguous contexts employing a sentence completion task technique. Sentence completion tasks have an obvious production component, as they involve generation of structures, but they also have a strong comprehension component. In a first stage of reading the first words of the sentence, readers assign an interpretation and draw predictions on upcoming structure. Readers then generate the continuation of the missing part of the sentence. The projected structure needs to necessarily be very detailed and include all the fine-grained information about constraints which will determine lexical selection. If PR-availability does influence structural projection or prediction and posterior generation, a markedly regular and bounded type of productions are expected.

We test these predictions in two completion studies in Spanish and English containing minimally different sentences with perceptual or non-perceptual predicates, as in (20):

(20)   a.   Juan vio a la chica que ...
              John saw the girl that ...
        b.   Juan vive con la chica que ...
              John lives with the girl that ...

In English, the complementizer 'that' was chosen instead of 'who' because it shares properties with the Spanish complementizer 'que' (i.e. both can introduce events, whereas 'who/quien' can only introduce entities), and also because most research in RC attachment in English have opted for this option too.

To evaluate participant's completions, every constraint described in section

5.1.2 constitutes a criterion used in the analysis of our results: for any generated completion to be considered PR-compatible, it needs to consistently fit every constrain. The task was evaluated in Spanish and English and the same materials used in Spanish were translated and evaluated in English. Perception verbs take events in both English and Spanish, and in both languages perception verbs can take DP with bare infinitive forms and SCs as their complements, but only in Spanish there is an additional option, the PR construction. As a consequence, only in Spanish, when the complementizer 'que/that' is found following an object DP in the predicate of a perceptual verb, there is ambiguity between an RC or a PR. Such ambiguity is nonexistent in English. The comparison of results in Spanish and English helps to elucidate whether a PR-effect is explained by grammar or whether it could be analysed purely in terms of the lexical contrast between perceptual and non-perceptual predicates.

As discussed in chapter 3, there is a mild effect of the lexical manipulation also in non-PR languages, although not strong enough to trigger a preference for High Attachment. Grillo et al. (2015a) investigated whether results found by Grillo and Costa (2014) in PR-languages could be explained as dependent on the manipulation of predicate semantics (perceptual verbs vs. non-perceptual verbs). The results showed that although there is a modulatory role of predicate semantics, with more high attachment after perceptuals, the overall preference still was low attachment in English. Pozniak et al. (2019) also investigated the resolution of PR/RC ambiguity in a PR language (French) and a non-PR language (English). The results showed that sentences with tense match between main and embedded clause were parsed more easily than those with tense mismatch under perceptuals in French. No difference was observed in English. In other words, the mismatch caused disruption only under perceptuals and only in French (the initial PR parse had to be reanalysed), but not in English, because tense match is needed in PRs. Results in English did not show any effect of tense, however, sentences with perceptuals were rated higher than sentences with non-perceptuals.

If PR-first also applies to production, we expect to find a similar pattern across the two languages limited to completion of sentences containing matrix non-perceptual predicates, and a different pattern across the two languages of completions in the condition with perceptuals, but a similar pattern with non-perceptuals. Completions in Spanish will be fairly more regular and constrained by PR-constraints only in the perceptuals condition, and whilst a modulatory role of predicate semantics could be observed, it would affect both languages and thus differences between English and Spanish could only be explained by PR-availability.

5.2 Method

5.2.1 Participants

Forty Native British English speakers (Mean age=37, SD=12, 31 female) and forty Native European Spanish speakers (Mean age=32, SD=10, 16 female) were recruited on *Prolific Academic*. Participants were monolinguals or late bilinguals, but none of them them was early bilingual. All participants gave informed consent and were compensated for participation.

5.2.2 Materials

Twenty-four snippets adapted from the attachment questionnaire (see Appendix IV) conformed the stimuli. The snippets contained a subject and matrix verb followed by an object DP and a complementizer/relative pronoun 'that'. Only the first DP of the original complex DP was kept. A PR-licensing environment was allowed in half of the materials with perceptual matrix verbs, a non PR-licensing environment was granted in the other half with non-perceptual matrix verbs. Tense in the matrix verb was present in half of the materials and past in the other half.

Materials in Spanish:

Perceptive	Present	Ian **ve** al dentista que...
Perceptive	Past	Ian **vio** al dentista que...
Non-perceptual	Present	Ian **trabaja** con el dentista que...
Non-perceptual	Past	Ian **trabajó** con el dentista que...

Materials in English:

Perceptive	Present	Ian **sees** the dentist that...
Perceptive	Past	Ian **saw** the dentist that...
Non-perceptual	Present	Ian **works with** the dentist that...
Non-perceptual	Past	Ian **worked with** the dentist that...

Two variables were manipulated: type of matrix verb (perceptive versus non-perceptual) and tense (past versus present). The tense manipulation was included to improve our ability to use the Tense Matching criterion for PR-compatibility in a meaningful way (see more on this below).

Seventy-two fillers were interspersed with the 24 experimental items. The fillers contained prepositional clauses (e.g. The golf player argued with...), complement clauses (e.g. Sam believes that...), and because-clauses (e.g. The lecturer bought the book because...).

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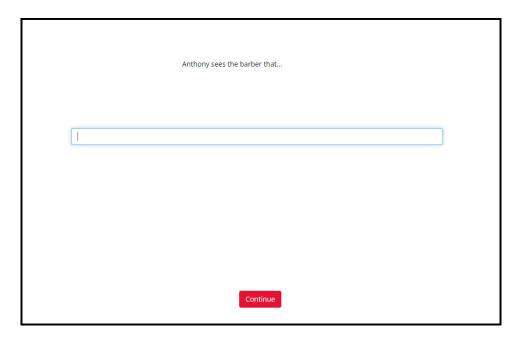
Figure 5.1: Screenshot of the presentation of the task

5.2.3 Procedure

The experiment was created with the online behavioural experiment builder Gorilla (www.gorilla.sc, Anwyl-Irvine et al. 2019). The sentences were presented individually in the centre of the screen in a Latin square design. The order of presentation was randomised.

Participants were asked to complete each sentence with a natural and spontaneous short continuation. They were asked to press the key 'Continue' after the completion was written to have the following item displayed on the screen (see Figure 5.1).

A few practice trials helped participants familiarise themselves with the method, and were excluded from data analysis.

5.2.4 Data Analysis & Results

Table 5.2: Mean percentage of PR-compatible answers in English and Spanish

	Perceptual	Non-perceptual
Spanish	51%	7%
English	12%	7%

Participants' completions were analysed following a pre-established set of criteria (corresponding to the strict criteria for PR-licensing), and each completion was coded as PR-compatible or PR-incompatible for both languages. A summary of results can be found in Table 5.2. This is, English completions were

also analyzed as if they could be PR-compatible even though they are not. For an answer to be marked as PR-compatible, each one of a number of properties (including e.g. Tense Matching, Imperfectivity, inner aspect, etc.) had to be met (for the full list of criteria see Section 5.1.2).

A very small number of ungrammatical completions were excluded from analysis, the total number of excluded completions was four in the Spanish data, and four in the English data. Furthermore, the classification of completions revealed that not all PR-incompatible completions were RCs. The additional structures comprise Complement Clauses in both Spanish and English, and temporal modifiers and RCs embedded in SCs in English. The variety of alternative structures was wider in English than in Spanish.

The presence of these structures represented the 7.5% of the total number of completions in the English data, which were excluded from analysis.

A few examples of alternative structures from the English data are included here:

(21) Complement Clauses (48 cases)

   a. Vanessa cooperated with the butcher that the meat pack could be adapted slightly.
   b. Anthony collaborates with the barber that the new haircut looks great.
   c. William trusted the singer that she was better than him.

(22) Temporal modifiers (2 cases):

   a. Michael saw the dentist that day.
   b. Martha looked at the lawyer that afternoon.

A more interesting finding, in line with the idea that perceptual verbs show a strong tendency to embed situations/events is that, in a number of occasions, participants produced SCs in the environment of perceptual verbs in English, embedding the obligatory RCs within the subject of these SCs (11 cases). In each instance the verb of perception *to hear* was involved, in either its past or present form:

(23) a. Edward heard the young man that had been hurt was nice.
   b. John heard the city councillor that he knew was hurt.
   c. Alex hears the tenant that was evicted is back.

In Spanish only 5 cases of Complement clauses were found, which represents 0.5% of the total number of completions (and were also excluded from analysis). Some examples are the following:

(24)   a.   Ana discrepa del médico que tenga algo grave en la rodilla.
               'Ana disagrees with the doctor in that he has a serious knee injury.'
        b.   Daniela concuerda con el maestro que todos debemos ir a la huelga.
               'Daniela agrees with the professor that we all should go on strike.'

5.2.4.1   Analysis of completions in Spanish

Original examples from participant's answers in the sentence completion task and their analysis are provided in this section to give an accurate view of how the classification process was carried out. What is being evaluated is whether participant's completions fit PR-defining criteria. Oftentimes, more than one reason justified the classification of a completion as PR-incompatible. To illustrate the process, we list a few actual examples from our study that were classified as PR-incompatible, and include a short commentary on the rationale for each decision.

☐ Completion 1:
Manolo ve al dentista que más diplomas tiene en su muro.
'Manolo saw the dentist that more diplomas has on the wall.'

The completion does not respect the constraint of Eventive Predicate for two main reasons: first, the verb 'to have' introduces properties, not events, and second, the particle 'more' is comparative in this context. The comparison is employed to build a contrast set, which is the set of dentists that have diplomas on the wall.

☐ Completion 2:
Ricardo mira al policía que no quiso aceptar el soborno.
'Ricardo looks at the policeman that did not want to accept the bribe.'

At least two criteria allow treating this item as PR-incompatible: Tense Mismatch (the main predicate is present and the embedded predicate is past) and Perfective Aspect (the aspect of the embedded predicate is not imperfective).

☐ Completion 3:
Eduardo oye al joven que habla siempre a gritos.
'Eduardo hears the young man that always speaks loudly."

The time adverbial 'siempre' (always) converts the embedded clause in an habitual, thus incompatible with PRs.

☐ Completion 4:
Guillermo ve a la cantante que no soportamos.
'Guillermo sees the singer that we do not stand.'

The constraints Subject relative and Eventive predicate are not met because the completion has an object gap instead of subject gap, and the verb 'to' stand' plus the negative particle disallow an eventive reading.

☐ Completion 5:
Juan se fía del concejal que trabaja en asuntos sociales.
'Juan trusts the city councillor that works in Social Affairs.

Whereas the predicate 'to work' allows an eventive reading (e.g. I see the man working), the embedded predicate here does not denote an event of working, but rather a property of working/having a job position in the Ministry of Social Affairs.

☐ Completion 6:
Andrea estudia con el chico que le gusta.
'Andrea studies with the boy that she likes.'

Subject Relative and Eventive predicate requirements are not met because the main subject is also the embedded subject, and the verb 'to like' is a psychological not perceivable predicate.

Let's now consider some PR-compatible answers. Notice that we include in this category any continuation which matches the criteria for PR-compatibility *within the embedded clause*. This means that we at times classify as PR-compatible, continuations of items containing non-perceptual matrix predicates and that thus

clearly cannot be considered PRs. This is because our goal is to compare the proportion of continuations which satisfy our criteria across the two types of predicates. It's important to exclude that whatever effect we find under perceptual verbs is not due simply to a general tendency of our participants to e.g. use matching tense or imperfective aspect in their continuations across the board. While *PR-compatibility* is a misnomer when it comes to completion of sentences with predicates that do not select for PRs (and for all completions in non-PR languages like English), it stands as a helpful short form for all the criteria that need to be satisfied for an embedded CP to be PR-compatible. The next example provides a clear illustration of this:

- Completion 8:
  Juan se fía del concejal que roba.
  'Juan trusts the city councillor that steals.'

  While the most natural interpretation of this sentence involves a habitual reading of the embedded predicate (and thus PR-incompatibility) our criteria still rule this in as PR-compatible because the episodic reading is not ungrammatical in principle. Note that this is a conservative way of counting, which simply applies the criteria in an objective way.

- Completion 9:
  Ricardo miró al policía que estaba deteniendo a su amigo.
  'Ricardo looked at the policeman (that was) arresting his friend.'

  This is a clear example of PR-compatible continuation: the DP *el policía* is the subject of the embedded clause and the embedded predicate describes an ongoing event. The whole sentence, because of the matrix verb *mirar*, also happens to be compatible with a PR reading. Obviously an RC reading cannot be excluded. This is why we talk about criteria for PR-compatibility, rather than number of PR-completions in absolute terms.

5.2.4.2 Analysis of completions in English

Even though English is not a PR language, the evaluation of completions in English serves as a control for the data in Spanish. The same criteria are used in both languages to classify PR-compatibility of the answers. To illustrate the process, we list a few original examples from our study that were classified as PR-incompatible, and include a short commentary on the rationale for each decision.

- □ Completion 1:
  Michael lives with the dentist that everyone is talking about.

The DP *the dentist* is not the subject of the embedded CP, but the complement of the preposition *about*, and 'Everyone' takes the subject position of the embedded clause. The completion is thus classified as PR-incompatible.[4]

☐ Completion 2:

Edward hears the young man that thinks the Earth is flat.

The predicate is psychological, not eventive and not directly perceivable, so we treat this as a PR-incompatible continuation.

☐ Completion 3:

Martha worked with the lawyer that won the Henderson case.

The embedded predicate *won* here can only denote a terminated event, as thus mismatches the aspectual criteria for PR-compatibility.

☐ Completion 4:

Anthony saw the barber that was old.

This is an individual-level predicate, thus PR-incompatible.

☐ Completion 5:

Theresa listened to the old man that used to be her neighbour in her previous house.

The use of Past habitual 'used to' is incompatible with a PR-reading.

☐ Completion 6:

Rachel looks at the deputy that was wearing a new suit.

Tense of the embedded predicate mismatches matrix Tense (past under present).

Some examples of PR-compatible answers:

■ Completion 7:

Alex hangs out with the tenant that is cleaning out his home.

■ Completion 8:

Martha looks at the lawyer that squints.

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[4]See discussion above on our use of PR-compatibility as a descriptive device for the properties of embedded CPs in a non PR-languages like English.

- Completion 9:
  Vanessa cooperated with the butcher that was chopping her meat.

Each of the completions above obeys the criteria for PR-compatibility (even though, it is worth repeating once more, they clearly cannot be considered PRs as English does not license this structure). The embedded predicates all describe directly perceivable (arguably ongoing) events and match the matrix predicate in Tense.

An important proviso should be made here: Tense match is not a sufficient condition to ensure simultaneity in English RCs, in fact it is dubious that English RCs even allow a simultaneous reading of the situations described in the matrix and the RC predicates. Our informants tell us that simultaneity is perhaps allowed in an 'accidental' sort of way, but they also made it clear to us that this is not the preferred reading of Tense matching in RCs. This is an important issue, which might in part explain why PRs are not allowed in English, as arguably the availability of a simultaneous reading should be a pre-requisite for PR-availability. We will not investigate this issue further here, but it's important to point out that we opted for a very conservative criterion when evaluating completions in English, i.e. we counted as PR-compatible sentences like Completion 7, which display Tense match, even though simultaneity might (and likely does not) hold.

Statistical Analysis

Results were analyzed with R (R Core Team, 2018) and generalized linear mixed effects modelling (glmer) with binomial distribution using the package lme4 (Bates et al., 2015). As fixed effects, we entered *Verb type* (Perceptual vs Non-perceptual) and *Language* (Spanish vs English) (with interaction term) into the model, and *participants* and *items* as random effects, with crossed random intercepts for Subjects and Items. All predictors were contrast coded. The results showed a significant effect of the INTERACTION between Verb type and Language (β= -2.3356, *SE*=.4377, *z*= -5.337, *p*<.0001). The analysis also shows a main effect of language (β=1.0744, *SE*=.2544, *z*=4.223, *p*<.0001) and main effect of Verb type (β=-1.6730, *SE*=.2445, *z*=-6.844, *p*<.0001).

Two additional models were run to break down the interaction, one model for the subset of perceptual verbs and another for the subset of non-perceptual

verbs. The model with perceptual verbs indicated a significant difference between English and Spanish (β= 2.2385, SE=.3253, z=6.881, p<.0001). The model with non-perceptuals did not show any difference between both languages (β=-0.09071, SE= .34972, z=-0.259, p<.795).
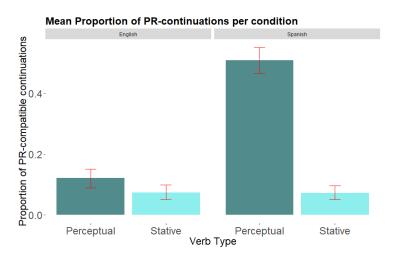
Figure 5.2: Mean proportion of PR-compatible continuations

5.2.5 Analysis of results in Spanish

Post hoc analysis in Spanish shows a main effect of verb type (β=-2.8068, SE=.3134, z=-8.957, p<.0001) indicating a significantly higher production of PR-compatible completions following perceptual verbs (51%) in comparison to non-perceptual verbs (7%).

Table 5.3 details the % of completions that respected constraints described in section 5.1.2 in the condition with perceptual verbs and table 5.4 for he condition with non-perceptuals. Therefore, the first column indicates % of tense match between matrix and embedded clause, the second % of appropriate aspect for PR-compatibility as described in section 5.1.2, the third % of Subject Relatives, the fourth % of completions without disallowed time adverbials, and the fifth % of eventive predicates. The last column indicates final % of PR-compatibility.

Table 5.3: % PR-compatible responses in perceptual verbs in Spanish

	Tense match	Outer Aspect	SR	Time Adverbials	Eventive predicate	PR-compatible
Past	95%	59%	95%	96%	85%	51%
Present	72%	78%	95%	94%	80%	50%
Total	78%	65%	95%	95%	77%	51%

Table 5.4: % PR-compatible responses in non-perceptual verbs in Spanish

	Tense match	Outer Aspect	SR	Time Adverbials	Eventive predicate	PR-compatible
Past	91%	27%	95%	94%	58%	8%
Present	41%	46%	91%	94%	55%	7%
Total	66%	37%	93%	94%	58%	7%

Across the board, the principal reason to rule out PR-incompatibility in both perceptuals and non-perceptuals is Aspect, followed by Eventive predicate. The main difference between perceptuals and non-perceptuals also relies on Aspect and type of predicate. These two constraints appear to be fundamental for PR identity.

The percentage of time adverbials indicating habitual events, or forcing a shifted reading, is very low, 5% in perceptuals and 6% in non-perceptuals. The percentage of object relatives is also very low, 5% in perceptuals and 7% in non-perceptuals, which was highly predictable given the higher complexity and dispreference of object relatives attested in the vast literature on this topic.

5.2.6 Analysis of results in English

Post hoc analysis in English does not show a main effect of verb type (β=0.4717, *SE*= .3352, *z*=-1.407, *p*<.159).

Table 5.5 details the % of completions that respected constraints described in section 5.1.2 in the condition with perceptual verbs and table 5.6 for he condition with non-perceptuals. Therefore, the first column indicates % of tense match between matrix and embedded clause, the second % of appropriate aspect for PR-compatibility as described in section 5.1.2, the third % of Subject Relatives, the fourth % of completions without disallowed time adverbials, and the fifth % of eventive predicates. The last column indicates final % of PR-compatibility.

Table 5.5: % PR-compatible responses in perceptual verbs in English

	Tense match	Outer Aspect	SR	Time Adverbials	Eventive predicate	PR-compatible
Past	97%	11%	97%	97%	65%	9%
Present	40%	20%	94%	95%	57%	15%
Total	68%	15%	95%	96%	61%	12%

Eventive predicate is the main cause of PR-incompatibility in both perceptuals and non-perceptuals, followed by Outer Aspect. There is an observable

Table 5.6: % PR-compatible responses in non-perceptual verbs in English

	Tense match	Outer Aspect	SR	Time Adverbials	Eventive predicate	PR-compatible
Past	93%	12%	95%	97%	45%	2%
Present	47%	18%	95%	96%	42%	12%
Total	69%	15%	95%	96%	44%	7%

difference, across verb types: perceptuals and non-perceptuals only showed a different pattern with Eventive predicates, with a higher number of eventive completions after perceptuals as initially predicted.

5.3 Discussion

The results of the completion task in Spanish and English paint very different pictures for each language. In English, an heterogeneous picture emerges for each of the criteria of PR-compatibility across both perceptual and non-perceptual predicates. The highest percentage of PR-compatible continuation is 15%, even using the conservative criteria we adopted here, which ruled in as PR-compatible continuations which satisfied Tense matching even in the potential absence of a simultaneous reading.

In Spanish, however, the data show a very different picture. A clear asymmetry across verb type emerges, where a defined pattern polarises completions is observed after perceptual verbs (i.e. in PR-licensing environments), with slightly more than half of the completions obeying every criteria for PR-compatibility. On the other hand, completions after non-perceptuals (i.e. where only RCs are licensed) show an overall heterogeneous and unrestricted pattern that do not accommodate PR restrictions.

In sum, the (lack of) pattern of continuations with non-perceptuals in Spanish, matches that found in English across both verb types, i.e. no specific pattern is observed and an extremely small percentage of continuations obey the criteria for PR-compatibility. The oddball is constituted by the pattern of continuations under perceptual verbs in Spanish only, where we find more than five times as many PR-compatible continuations than in the other conditions. In sum, PR-compatible continuations are observed in the only PR-compatible environment (i.e. perceptual verbs in Spanish). When only RCs are available (non-perceptuals in Spanish, and non-perceptual and perceptual verbs in English), continuations do not show a specific pattern and do not obey PR-constraints.

The observed contrasts parallel those found in the parsing literature. The

contrast between perceptuals and non-perceptuals expands upon previous findings from attachment questionnaires (Chapter 4. In the current data, the observed difference between perceptuals and non-perceptuals (51% and 7% respectively) was far more salient than that found in attachment questionnaires (roughly 57% vs. 38%), indicating a clear influence of PR availability in generation as well.

The null results in English showed that differences between PR-licensing and non-licensing environments observed in Spanish cannot be reduced to predicate semantics effects, in line with what has already been shown in previous research (Grillo et al., 2015a; Pozniak et al., 2019). The low percentage of PR-compatible continuations, the lack of difference between predicate types, and crucially, the difference between English and Spanish only in the condition with perceptual verbs, but not with non-perceptual verbs, plainly supports PR-*first* Hypothesis.

5.3.1   Implications for future work on production

The replication of results across domains is relevant for PR-*first* Hypothesis. Recent proposals in Psycholinguistics suggest shared mechanisms for comprehension and production. The two processes seem to be intertwined as there is generation of structural preferences and predictions when taking in linguistic input on one side, and on the other there seems to be a close cooperation between generator and parser when building sentence structures. If the parser and the generator fundamental properties are identical, parsing preferences observed in the language processing literature should also be suited to generation. We built on these shared mechanisms to further study PR/RC ambiguities.

One factor often highlighted in the literature as determinant to bridge comprehension and production is relative frequency. The low frequency of PRs shown in corpus studies available so far (Aldama et al., 2017) would predict a low generation of PRs. However, the low frequency distribution of PRs did not seem to have a strong effect in parsing, and neither seemed so in generation. PRs appear to be predicted and generated in considerably large numbers in spite of their low frequency. Therefore we can claim that the results fit predictions from most of the models that claim a comprehension/production alignment. It is nevertheless difficult to explain the obtained results if the bridge between comprehension and production is the distributional pattern of PRs as follows from MacDonald (2013)'s account.

One (important) limitation here is that corpus studies on PR-availability are so far limited in number and, as mentioned above, the PR/RC ambiguity limits our ability to decide whether a given entry in the corpus should be classified

as PR or RC. In the future, the criteria established for the present production study could be implemented also in the study of corpora. Admittedly, this still has limitations, but so does including only unambiguous PRs (i.e. PRs containing either proper names or pronouns) in the count. A combination of the two measures could give us a better understanding of the relative frequency of PRs and RCs in a given language.

The data obtained in this study can be relevant for models of language production. The important finding here is that participants appear to have planned the fine grained details of a forthcoming clause (including Tense, outer and inner aspect) in advance. The fact that participants build syntactic structure of more than a clause in advance is something not new in the production literature. Research has revealed that the process is multistage, and most of the models of language production concerned with explaining how conceptual information is transformed into a proper sequenced set of linguistic representations (Dell, 1986; Fromkin, 1971; Garrett, 1975; Levelt, 1989) agree that there is a first stage of abstract word representations called "lemmas", then a stage of grammatical encoding where grammatical structures for words and morphemes are defined, followed by the projection of phonological form specifications that will guide motor planning and final articulation. The data obtained in this study seems to indicate that an initial preference for an eventive reading built up after the perceptual verb have cascading effects on successive levels of production planning, setting what needs to be active on the higher (more specific) level.

There is evidence from speech errors analysis and structural priming studies (J. K. Bock, 1986; K. Bock et al., 1990; Chang et al., 2000; Pickering et al., 2008) to establish two autonomous sets of processes in the transition between conceptual planning and grammatical encoding. First, a stage of functional encoding assigns grammatical functions (subject, verb, object) to selected lemmas in order to create a functional structure. Then in a stage of positional encoding, morphological forms are associated with the grammatical functions and assigned to different positions in structural frames that encode syntactic structure of the utterance. In the production research there is no doubt that planning, as well as parsing, occurs incrementally, as articulation sets off before the entire structure has been planned and all constituent words have been retrieved (Kempen et al., 1987; Levelt, 1989). The results presented here seem to indicate that the structural encoding necessarily has to include very detailed, fine-grained, syntactic and semantic information such as tense, grammatical aspect, lexical aspect, or type of predicate.

Many relevant questions rest unanswered. How is the generation process

being performed, is it generated serially or in parallel? Is there competition between structural candidates? And if so, what determines the selection of one particular structure? If both the parser and the generator make structural decisions because both need to select among a number of structural candidates consistent with the input, in the case of the parser, or the message to convey, in the case of the generator, is the same mechanism responsible of the selection in both cases?

There are a few limitations of this study. One limitation is that in spite of the highly restricted context and the number of constraints PRs impose, a PR-compatible answer is, by definition, given that we used common nouns in our prompts, also an RC-compatible answer. For that reason English speakers were also tested as a control group using close translations of the Spanish prompts. Although any continuation that match criteria for PR-compatibility is also compatible with an RC reading, it is difficult to explain that the difference in PR-compatible continuations across the two languages(51% in Spanish and 12% in English) is limited to perceptual environments without making reference to the role of PR-availability. Likewise, it would also be difficult to explain why the highly uniform and regular pattern found with perceptuals in Spanish was not observed with non-perceptuals and neither was observed in any condition in English. This limitation is thus somewhat overridden by the clarity of the results.

Finally, the anecdotal finding in English of cases where the RC was embedded into a SC complement of a perception verb, lines up with results from Grillo et al. (2015a) when comparing reduced RCs and SCs: the availability of an eventive SC reading strongly affected ambiguity resolution in English in ways that mirror the PR preferences found in PR-languages. The general picture is that across languages there appears to be a parsing preference for eventive SCs over restrictive RCs whenever SCs are available. In future research it would be desirable to directly investigate this preference of SCs over RCs in production, as our present findings are purely anecdotal given that our task was only designed to elicit RCs or PRs. The same applies to the observed occurrence of other alternative structures such as CCs or temporal modifiers, which offer further support to the existing literature on RC avoidance (Altmann et al., 1992; Demestre et al., 2004; Mitchell et al., 1992; Staub et al., 2018).

To summarize, the data presented in this chapter extend the empirical coverage of the PR-*first* Hypothesis to the domain of sentence production and further show that neither frequency or pragmatics alone are able to explain the observed preference for PRs over RCs. The present study also introduces an original methodological innovation on how to overcome the limitations posed to completion and corpus study by string identical PR/RC sentences. Counting relative proportion of continuations (in)compatible with PRs in minimally different

environments allows us to draw information about parsing preference also in the absence of absolute numbers.

The evidence gathered here suggests there is an alignment between comprehension and production, at least in the case of PR/RC ambiguities. Production, studied the way we present in this work, comprises a strong comprehension component, making it suitable to also explore predictions built while reading and their influence on posterior production. Predictions and planned structure are influenced by PR-availability having a cascade effect on posterior production, the scope of which encodes fine-grained syntactic and semantic information that guides subsequent lexical selection.

Eye-tracking PR-*first* effects

6.1 Introduction[1]

This chapter presents an eye-tracking study in Spanish testing attachment preferences in PR/RC ambiguous contexts. The goal is to time-course eye gaze and unveil the timing of disambiguation of local PR/RC ambiguities using the classic [matrix verb + complex DP + que clause] constructions with perceptual and non-perceptual matrix verbs, using gender morphology as a mean of disambiguation. This experiment adds to the bulk of evidence presented in this thesis with an online perspective following standards in the field. It constitutes the first online study in Spanish tackling the PR/RC ambiguity.

6.2 Eye-tracking and other online methods

Offline methods such as those employed in previous chapters of this thesis, completion tasks or attachment questionnaires, are useful to investigate participant's final interpretations of a sentence, that is the ultimate product of a number of processes involved not only in parsing, but also (potentially) in inferential reasoning about the sentence form and meaning, its connection to a reader's previous knowledge about the world and memory of the parse itself. They involve, ultimately conscious judgements about attachment or decisions on how to complete a sentence. On the other side, online methods measure how participants process sentences as they incrementally unfold. This chapter and the next one

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[1]This chapter is based on: Aguilar, M., Gavilán, J.M., Ferré, P., Hinojosa, J.A., & Demestre, J. (2020). The actress was on the balcony, after all: Eye-tracking locality and PR-effects in Spanish. (Under review in *Cognition*)

focus on the online parsing of PR/RC ambiguities. We present the results of two eye tracking while reading studies designed to explore how the parsing of these structures unfolds in time in the resolution of (temporarily) ambiguous [DP1 of DP2 + PR/RC] structures (this chapter) and in the resolution of (temporarily) ambiguous PR/RC sentences in the absence of an attachment ambiguity (next chapter).

The choice of this technique lies in the advantages it offers in comparison to other common online methods in psycholinguistics, self-paced reading, and Event-Related Brain Potentials (ERPs). In what follows, I will briefly describe the above mentioned techniques and the advantages eye-tracking offers. Readers familiar with these methods can safely skip the remainder of this section to Section 6.3.

In Self-Paced Reading task readers have sentences presented one by one on the screen of the computer. The words that conform the sentence are masked, and readers are asked to press a button to unmask the words as they read. There are mainly two types of Self-Paced Reading task: the moving window task and the stationary window task. In the moving window task, the computer screen presents a pattern of dashes where each dash masks a letters of a word, separated by spaces. When readers first press a button, a word or a segment is unmasked and the reader is asked to press the button again as soon as they have read the word/segment. Then, the word/segment is replaced by the pattern of dashes again, and continues so forth until the end of the sentence. In the stationary window task the process is quite similar, with the difference that the words/segments appear at the same position in the screen, usually the centre. This technique became quite popular especially because it is fairly easy to implement, economical (with free software available such as DMDX (Forster et al., 1999) or PSYSCOPE (Cohen et al., 1993)), and convenient, as no extra equipment is needed and researchers can run the task on a laptop. However, while this is a relatively sensitive technique to capture online processes in reading, major problems with Self-Paced Reading have to do with ecological validity of the task. First, the segmentation of the sentences into words or bigger segments posits a problem, not only because of its artificiality, but also for the effects of the type of segmentation itself. Some types of segmentation might interfere with prosody, as it is natural to pose an intonational break at the end of a segment. Moreover, common regressive movements in natural reading are not possible in this task.

Event-Related Brain Potentials (ERPs) are voltage changes that can be obtained measuring electrophysiological activity at the scalp. These tiny voltage changes can be triggered by certain cognitive processes, such as word recognition and sentence processing. For instance, there is consensus that a negative peak of electricity flow triggered around 400 ms (named N400) usually happens after

the onset of a semantic unexpected word. On syntactic grounds, some types of syntactic phenomena (e.g. ungrammatical errors, garden path sentences, filler-gap dependencies, linguistic complexity) can trigger a positive peak happening around 600 ms (P600) (see Kutas et al. 2006 for an overview). The presentation of sentences in (most) ERP experiments happens one word at a time, using the rapid visual serial presentation (RSVP) paradigm, and the response to a critical word is measured. ERP research and eye tracking provide distinct types of information. The former can capture differences between syntactic and semantic violations as the two have different ERP signatures. However, it is problematic to draw conclusions about cognitive timing based on the latency of ERP effects.

Conversely, with eye tracking data, it is easier to figure out the relative amount of difficulty induced by an effect, although it is difficult to tell different kinds of processing apart, as there is not a behavioural pattern associated with semantic violation and a different one for syntactic violation, for instance. Eye-tracking consists in measuring the location and duration of participant's eye movements (fixations and saccades) on the screen of the computer when reading, or when participants are presented with a visual scene while they hear spoken language (called Visual World Paradigm). Eye-tracking research has been widely used to investigate the timing of parsing different type of structures, the role of anticipation and expectation in parsing, the role of semantic, pragmatic, and prosodic information, garden-path phenomena, among other. Unlike Self-Paced Reading, eye-tracking does not have to deal with the segmentation problem as sentences can be presented as a whole, and it offers the possibility to track regressive eye movements to previous regions in the sentence, reflecting a more natural reading behaviour (Rayner et al., 1988). For Clifton Jr et al. (2011), Staub et al. (2007) and many other, eye-tracking studies are among the most valuable way of exploring the time-course of comprehending written sentences because it can capture fine details of the time course of syntactic analysis. In addition, it is relatively cheap compared to ERPs and brain imaging.

Eye movements while reading can provide us with rich information about how attention, the eyes, and the parser interact, and that includes the time-course of a linguistic event, or in other words, the time it takes the parser to deal with a specific event, but also it provides information about what the parser does when it encounters difficulty, for instance an unexpected word or structure. In such cases, eye movements might backtrack and make regressive movements to earlier regions of the sentence, they might proceed to the next bit of sentence, or they might just linger to the complicated word/region.

The first study that examined the relation between eye movements and syntactic preferences (Frazier et al., 1982), found disruption effects already at the

very first fixation on the disambiguating region in sentences such as:

(1)   The second wife will claim the entire family inheritance belongs to her.

Their results showed that *the entire family inheritance* is initially integrated into the parse as the direct object of *claim*, instead that as the subject of the embedded verb. The cost of integration of *the entire family inheritance* as the subject of the embedded verb surfaced immediately in longer first fixation duration followed by more regressive eye movements to earlier regions. However, problems with syntactic processing do not always appear that quickly in the eye movements record. Generally speaking, properties of lexical items (especially frequency of occurrence) and their predictability in a given context, have consistently been reported to affect early measures such as first fixation duration and first pass (Staub et al., 2007). In contrast, the effects of syntactic processing have been more difficult to predict. These effects can sometimes appear quickly at first fixation duration, although that does not happen very often. Oftentimes, they show up as increases in first pass reading times, or only as an increased go-past, or even only as an increased time in the spillover region (Clifton Jr et al., 2011). In fact, it has been difficult to find specific patterns derived by different types of effects (Clifton Jr et al., 2007). Apart from the type of ambiguity or syntactic difficulty at stake, other factors that might determine eye movements are how the syntactic ambiguity is resolved/disambiguated, the goal of the task, or subjects' reading skill, among other possible factors.

There are two questions inherently related as regards syntactic parsing. One is the just exposed question of where effects of syntactic anomaly should be expected to surface (first fixation, first pass, etc..), and the second related question is what the eyes do when they encounter difficulty. Nevertheless, this technique is not exempt from limitations. Limitations have to do with the interaction between parsing and the eye movement control system. It is important to highlight that, as Vasishth et al. (2013) pointed out, eyes do not move in perfect synchrony with the parser, and the complexity of the eye-parser connection should be better developed in a detailed theory. One example of the eye-parser asynchrony is the perceptual span. The perceptual span is the information perceived at a particular fixation point. The perceptual span covers from 3 to 4 character spaces to the left of the centre of the fixation, and about 15 character spaces to the right of the fixation (Rayner et al., 1989). Open-class words will not be skipped normally (specially if they are longer than six letters), whereas functional words (which are normally short words) have a low fixation rate (approximately between 19%-38% chance of being fixated) (Rayner et al., 1988; Rayner et al., 1989). This can be

disadvantageous when a disambiguating word or a region of interest consists of a word that is either short or functional. Moreover, in some cases there seems to be some kind of asynchrony, or different offsets, in the connection between eye movements and mental processes. Spillover effects are another example that the eye-mind mapping is not perfect. These effects happen when uncompleted processing spills over from the end of one response measure to the beginning of another which immediately follows. This happens when certain aspects of processing are added to a queue or buffer so that they can be dealt with later. Spillover effects are oftentimes coded in the duration of a first fixation.

6.3 Testing effects of PR availability: an eye-tracking while reading study

This study aims at filling a gap in the research on PR/RC ambiguity. While the offline effects of PR-availability have been attested in a number of languages, the number of online studies is considerable more limited (Pozniak et al., 2019). In the present study, eye-tracking technique while reading was employed in an attempt to answer two questions. The first question asked how the process of PR/RC disambiguation takes place in real time. The second question is concerned with attachment preferences in RCs when PR-availability is controlled for. With that purpose in mind, an experiment was designed following classic studies in the RC attachment ambiguity literature, with temporary ambiguous sentences preceded by two potential antecedents and an ambiguous PR/RC which was eventually disambiguated toward high or low attachment. Gender morphology was used to trigger high or low attachment through gender agreement between the embedded verb and one of the two precedent DPs. The inclusion of an adjectival secondary predicate inflected with gender morphology, which only agreed with DP1 or DP2, followed the embedded verb. In the example in (2), for instance, the sentence is disambiguated toward high attachment when the adjective is 'contento' as it agrees in gender only with the first DP, and the sentence is low-attached when the adjective is'contenta'.

(2)   Nuno vio al entrenador$_{\text{MASC}}$ de la tenista$_{\text{FEM}}$ que lloraba contento$_{\text{MASC}}$ /contenta$_{\text{FEM}}$ por la victoria.
        'Nuno saw the coach of the tennis player (who was) crying *happily* for the victory.'

The selection of the depictive secondary predicates was carried out in accordance with semantic properties previously described in the literature. Concretely,

the attribute described by the predicate must be an intrinsic and transitory property, as noted by (Rothstein, 1983), and also by Hernanz Carbó (1988), who defended that only adjectives that can be predicated with the Spanish verb *estar* 'to be' (e.g. Sergio está estresado / 'Sergio is stressed out'), i.e. stage level predicates, are accessible to secondary predication, in opposition to adjectives that cannot be predicated with the verb 'to be' when it denotes a permanent state (the verb *ser* in Spanish) (e.g. *Sergio es estresado / 'Sergio is stressed out'), i.e. individual level predicates.

Gender disambiguation was chosen for a number of reasons. The first reason is that it allowed us to have a focused point of disambiguation, keeping length of the region equal, with minimal changes across conditions (in Spanish the gender morphemes for masculine and feminine just differ in one letter, with the substitution of the morpheme 'o' for masculine for the morpheme 'a' for feminine). These are major advantages in comparison to other sources of disambiguation such as number agreement or pragmatic information. In the first place, pragmatic information is oftentimes not focused in one word but rather spreads over a region of two or three words. Contrarily, number disambiguation can be focused on the singular/plural morpheme, but length of the words cannot be kept the same across conditions. Furthermore, number raises the problem of plural attraction effects, as plurals seem to attract adjunction of the RC across the board (Acuña-Fariña et al., 2014; Deevy, 2000).

To sum up, the goal of this study is twofold. The first goal is to test the online effects of PR-availability in Spanish using the [complex DP + 'que' clause] design with disambiguating information following the embedded verb. The second goal is to attest attachment preferences in Spanish in contexts which disallow PRs, i.e. were RC is the only possible parse. This is essential to test the alleged cross-linguistic variation in RC-attachment preferences. Following PR-*first*, if the PR-parse is projected at the matrix verb level, a cost of integration of the disambiguating word should be observed when this forces low attachment in PR-compatible contexts, since PRs can only take the first DP as the subject of the embedded clause. Therefore, low-attached sentences are expected to be harder to parse than high-attached sentences in the condition with perception verbs. In contrast, the pattern of results is expected to be right the opposite in RC-only contexts. If locality principles apply in Spanish, a processing cost should be observed in high-attached sentences following non-perceptual verbs.

Next section presents an eye-tracking while reading experiment, preceded by a norming study aimed at evaluating and controlling the plausibility of the target items.

6.4 Eye-tracking study

6.4.1 Participants

Forty-two European Spanish native speakers (mean age=21.33, SD= 5.38, 36 women) recruited at Universitat Rovira i Virgili (Tarragona, Spain) participated in the experiment in exchange for course credit. All had normal or corrected-to-normal vision, and reported no reading or other language-related disorders. All the participants gave their informed consent before taking part in the study and were naive as to the goals of the experiment.

6.4.2 Materials & Design

6.4.2.1 Norming study

A preliminary plausibility study with an initial pool of 61 target items was carried out to test the plausibility of the sentences to ensure that both interpretations (high and low) were equally plausible. Each item was presented in two versions: Version A contained sentences with a complex DP in the subject position, followed by the main verb, the adjective secondary predicate and a prepositional phrase or direct object. There is no ambiguity of Attachment here, as only DP1, the subject of the sentence, can agree with the secondary predicate. Version B contained a single DP subject followed by the main verb, the secondary predicate and a prepositional phrase or direct object. Therefore, there is only one minimal difference between both versions: version A contained the complex DP and version B only the DP that corresponds to DP2 in version A. Version A and version B correspond to the interpretation that obtains as a result of the RC disambiguation toward high and low attachment, respectively ((3)).

(3)   **Version A**
El dermatólogo$_{\text{MASC}}$ de la presentadora$_{\text{FEM}}$ reía dichoso$_{\text{MASC}}$ en la fiesta.
'The dermatologist of the presenter laughed happily at the party.'

(3)   **Version B**
La presentadora$_{\text{FEM}}$ reía dichosa$_{\text{FEM}}$ en la fiesta.
'The presenter laughed happily at the party.'

Seventy-seven European Spanish native speakers (mean age= 26.7, SD= 10, 40 women), who did not take part in the main experiment, evaluated the plausibility of each sentence in a Likert scale from 1 ("not plausible") to 5 ("very plausible"). Each participant evaluated the plausibility of only one version of each item, and versions were counterbalanced in each participant group. Only

pairs of sentences with scores greater than 3 in the two versions (i.e. rated as "fairly plausible") were preselected. From that selection, all pairs of sentences that showed significant differences in plausibility between both versions were discarded.

6.4.2.2 Final materials

Following the plausibility norming, a final set of 32 experimental items was selected to construct 32 quartets. Full list of target items is available at Appendix VI. Each quartet was composed of two sentences with perceptual matrix verbs and two sentences with non-perceptual matrix verbs. Half of the sentences with perceptual verbs were disambiguated towards DP1 (high attachment) and the other half towards DP2 (low attachment), using gender agreement between one of the antecedents and the adjective secondary predicated, and the same applies to sentences with non-perceptual verbs, following a latin square design. The gender of DP1 and DP2 was counterbalanced, as well as the gender of the disambiguating word. Moreover, lexical-semantic potential effects were controlled as both, antecedent DPs and disambiguating words, were matched for length, frequency, concreteness, arousal and valence (see Appendix V for detailed description).

An example of target sentences is presented in (4)[2]

(4)   a.   **Perceptual, High Attachment**
           Juan vio al entrenador$_{\text{MASC}}$ de la tenista$_{\text{FEM}}$ que lloraba amargado$_{\text{MASC}}$ por la derrota.
           'Juan saw the coach of the tennis player that wept bitterly for the defeat.'

      b.   **Perceptual, Low Attachment**
           Juan vio al entrenador$_{\text{MASC}}$ de la tenista$_{\text{FEM}}$ que lloraba amargada$_{\text{FEM}}$ por la derrota.
           'Juan saw the coach of the tennis player that wept bitterly for the defeat.'

      c.   **Non-perceptual, High Attachment**
           Juan conoció al entrenador$_{\text{MASC}}$ de la tenista$_{\text{FEM}}$ que lloraba amargado$_{\text{MASC}}$ por la derrota.
           'Juan met the coach of the tennis player that wept bitterly for the defeat.'

      d.   **Non-perceptual, Low Attachment**
           Juan conoció al entrenador$_{\text{MASC}}$ de la tenista$_{\text{FEM}}$ que lloraba amargada$_{\text{FEM}}$

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[2]Notice that this is just an example, the actual materials also include the configuration [DP1$_{\text{FEM}}$ of the DP2$_{\text{MASC}}$] in roughly half of the materials.

por la derrota.

'Juan met the coach of the tennis player that wept bitterly for the defeat.'

Seventy-five fillers were intertwined with target items. Fillers contained 16 unambiguous PRs, which contained proper nouns that cannot be modified by restrictive RCs (e.g. *El técnico de laboratorio observó a Rosa que estaba escribiendo las fórmulas en la pizarra*/The lab technician observed Rosa writing the formulas on the board) which were included to balance the number of unambiguous RCs in the condition with non-perceptuals (i.e. there is no PR/RC structural ambiguity with non-perceptuals, just Attachment ambiguity), following the procedure by B. Fernandes et al. (2018) to avoid adaptation/repetition effects. The rest of fillers consisted in sentences in active and passive voice without structural ambiguity. The total number of items were 107, and approximately one third of them (n=33) were followed by a comprehension question, which covered the content of the embedded clause or the matrix clause, but never the ambiguity resolution.

6.4.3   Procedure

Participants were tested individually using an EyeLink 1000 (SR Research) eye tracker to record eye movements while reading. Stimuli were presented at a constant distance of 60 cm from a 19-inch computer screen set to a resolution of $1{,}024{\times}768$ pixels. Viewing was binocular but only the right eye's movements were continuously recorded at a sampling rate of 1000 Hz. Sentences were presented in randomised order in a left-aligned single line in the center of the screen in black lowercase (Arial, 24). Before the experiment began, participants read the instructions and completed a short practice of 6 sentences to become familiar with the procedure.

Before each recording session, a calibration procedure using a standard 9 point calibration routine was performed. Recalibration took place after a break, and whenever necessary throughout the experiment. Before each trial, participants were asked to fixate on a fixation point on the left side of the screen to ensure proper gaze measurement and attention. The fixation point marked the beginning of the sentence, coinciding with the first letter, and the sentence would only display when participants' fixations were successfully detected on the fixation point. Stimuli were presented using SR-Research Experiment-Builder software.

6.4.4   Data analysis & Results

Accuracy rates in the answer to the comprehension question were above 75% for all participants. Prior to data analysis, trials with blinks, track loss, or data collection error were deleted. In addition, eye fixations under 80ms in duration were merged into longer fixations within the distance of the visual angle of 0.5. Remaining fixations shorter than 80ms or longer than 1000ms were deleted.

Analyses of target items were carried out on four regions as shown in (5) separated by the vertical pipe (|).

(5)   Juan vio al entrenador de la tenista | que | lloraba | contenta | por la victoria.
'Juan saw the coach of the tennis player that cried happily for the victory.'

The first region contained the 'que' word. This region is analysed in spite of its short length and high probability of being skipped because it might be informative to know what happened at the matrix verb level. If a PR-parse is projected at the matrix verb level, the integration of 'que' should be eased as it is part of the PR. Conversely, in the case of RCs, the encountering of 'que' is the point that necessarily triggers the computation of a restrictive reading.

The second region contained the embedded verb. The third region is the region of interest (RoI), which contained the disambiguating word: the adjective inflected with morphological gender information which agreed with just one of the antecedents (DP1 or DP2). In the example in (5) that word was 'contenta'. The fourth region contained the spillover region. This region contained between two and three words which in most cases formed a Prepositional Phrase (PP) (e.g. *por la victoria* in the example (5)).

Analyses were computed for four eye-movement measures, two of them considered early measures (first fixation and first pass duration), and two of them late measures (total times and go-past). First Fixation duration is the duration of the first fixation in a region, from the time the region is first entered from the left, until a subsequent fixation is made. First pass duration (also called first pass reading time) is the sum of all fixations in a region from first entering the region until leaving the region (either to the right or to the left), given that the region was fixated at least once. Go-past is the sum of fixation duration from the time the region is first entered from the left until it is exited to the right (including any fixations made to the left of the region). Total Time Duration is the summed duration of all fixations on the region, including re-readings. These measures

were log-transformed, and in the cases where the measure returned no data, that is, there were no fixations on the region, the trial was treated as a missing value in the analysis.

The first fixation measure was not computed at the spillover region given its length (between two and three words). In addition, two additional binary measures were also computed and reported for all regions with exception of the spillover region: skipping rates (coded 1 if the target region was fixated, and coded 0 if the region was skipped), and proportion of regressions out of the region (coded 1 if the fixation following first-pass fixation(s) on the target region was regressive, and coded 0 if the fixation following first-pass fixation(s) on the target region was progressive).

Data were analysed with R R Core Team (2018) fitting linear mixed effects model (Baayen et al., 2008) to the reading times data, implemented using the *lme4* package (Bates et al., 2015) for each dependent measure on each region of interest. The model included *Verb type* (Perceptual vs Non-perceptual) and *Attachment* (High vs Low) as fixed effects, with interaction term into the model, and participants and items as random effects. Analysis of the regressions and skipping measures were analysed using mixed effects logistic regression, with the same random and fixed factors (Jaeger, 2008). All predictors were contrast coded.

The results for each region will be discussed in the order in which the regions appear in the sentence.

Results at the 'que' region

Results for this region are summarised in table VII.1 for descriptive statistics and table VII.2 for inferential statistics available in the Appendix VII. There was a marginal effect of verb type, with longer total times when the matrix verb was non-perceptual (*coefficient*=0.09, *SE*=0.05, *z-score*=1.67, p<.09). In addition, there was significantly more skipping rates following perceptual verbs (*coefficient*=-0.40, *SE*=0.18, *z-score*=-2.25, p<.025).

Results at the embedded verb region

Results at this region are summarised in table VII.3 for descriptive statistics and table VII.4 for inferential statistics available in the Appendix VII. There were not any significant effect at any reading measure (all ps>.05). Only proportion of regressions-out showed increased probability to re-read previous regions in the condition with non-perceptual verbs (*coefficient*=0.42, *SE*=0.22, *z-score*=1.90, p<.05).

Results at the RoI

Results for this region are summarised in table for descriptive statistics VII.5 and table VII.6 for inferential statistics available in the Appendix VII.
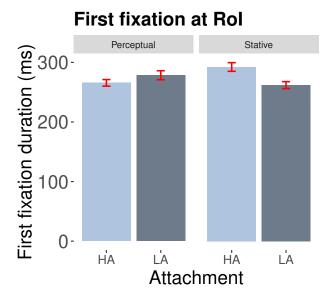
Figure 6.1: First fixation duration at the disambiguating word error bars represent SE
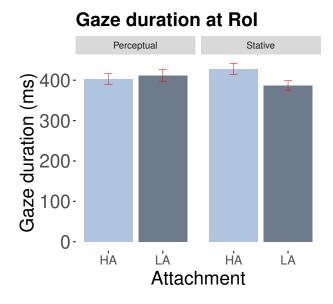
Figure 6.2: First pass at the disambiguating word (error bars represent SE)

The results of First fixation duration showed a significant effect of Attachment (*coefficient=-0.04, SE=0.02, z-score=-2.09*, p<.03), and a significant interaction between Verb type and Attachment (*coefficient=-0.12, SE=0.03, z-score=-3.09*, p<.001). The interaction is explained by a selective effect of Attachment in the condition with non-perceptual verbs (*coefficient=-0.101, SE=0.027, z-score=-3.682*, p<.001), low-attached sentences being read faster than high attached sentences, but no effect on perceptual verbs (*coefficient=0.021, SE=0.027, z-score=0.761*,

Figure 6.3: Total Reading times at the disambiguating word (error bars represent SE)

p=0.446), as depicted in Figure 6.1. The analyses of first pass delivered similar results. There was a marginal effect of Attachment (*coefficient*=-0.045, *SE*=0.025, *z-score*=-1.82, p<.06), and a significant interaction between Verb type and Attachment (*coefficient*=-0.1, *SE*=0.05, *z-score*=-2.21, p<.02), that again showed a selective effect on non-perceptuals (*coefficient*=-0.099, *SE*=0.035, *z-score*=-2.835, *p*=0.004) but not on perceptuals (*coefficient*=0.008, *SE*=0.036, *z-score*=0.237, *p*=0.812) (see Figure 6.2). In go-past there was a marginal effect of attachment (*coefficient*=-0.05, *SE*=0.03, *z-score*=-1.87, p<.06), with longer times for high-attached sentences. The analysis of Total reading time showed a significant interaction (*coefficient*=-0.11, *SE*=0.05, *z-score*=-2.02, p<.04). This time, further analysis indicated a selective effect of Attachment only in the condition with perceptuals (*coefficient*=0.087, *SE*=0.040, *z-score*=0.040, *p*=0.029), but not in the condition with non-perceptuals (*coefficient*=-0.024, *SE*=0.041, *z-score*=-0.598, *p*=-0.598). The effect of Attachment on perceptual verbs indicated an advantage of high-attached sentences (see Figure 6.3). Finally, there were no differences in skipping rates across conditions, but the probability of making regressive movements to previous regions was significantly higher in the case of non-perceptual verbs, as the analysis of Regressions-out showed (*coefficient*=0.35, *SE*=0.16, *z-score*=2.18, p<.02).

Results at the spillover region

Results for this region are summarised in table VII.7 for descriptive statistics and table VII.8 for inferential statistics available in the Appendix VII.

The results for first pass did not show any significant effects (all ps>.05).

Figure 6.4: Total Reading times at the spillover region (error bars represent SE)

In go-past, the analysis showed a significant effect of Attachment with longer times in low attachment than in high attachment (*coefficient*=0.10, *SE*=0.04, *z-score*=2.51, p<.01).

The results in total reading times showed a general cost of processing low-attached sentences (*coefficient*=0.08, *SE*=0.03, *z-score*=2.8, p<.004), and a selective effect of Attachment in perceptual verbs (*coefficient*=0.144, *SE*=0.041, *z-score*=3.513, p<.001), but not in non-perceptual verbs (*coefficient*=0.023, *SE*=0.045, *z-score*=0.524, *p*=0.599), showing processing costs of low-attached sentences under perceptual verbs, as Figure 6.4 shows.

6.4.5 Discussion

We conducted an eye tracking experiment aimed at investigating whether PR-effects and locality principles apply to Spanish in online processing of PR/RC ambiguities. With this aim, PR-licensing and PR non-licensing environments were tested in temporally ambiguous sentences, eventually disambiguated toward high or low attachment by means of gender agreement. The results of this research present new evidence from Spanish in support of the universality of principles of locality: online effects of locality apply to Spanish when PR-availability is controlled. The results also give support to the PR-*first* Hypothesis, as the PR-parse is preferred in ambiguous PR/RC sentences. This constitutes the first evidence in Spanish of online PR-effects.

In the case of RCs in PR-incompatible contexts, there was a steady processing cost when the RC was disambiguated non-locally, which arose immediately at the encounter of the anomaly and quickly recovered by the time the eyes move on

to the following region. This constitutes the first evidence of early local preference in Spanish in the RC attachment ambiguity literature. As such, our results contrast with previous findings in that, to date, a bias to high attachment preference has been observed in online studies in Spanish. Eye-tracking studies (Carreiras et al., 1999) reported a late preference (total reading times) for high attachment. Experiments with ERPs observed a modulation of the P600 waveform indicating syntactic reanalysis when RC was forced to attach low as reported (Carreiras et al., 2004). However, it is important to highlight that none of these online studies controlled for PR availability, which could crucially account for the difference in results.

In the case of PRs, there seemed to be no initial preference for neither low or high attachment. Instead, readers kept on reading the following region, without showing spillover effects, backtrack or re-readings of previous regions of the sentence. Eventually, in total reading time, readers seem to become aware of the anomaly and start to show integration costs of low-attached sentences only under perceptual verbs. Taking into account the higher skipping rates at the 'que' region following perceptual verbs, and the longer reading times in the condition with non-perceptuals, one possible interpretation of the data is that the PR-parse was strongly projected at the matrix verb level and readers initially overlooked disambiguating information, which was only eventually accessible for the parser.

The overlooking of gender or number features has been previously reported in the eye-tracking literature. One classic example is the work by Pearlmutter et al. (1999) with sentences like (6), in which the verb agreed or did not agree with the subject (the key) in number.

(6)   The key to the cabinet/cabinets was/were rusty from many years of disuse.

The results of that study showed no effect of the manipulation on the verb itself, except in late measures (total reading time), and in the following region. In the PR/RC literature there are also a few cases where disambiguation information was largely ignored. Grillo et al. (2015b) and Tomaz et al. (2014) showed increased number of comprehension errors when PRs were available and an RC reading was forced. Since our comprehension questions did not focus on the disambiguation information, question accuracy in function of item condition cannot be factored in to compute focalized shallow processing in the particular condition of perceptual verbs followed by PR-incompatible information.

Comparing with previous studies in the particular topic of PR/RC disambiguation, there is just one previous online study (Pozniak et al., 2019) which

showed effects in go-past at the disambiguating region. However, there are a number of important differences between the two studies. First of all, the eye-tracking study in Pozniak et al. did not involve attachment ambiguities, and while it did also manipulate verb type, this was crossed with a Tense manipulation which allowed to compare locally and globally ambiguous PR/RC sentences with globally unambiguous RCs. Independent properties of the processing of tense and the specifics of the experimental design in Pozniak et al. study (besides the fact that this study was in French) make the two experiments difficult to compare and might be accountable for the observed differences in location of the effect between the two studies. The principal difference is the availability of reliable cues in their experiment which made tense mismatch predictable. The tense manipulation in their experiment was performed in the matrix verb (present/past), whereas the embedded verb was always in past tense. Therefore, a matrix verb in present tense indicated a tense mismatch with the embedded verb which forced the RC-parse in otherwise PR-licensing contexts. This might explain regressions from the embedded verb to previous regions of the sentence in order to check for simultaneity requirements of PRs.

Both effects of PR-availability and locality can be explained by *Construal* theory. First, this theory assumes that arguments are preferred to adjuncts, and that seems to be the case in the preference for a PR projection (given that PRs are arguments) over an RC projection. Second, the parsing principle of Late Closure would favour low attachment in RC contexts, which clearly showed the data of this experiment. On the other hand, given that the data currently available on the frequency of PRs in Spanish (Aldama et al., 2017) appears to show that this structure is not very frequent, frequency-based theories, or any theory that assumes a central role of exposure to a specific syntactic structure, cannot easily account for these results.

Finally, *Unrestricted Race Models* would offer an alternative explanation based on the global or temporal ambiguity of each condition. The situation in terms of ambiguity is the following: the condition with perceptual verbs was three times ambiguous, and the condition with non-perceptual verbs was just two times ambiguous. The condition with perceptual verbs has a global PR/RC ambiguity, and also an attachment temporal ambiguity, eventually resolved. The condition with non-perceptual verbs solely contains a temporal attachment ambiguity. Unrestricted Race Models predicts an ambiguity advantage in cases of balanced ambiguity, provided that any interpretation is free to be adopted in globally ambiguous sentences. In contrast, disambiguated sentences might require several reanalysis, which computes as processing difficulty. Therefore, the degree of processing difficulty depends on how often the initial analysis had to be revised:

the more often the reanalysis, the greater the processing difficulty. In the cases of unbalanced ambiguities, the model predicts no difference between the globally ambiguous condition and disambiguated conditions toward the preferred structure, and both of them would differ from the disambiguated condition toward the dispreferred structure.

The question that arises now is whether PR/RC ambiguity is a balanced or an unbalanced ambiguity. Considering previous experiments in Spanish (see chapter 4), the preference in PR-licensing environments for high attachment is around 60% (which we interpret as a preference for PRs), and thus, preference for low attachment (interpreted as preference for RC) the other 40%. That means both structures are quite active in the race. In such cases, Unrestricted Race Model would predict an ambiguity advantage of the condition with globally ambiguous sentences, which is our case belongs to the condition with perceptual verbs and high attachment, because a high attachment resolution is compatible with both a PR and an RC parse, whereas in the condition with perceptual verbs and low attachment, the PR/RC ambiguity is resolved toward RC-parse. Therefore, the advantage in the former could be explained due to ambiguity advantage. However, we do not have an unambiguous PR-only condition to fully test the predictions of the Unrestricted Race Model.

6.4.6 Conclusion

The results presented here provide relevant information about two questions raised in the Introduction. The first question is what preferences do Spanish speakers have in RC attachment ambiguity, once the PR-availability is controlled for. The answer to this question is straightforward: the parser prefers to build local relations between the RC and nearest DP from very early on supporting locality principles. This finding makes an important contribution to the literature as Spanish, the first language reported to behave non-locally in the literature, aligns with languages like English in RC attachment preferences.

The second question asked how does the PR/RC ambiguity resolution takes place in time. Our results indicated that there is a clear effect of PR-availability in Spanish which surfaces in late reading measures, perhaps due to initial overriding of contradictory information. Overall, the results give support to PR-*first* Hypothesis, and point to PR-availability as a potential confounding which can partly explain cross-linguistic variability reported in the previous literature.

This evidence supports that cross-linguistic differences in RC attachment are reducible to grammatical factors and highlights the importance of controlling the availability of PRs in future research.

One limitation of this study is the interpretation of high attachment advantage as a preference for a PR reading, while in fact, RCs cannot be discarded as a possible parse. We address this issue in the next chapter, where we present the results of an additional eye-tracking while reading study which provides a more direct test of the online parse of PR/RC ambiguities, avoiding the additional complications raised by attachment ambiguities. We use aspectual restrictions on PR-availability to test the effects of forcing an RC reading of otherwise PR-compatible sentences.

SELECTIVE EFFECTS OF ASPECT IN THE PARSING OF (PSEUDO) RELATIVE CLAUSES

7.1 Introduction

The previous chapter showed the effects of PR-availability in the online parsing of temporary ambiguous PR/RC sentences, in which attachment resolution to either DP1 or DP2 was forced by means of gender agreement. In this chapter, we present preliminary results from a pilot study in an attempt to provide a more direct evidence of PR-preference while avoiding the complexities associated with attachment ambiguity. A different approach to explore PR/RC disambiguation is employed in this study building on the aspectual constraints associated with a PR interpretation. One of the constraints on PRs described in chapter 3 is that PRs only accept imperfective form in the embedded verb (1-a). We can interpret this as a consequence of the requirement that there must be a simultaneous reading between the main and the embedded predicate due to the fact that PRs in the environment of perceptual predicates denote directly perceived situations. Therefore, aspect can be used in a sentence such as (1-b) to force an RC-parse of an otherwise locally ambiguous sentence:

(1) a. Sara vio al   hombre que **estaba** corriendo.
         Sara saw DOM.the man   that was   running.
         Sara saw the man that was running.
     b. Sara vio al   hombre que **estuvo**   corriendo.
         Sara saw DOM.the man   that had.been running.
         Sara saw the man that had been running.

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The (preliminary[1]) results of the experiment presented in this chapter, which makes use of this property of Spanish aspectual morphology, provide more direct support for the PR-first Hypothesis.

The advantage of using a single DP, instead of the complex DP used in the previous study, is that this allows us to investigate the PR/RC disambiguation while avoiding potential confounds deriving from issues of plausibility, referentiality, among others, commonly associated to the resolution of ambiguity of RC attachment when two hosts in a complex DP are available. Before presenting the experiment, we summarize the results of two recent sets of studies in French, English and Italian which directly connect with the present experiment and briefly discuss some potential shortcomings they present. We will argue that the aspectual manipulation adopted here offers an elegant solution to these issues and complement the original results.

In two recent sets of experiments, Pozniak et al. (2019) and B. Fernandes et al. (2018) also employed PR constraints to allow/disallow a PR reading in French and Italian, respectively. Both studies, manipulated PR-availability through a manipulation of tense (mis)match between the matrix and the embedded verb. An example of the experimental design in Pozniak et al. (2019) is given in Table 7.1:

Verb Type	Tense	Example item
Perceptual	Match	*Jean **a vu** la fille qui **poussait** la femme.* John **saw** the girl that **pushed** the lady.
	Mismatch	*Jean **voit** la fille qui **poussait** la femme.* John **sees** the girl that **pushed** the lady.
Non-perceptual	Match	*Jean **était marié à** la fille qui **poussait** la femme.* John **was married to** the girl that **pushed** the lady.
	Mismatch	*Jean **est marié à** la fille qui **poussait** la femme.* John **is married to** the girl that **pushed** the lady.

Table 7.1: Example of experimental item from Pozniak et al. (2019).

In this design, the now familiar manipulation of verb type (perceptual/PR-taking vs. non-perceptual/RC-only) is crossed with a Tense manipulation (Match vs. Mismatch). Crossing these two factors allows to test the effects of forcing an RC

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[1]Due to time and financial constraints, at the time of writing we were only able to collect data from 28 participants. While the results are encouraging, this is a relatively small number for an eye-tracking study and we aim to collect twice as many for the paper version of this chapter.

reading on an otherwise PR-compatible environment. Of the four conditions this generates, only one is globally ambiguous between a PR and an RC reading (Perceptual Match). When the sentence contains a matrix perceptual verb followed by a Tense mismatch in the embedded clause, PR-first predicts that the parser's initial choice for the PR analysis will have to be revised once the mismatching tense is encountered. Longer fixation times are therefore expected for this region for Tense Mismatch than Tense Match, but only in the environment of perceptual verbs. This is because non-perceptual predicates only allow an RC reading of the embedded CP and the Tense manipulation is irrelevant for RCs.

Pozniak et al. (2019) found that forcing an RC reading in PR-compatible environments led to both lower acceptability and longer fixation duration at the disambiguation region (*pushed* in Table 7.1). However, as B. Fernandes et al. (2018) also show for Italian, the online effect in Pozniak et al. (2019) was susceptible to adaptation and disappeared in the second half of the experiment. B. Fernandes et al. (2018) argued that the experimental design of these studies introduced a reliable cue that triggered adaptation effects: whenever an RC-reading was forced in a PR-compatible environment, the matrix perceptual verb appeared in the present tense. In a follow-up offline acceptability study, B. Fernandes et al. (2018) showed that adding a small number of sentences with perceptual verbs in present tense followed by PRs was enough to significantly disrupt adaptation.

The current study presents an experimental design which avoids the presence of early cues that can potentially trigger adaptation and partly obfuscate the effect of PR-first. Spanish allows us to use aspectual disambiguation minimizing differences across condition: Perfective/Imperfective marking is achieved through morphological marking on the auxiliary (as in (1). In Spanish, furthermore, there is an almost complete ortographic overlap between the perfective (*estuvo*) and the imperfective (*estaba*) form, so that the matrix verb (and tense specification) can be kept identical across conditions, avoiding the effect of early cues, while the manipulation is just effected in the embedded auxiliary.

Therefore, sentences with perception verbs followed by perfective embedded aspect are just locally ambiguous until the aspectual form of the embedded verb disambiguated towards an RC parse. The simultaneous reading between main and embedded predicate only holds when the embedded aspectual form is imperfective. The use of perfective forces a shifted interpretation.

The work of Pozniak et al. (2019) and B. Fernandes et al. (2018) showed that tense match was preferred in PRs, but the results also show (at least numerically) a preference for tense match in RCs, an observation also supported by the previous literature on the processing of tense in embedded clauses (Abusch 1997; Dickey 2001; Enç 1987; Ogihara 1994; Stowell 2007, among many other). Tense

interpretation in embedded sentences has been widely investigated, particularly constructions with a past tense embedded under another past tense. In some languages, called Sequence of tense (SOT) languages, a construction like the example in (2) is ambiguous between a simultaneous reading and a back-shifted reading, although the preferred reading is the simultaneous one where the embedded past tense is not a semantically interpretable past tense conveying anteriority, but rather is considered a null, sometimes called zero tense, whose default interpretation is simultaneity with the matrix clause past tense.

(2)   John said that Mary was pregnant.

For other non-SOT languages such as Japanese (Ogihara, 1994) or Polish (Sharvit, 2014), a past-under-past construction encodes a back-shifted reading, and simultaneity is achieved through present-under-past constructions.
In Spanish, as a SOT language, tense match is preferably interpreted as a temporal overlap between the matrix eventuality and the embedded eventuality, which gives raise to simultaneity. A simultaneous reading of the main and the embedded predicate is supposed to facilitate reading in both, PRs and RCs, but the magnitude of the effect is expected to be bigger in the case of PRs. This effect indicates that PRs are preferred, because the penalisation on tense mismatch under perception verbs can be explained by the cost of integration of a mismatching tense under a PR-parse, and the subsequent (forced) RC-parse. Under non-perceptual verbs the parsing of tense mismatch might not be preferred but still is easier to integrate as tense is referential in RCs and largely dependent on the predicate semantics. For instance, in the case of tense mismatch, a non-simultaneous construal could take the shape of a back-shifted reading (3) or a future-shifted reading of the RC in function of the main predicate semantics.

(3)   a.   María dio a luz   al hombre que corrió la maratón.
             María gave to birth the man   that ran   the marathon.
             'María gave birth to the man who ran the marathon.'
        b.   María otorgó   un trofeo al hombre que corrió la maratón.
             María awarded a trophy the man   that ran   the marathon.
             'María awarded a trophy to the man who ran the marathon.'

The aim of this study is to investigate the PR-first hypothesis avoiding the complexities of attachment involved when two hosts are available. The advantage of this study in comparison to Pozniak et al. (2019) and B. Fernandes et al. (2018) is the avoidance of any reliable cue towards an RC resolution as items are identical until the disambiguation point. Moreover, the construal of temporal eventualities here uniquely depends on aspectual information.
The results of the two studies presented in what follows are preliminary. The first

study is an acceptability study meant to gather information about offline preferences. The predictions for this study, in line with PR-first, are higher acceptability scores for simultaneous readings than that for shifted readings in the condition with perception verbs, as the cost of having to integrate an RC forced by the aspect mismatch should be reflected in acceptability ratings. Whereas it is also expected to be a cost of aspect mismatch in the condition with non-perceptuals, the magnitude of the effect should not be equal to that in perceptuals, because reanalysis is not needed here. Hence, the effect, if present, is expected to be smaller than in PR-compatible environments. The second study is an eye-tracking experiment while reading aimed to test the online effect of PR-availability and the role of the simultaneity requirement of PRs building on aspectual constraints. The predictions here are the same as in the acceptability test.

7.2 Acceptability study

7.2.1 Method

7.2.1.1 Participants

Sixty participants (34 men) recruited in Prolific Academic participated in the experiment in exchange for a small fee. All participants were native speakers of European Spanish, were born in Spain and were living in this country at the time of the experiment. The participants did not have any language related disorder, and their ages ranged between 20 and 44 years old (mean age= 31 y.o.). The task lasted around 20 min to be completed.

7.2.1.2 Materials & Design

Twenty-four experimental sentences were constructed in 4 different versions each, following a 2x2 design combining Verb type (perceptual vs. non-perceptual) and Aspect (imperfective vs. perfective) in declarative sentences with Right Branching (Pseudo) Relative Clauses in Spanish. Full list of target items available at Appendix VIII. Each sentence had the following structure: DP + matrix-V + complex DP (DP1 of DP2) + CP (complementizer 'que' + embedded V). Half of the materials contained a perceptual matrix verb, the other half a non-perceptual matrix verb. Imperfective was the aspectual form in half of the materials, and perfective in the other half as in example (4).

The 24 target items and additional 71 fillers created 4 lists using a latin-square design. All fillers were grammatical and none of them contained RCs or PRs. Every sentence was followed by a comprehension question and the presentation of materials was counterbalanced.

(4)   a.   **Perceptual / Imperfective**

            Santiago vio al médico que estaba leyendo en la sala.

            'Santiago saw the doctor reading/that was reading in the room.'

    b.   **Perceptual / Perfective**

            Santiago vio al médico que estuvo leyendo en la sala.

            'Santiago saw the doctor that had been reading in the room.'

    c.   **Non-perceptual/ Imperfective**

            Santiago conoció al médico que estaba leyendo en la sala.

            'Santiago met the doctor that was reading in the room.'

    d.   **Non-perceptual / Perfective**

            Santiago conoció al médico que estuvo leyendo en la sala.

            'Santiago met the doctor that had been reading in the room.'

7.2.1.3   Procedure

The experiment was created with the programming website GORILLA. Data from five participants were excluded from analysis because accuracy in the answer to the comprehension question was less than 80%. Experimental sentences were presented one by one on the centre of the screen. Participants were instructed to read the sentences at their normal pace and select a punctuation in a 10-point Likert scale where 1 was completely unacceptable, and 10 completely acceptable. Participants next pressed the space bar and answered a yes/no question displayed in the centre of the screen. The comprehension question on target items comprised questions about the RC part (e.g. ¿Estaba el médico leyendo el periódico? / Was the doctor reading the newspaper?) and also about the main predicate (e.g. ¿Estaba Ana casada con un médico? / Was Anna married to a doctor?)."Yes"was the correct answer for half of the questions and "No"for the other half. All sentences including fillers were grammatical.

Before start, participants made a short 4 sentence practice to become familiar with the procedure. The experiment lasted around 15-20 minutes.

7.2.2   Data analysis & Results

Data were analysed with R Core Team (2018) fitting Cumulative link models (CLM) for ordinal data using the package 'ordinal' (Christensen, 2019). *Verb type* (Perceptual vs non-perceptual) and *Aspect* (Imperfective vs Perfective) were introduced as fixed factors, with interaction term into the model, and participants and items as random effects. All predictors were contrast coded.

The analysis showed a main effect of Verb type (coefficient=-0.3016, SE=0.1246, z=-2.420, p=.0155), a main effect of Aspect (coefficient=-0.5191, SE=0.1253, z=-4.144 , p<.0001), but no interaction (coefficient=0.3479, SE=0.2483, z=1.401,

Ana se casó con el bombero que estuvo corriendo en la maratón.

Completamente inaceptable | 1 2 3 4 5 6 7 8 9 10 | Completamente aceptable

Figure 7.1: Screenshot of the task

p=.161). There was no effect of item position (all ps<.05).

Table 7.2: Mean acceptability rates per condition

Perceptual		Non-perceptuals	
Imperfective	Perfective	Imperfective	Perfective
9.290	8.993	9.084	8.957

Mean acceptability rates
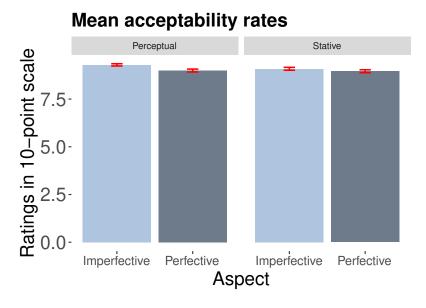
Figure 7.2: Mean proportion of PR-compatible continuations

7.2.3 Discussion

Not surprisingly, acceptability mean rates in all conditions were very high, as all sentences were perfectly grammatical. The results showed that sentences with perceptual verbs were rated as more acceptable than sentences with non-perceptual verbs. The results also showed that sentences with imperfective aspect were more acceptable than sentences with perfectives. This effect could be at least partly explained by the lower frequency of the auxiliary verb 'estuvo' in comparison to 'estaba'. The relative frequency (frequency of occurrence in parts per million) is 796,55 for the word 'estaba' and 87,58 for the word 'estuvo', as found in the corpus NIM Guasch et al. (2013).

Finally, although the difference between imperfectives and perfectives under perception verbs (0.297) was numerically greater than the difference found in non-perceptuals (0.127), the interaction was not significant. Perhaps the fact that all of the fillers were grammatical might have caused the lost of sensitivity of acceptability judgements due to disengagement. In fact, as it can be observed in Figure 7.2, ratings were very high in all conditions, which might have minimized the differences. Another possibility is that although Acceptability Judgements have been proved useful in Pozniak et al. (2019) and B. Fernandes et al. (2018), it might be due to the tense manipulation carried out in their experiments. Aspectual differences of the kind explored here might require a more fine-grained technique such as eye-tracking. Next experiment explores the time course of the PR/RC disambiguation in an eye-tracking while reading study employing the same materials as in the acceptability study. The predictions are that, if a PR-parse is projected after the encounter of a perception verb, perfective aspect should show selective cost of integration after perceptual verbs. Therefore, no effect of aspect is expected in the condition with non-perceptuals but a cost of integration of perfective aspect is expected in perceptuals.

7.3 Eye-tracking study

7.3.1 Method

7.3.1.1 Participants

Twenty-eight undergraduate students (mean age=21 y.o.) participated in the experiment after giving written informed consent. All were native speakers of European Spanish, had normal or corrected-to-normal vision, and reported no language-related disorders.

7.3.1.2 Materials

The materials for this experiment were the same materials and experimental design as in the Acceptability study (7.2.1.2).

7.3.1.3 Procedure

Participants were tested individually using an EyeLink 1000 eye-tracker (SR Research, Ontario, Canada) interfaced with a PC computer to record eye movements while reading. Stimuli were displayed on an CRT monitor, and chin and forehead rests were used to minimise head movements. Stimuli were presented at a constant distance of 60 cm from a 19-inch computer screen set to a resolution of $1,024 \times 768$ pixels. Viewing was binocular but only the participant's dominant eye movement was continuously recorded at a sampling rate of 1000 Hz. Sentences were presented in a centred single line in black text on a white background (Monaco, 11). Before the experiment began, participants read the instructions and completed a short practice of 6 sentences to become familiar with the procedure. Calibration was performed before the experiment, and when necessary throughout the experiment. Before each trial, a black box at the beginning of the sentence had to be fixated to trigger the onset of each sentence. One third of the items were followed by a comprehension question aimed at evaluate participant's attention and accuracy. The experiment lasted around 40 minutes.

UMass Eyetracking Lab Software was employed to implement the experiment (EyeTrack 7.10m) and analyze eye movement measures (EyeDry and SideEye).

7.3.2 Analysis & Results

Prior to analysis, trials with blinks, track loss or data collection error were deleted. A total of 37 trials were deleted on these base. In addition, eye fixations shorter than 80 ms in duration, and within one character of the previous or subsequent fixation, were incorporated into this neighbouring fixation. Remaining fixations shorter than 80 ms or longer than 1000 ms were deleted. 1.6% of fixations fell below the 80 ms cutoff, while a total of four fixations, none of which fell on a critical region, exceeded the 1000 ms cutoff. The space between words was included within the following or preceding word. Notice that the postcritical region excluded the final word of the sentence. This allowed us to interpret effects in this region as due to initial processing and hence conclude that they would not be contaminated by effects of sentence wrap-up (Just et al., 1980; Mitchell et al., 1978; Rayner et al., 2000; Rayner et al., 1989). Accuracy rates to comprehension questions were above 80% for all participants.

Initial analyses of target items were carried out on four regions as indicated in (5):

(5)   Santiago vio al médico que| estaba| leyendo| en la sala.
        Santiago saw the doctor that| was| reading| in the room.
        / / / / Region 0 / / / / / / |Region 1| Region 2| Region3.

Region 0 comprises the main predicate until the embedded verb (including the complenetizer 'que'). The region of interest (RoI) was region 1, the region that contains the auxiliar 'estaba' or 'estuvo', region 2 comprises the past participle, and region 3 the spillover region (i.e. the PP).

Three reading times measures were computed at each region. First-pass fixation times, also called gaze duration, is the sum of all fixations landing on the region when it is read through for the first time before leaving it, either to the left or to the right. Go-past time, also called regression-path, is the sum of all fixations from the first fixation until the reader leaves the critical region to the right, including any time spent to the left of the region, before moving on to the next region. Therefore, go-past time includes first-pass fixation times and regressive eye movements. Total time is the sum of all fixation duration within the region. An additional binary dependent measures was also computed, the proportion of trials where the region was skipped on the first pass (skipping rates).[2]

The reading times overall means and the proportion of trials on which there were regressions and skips can be found in table 7.3.

The proportion of trials on which the auxiliary (disambiguating) region was skipped on first pass reading, as shown in the table, was remarkably high (reaching in some cases 50% of the trials). Some analyses on this region delivered singular fit warnings and could only be carried out if random effects were removed. For that reason, following the description of the analyses of the data keeping the original division of regions, a second analysis is offered with a RoI merging the auxiliary and the verb region.

Data were analysed with R Core Team (2018) fitting Generalized Linear Mixed-Effects Models with binomial distribution using the package *lme4* (Bates et al., 2015). As fixed effects, we entered *Verb type* (Perceptual vs Non-perceptual) and *Aspect* (Imperfective vs Progressive), with interaction term into the model, and random intercepts for subjects and items. All predictors were contrast coded. The levels of the factor VERB TYPE were coded as 1/2 (Perceptual) and -1/2 (Non-perceptual), the levels of the factor ASPECT were coded as 1/2 (Imperfective) and

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[2]Due to a problem with *Side Eye*, the proportion of regressions could not be computed, and therefore, will not be reported in this chapter.

Table 7.3: Means (in ms) for reading time measures, and proportions for regressions and skipping measures, by condition, for each region.

	Main predicate	Auxiliary	Verb	Spillover
First pass				
Perceptual + Imp	2.408	280	347	640
Perceptual + Perf	2.287	280	414	641
Non-perceptual + Imp	2.906	285	319	627
Non-perceptual + Perf	2.563	323	327	624
Go-past				
Perceptual + Imp	2.408	497	439	1.802
Perceptual + Perf	2.287	426	476	1.925
Non-perceptual + Imp	2.906	427	508	2.035
Non-perceptual + Perf	2.563	524	566	1.885
Total time				
Perceptual + Imp	2.791	298	384	715
Perceptual + Perf	2.745	307	455	728
Non-perceptual + Imp	3.423	276	351	737
Non-perceptual + Perf	3.137	285	359	706
(p) skipping rates				
Perceptual + Imp	0,101	0,369	0,38	0,255
Perceptual + Perf	0,074	0,363	0,306	0,258
Non-perceptual + Imp	0,053	0,467	0,419	0,279
Non-perceptual + Perf	0,067	0,498	0,398	0,272

as - 1/2 (Perfective).

7.3.2.1   Analyses for regions auxiliary/ verb/ spillover

Auxiliary region

Analyses at this region have been affected by the high skipping rates, limiting statistical power. A summary of linear mixed-effect model estimate of effect of verb type and effect of aspect on each dependent measure, with SE of estimate, t or z value, and p-value for the auxiliary region is offered on table IX.1 available in Appendix IX. For reading time measures, a positive estimate on verb type reflects an increase in reading time (ms) in perceptual condition compared to non-perceptual. A positive estimate on aspect reflects an increase in reading time (ms) in perfective condition compared to imperfective condition. For regressions and skipping, a positive estimate on verb type reflects an increase in the proportion of regressions or skips in non-perceptual condition compared to the perceptual condition, and a positive estimate on verb type reflects an increase in the proportion of regressions or skips in perfective condition compared to imperfective condition. The same apply to the rest of tables presented in this chapter.

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The results in the auxiliary region showed significantly higher skipping rates in the condition with non-perceptual verbs (coefficient=0.49, SE=0.16, *z-score*=2.97, p=.002). In the rest of measures no significant effects were found (all p-values>.05). Analyses at First Pass reading times and Total reading time delivered singular fit warnings.

Verb region

Analyses at the verb region showed a main effect of Verb type at First-Pass time, with significantly longer reading times for perceptual than for non-perceptual verbs (coefficient=-0.09, SE=0.04, *t-score*=-2.09, p=.036). Although reading times are numerically higher in perfectives than imperfectives in the condition with perceptuals as shown in Figure 7.3, the interaction was not significant.

The pattern in total times on the verb region, depicted in Figure 7.4, matches that observed in First pass, that is, longer reading times in the condition with perception verbs and particularly when the aspect is perfective, although the difference was not reliable. Skipping rates were marginally higher in the conditions with non-perceptual verbs (coefficient=0.32, SE=0.17, *z-score*=1.86, p=.06) A summary of results for the verb region can be found on table IX.2 available in Appendix IX.
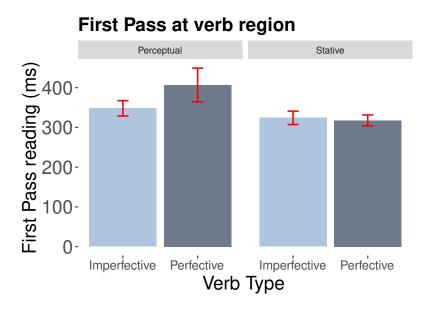
Figure 7.3: First Pass reading times at the verb region

Spillover region

No significant effects were found in this region (all p-values>.05). A summary of results at the spillover region can be found on table IX.3 available in Appendix IX.

Total time at verb region

Figure 7.4: Total Times at the verb region

Go–past at verb region
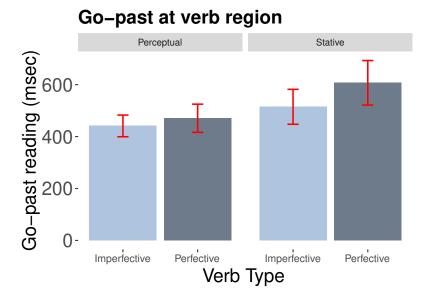
Figure 7.5: Go-past at the verb region

7.3.2.2 Analyses merging auxiliary and verb region

Since the perceptual span covers from 3 to 4 character spaces to the left of the centre of the fixation, and about 15 character spaces to the right of the fixation (Rayner et al., 1989), one possibility is that aspectual information was collected from the following region. In this section I present a new set of analysis merging the entire verb region (auxiliary + verb). The sentence was divided in regions in the following way. The RoI constituted by the auxiliary and the verb:

Santiago vio al médico que| estaba leyendo| en la sala.

Santiago saw the doctor that| was reading| in the room.

/ / / / / Region 0 / / / / / / / | Region 1 | Region 2.

In this section I will only present analyses on Region 1, where the auxiliary and
the verb region have been merged, as the analyses of the spillover region have
been presented in the previous section.

Mean reading times and proportion of regressions and skipping rates across con-
dition can be found in table 7.4.

Table 7.4: Mean reading times (ms) and proportion of regressions and skips at
the RoI (aux + participle) across conditions.

Condition	First pass	Go-Past	Total times	Skips
Perception+Imp	520.845	775.308	669.626	0.259
Perception+Perf	580.240	740.536	753.785	0.233
Non-perceptual+Imp	492.754	789.201	624.455	0.317
Non-perceptual+Perf	505.646	888.132	640.557	0.315

A summary of linear mixed-effect model estimate of effect of verb type and effect
of aspect on each dependent measure, with SE of estimate, t or z value, and p-
value for the auxiliary and verb merged region is offered on table 7.5. For reading
time measures, a positive estimate on verb type reflects an increase in reading
time (ms) in non-perceptual condition compared to perceptual. A positive esti-
mate on aspect reflects an increase in reading time (ms) in perfective condition
compared to imperfective condition. For skips, a positive estimate on verb type
reflects an increase in the proportion skips in non-perceptual condition compared
to the perceptual condition, and a positive estimate on verb type reflects an in-
crease in the proportion of skips in perfective condition compared to imperfective
condition.

Table 7.5: Linear mixed-effect model estimate of effect of verb type and effect of
aspect on each dependent measure, on the auxiliary and verb merged region, with
SE of estimate, t or z value, and p-value.

Measure	Region	Estimate	SE	t/z-value	p value
First pass time	Verb type	-0.088	0.053	-1.651	0.098
	Aspect	0.061	0.053	1.146	0.251
	Verb * Aspect	-0.082	0.107	-0.765	0.444
Go past time	Verb type	0.058	0.061	0.952	0.340
	Aspect	0.040	0.061	0.656	0.511
	Verb * Aspect	-0.013	0.123	-0.111	0.910
Total times	Verb type	-80.712	42.556	-1.896	0.057
	Aspect	52.092	42.530	1.224	0.220
	Verb * Aspect	-72.596	85.049	-0.853	0.393
Skipping rates	Verb type	0.427	0.189	2.261	0.023
	Aspect	-0.091	0.188	-0.487	0.626
	Verb * Aspect	0.173	0.376	0.461	0.644

First–Pass at verb region (aux+verb)

Figure 7.6: First Pass reading times at the RoI region (aux+verb)

Total time at verb region
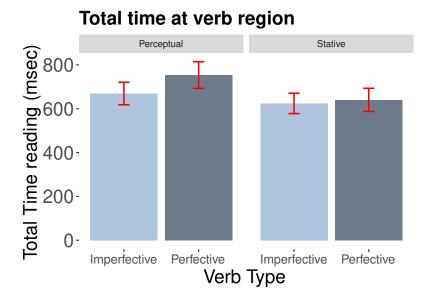
Figure 7.7: Total reading times at the RoI region (aux+verb)

First-Pass reading times were numerically larger in the condition with perfective aspect under perceptuals ($\approx$60ms vs. $\approx$12ms effect under non-perceptual verbs), as illustrated in Figure 7.6, the difference, albeit considerable, was only marginally significant. No effects were found in go-past reading times (all p-values>.05), however, the pattern of results shows an asymmetry in Go-past, where the effect of aspect goes in opposite directions for both type of verbs (see Figure 7.8). The results on total reading times showed a marginal effect of Verb type, with longer reading times for perceptuals. Once again, it seems that the difference might be due to increased times in the condition with Perfectives, as illustrated in Figure 7.7, but the interaction is not significant. In line with results from previous section, skipping rates were significantly more frequent in
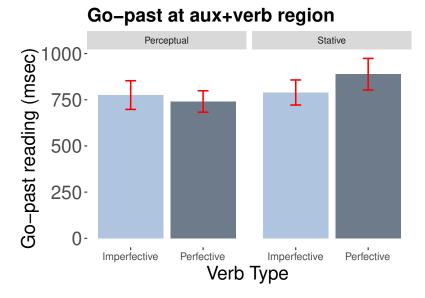
Figure 7.8: Go-past at the RoI region (aux+verb)

non-perceptuals.

7.3.3 Discussion

The results of this pilot study show an effect of verb type, with longer reading
times in the condition with percepual verbs. The results seem to be explained
by a selective effect of aspect across verb type, with numerically longer reading
time for perfective under perceptual than non-perceptual verbs. At this stage of
the experiment, the data only shows a numerical difference although the effect is
already perceivable in the figures.

The first set of analyses were performed at the auxiliary region, the verb region,
and the spillover. The verb was split into auxiliary and main verb because
information gathered at the auxiliary region is essential to disambiguate the
temporal ambiguity. However, skipping rates at this region are very high,
lowering statistical power to run analyses (and for that reason, auxiliary and
verb are merged in the second set of analyses). At the verb region, there is an
effect of Verb type at First pass time, which looking at the Figure 7.3 might be
facilitated by the selective effect of perfectives on perceptuals (although for now
the difference is just numerical). The second set of analyses were performed in
the joint auxiliary and verb region. Analyses at this region showed longer reading
times under perception verbs than in non-perceptual verbs, with a selective
numerical increase in the condition of perfectives that does not reach significance,
in first-Pass and total times.

In spite of the preliminary stage of this study, and the subsequent limitations, i.e.

small sample size and lack of statistical power, some conclusions can be drawn. The parser was apparently 'aware' of the PR/RC ambiguity, and consulted aspectual information contained in the auxiliary verb to disambiguate. The increased reading times found in the condition with perception verbs were specially high when aspect was perfective, which seems to indicate a cost of integration as predicted if a PR-parse was already projected.

Another fact that draws attention is the large percentage of skipping rates at the auxiliary region following non-perceptual verbs. If we look at the values, the auxiliary region was skipped nearly half of the time when preceded by a non-perceptual verb. The data seems to indicate that readers strategically turned their attention to the auxiliary region particularly after the encounter of a perception verb because the auxiliary contains useful information to resolve the PR or RC ambiguity. In the case of non-perceptual verbs, the aspectual information contained in the auxiliary is comparatively less relevant, as there is no structural ambiguity, and that might explain the significant increased probability of skipping over that region. Nevertheless, it cannot be affirmed that aspectual information was completely ignored in the condition with non-perceptual verbs, as this information could have been collected from the following word.

The fact that readers' reading strategy differed in both conditions is informative about the parser awareness of the PR/RC ambiguity and the role of aspect in the process of disambiguation. Aspect does have a double function in sentences with perceptuals verbs, that is, it does not only contribute to the construal of the temporal relation between Reference Time and Event Time, as it's also standard under non-perceptual verbs, but also to disambiguate between PR and RC reading. In spite of that, the high skipping rates found in this condition are surprising, given the importance of the temporal information contained in the aspectual form it should not to be overlooked.

That result would also support a PR-based account of Pozniak et al. (2019)'s findings: it is the simultaneity requirement of PRs which triggers the effect, rather than the Tense manipulation itself. Pozniak et al. found PR-effects in go-past time and proportion of regressions out. In the current study, there was not any effect in go-past. Since in their study the variable tense match/mismatch was determined by the matrix verb tense (embedded verb was always in past tense but main verb was past in half of the items and present in the other half), regressions might have been directed at the matrix verb region in order to check for (non)/simultaneity.

CONCLUDING REMARKS AND FUTURE DIRECTIONS

Overall, the results of this thesis support the PR-first Hypothesis and suggest that cross-linguistic variation in RC attachment is epiphenomenal and largely attributable to the asymmetric availability of PRs across languages.

Chapter 3 and Chapter 5 provide detailed information on PR-licensing contexts that might be useful for future research on RC attachment preferences to avoid the PR confound.

One of the aims of this work was to expand the empirical coverage of the effects of PR-availability to include languages not previously tested. Spanish was tested in this work through a number of offline and online experiments (two attachment questionnaires, two acceptability judgements, one sentence completion task and two eye-tracking while reading studies). The results have been robust across experiments in a variety of different research methods. The two attachment questionnaires in Chapter 4 showed there is an effect of PR-availability in Spanish, which is likely to (at least partly) explain previous findings in the literature. In the absence of PRs, this study showed local attachment is preferred.

This study also explored the interaction of PR-preference with other additional variables, in particular aspectual information, in the resolution of PR-RC ambiguities. The effect of aspect investigated in this study is quite novel in the literature. The differences between generics and definites are well known in the literature on nominals; generics being easier to parse out the blue. However this advantage has never been translated to the sentential distinction between habituals and episodic readings. The results of the acceptability judgement study showed that indeed, generic sentences (i.e. with imperfectives) are more acceptable

than episodic ones (i.e. with progressives) when the contrast takes place at the main predicate (simple active sentences) and when the contrast takes place in the embedded predicate (in the RC). Building on these results, experiments 4.5 and 4.6 in Chapter 4 directly tested the potential effects of generics in PR/RC ambiguities. The two variables should be expected to modulate parsing preferences in opposite directions: PR-availability favours high attachment while availability of a preferred habitual reading should favour an RC parse, resulting in a stronger pull towards low attachment. The results indicated that the effect of generics could not override the effect of PR-availability. Exploratory results showed that availability of habituals, however, did seem to interact with the strength of cumulative exposure/adaptation effects and modulate (but not reverse) preferences.

Another novel contribution of this work is the extension of the current research of PR-effects to the domain of generation/production (Chapter 5). The results of two sentence completion tasks paint a starkly different picture across Spanish and English. The experiment demonstrates a strong regularity in Spanish speakers' choice of words when completing sentences embedded under perceptual predicates (i.e. in PR-compatible environments). These regularities (observed in roughly 50% of the sentence completion), include the use of eventive predicates in the imperfective aspect and matching tense between the matrix and embedded predicate, i.e. all characteristics of PR-compatibility. Importantly, these regularities are not observed in the environment of non-perceptual predicates, where only RCs are licensed. Furthermore, this contrast between eventive and non-perceptuals is not observed in English, where the same pattern is observed across verb type.

This study exploits the idea of a single mechanism for parsing and generation to extend the *PR-first Hypothesis* to the generation domain. Moreover, the detailed set of criteria designed specifically for the analysis of the results of this experiment can also be of help in future corpus studies to determine which answers are compatible with a PR-interpretation and which are incompatible.

The final goal of this dissertation has been to investigate the time course of the disambiguation process in PR/RC ambiguity resolution, explored in Chapter 6 & 7. Two eye-tracking while reading experiments were designed for this purpose. The first experiment tested local PR/RC ambiguities using the classic [matrix verb + complex DP + que clause] constructions with perceptual and non-perceptual matrix verbs, using gender morphology as a means of disambiguation. The results showed a steady processing cost when the RC, in PR non-licensing environments, was disambiguated non-locally, and conversely, processing costs arose when local

attachment was forced in PR licensing environments. These results support both principles of locality and PR-first respectively. As regards timing, the time course of both effects was very different. Locality effects were already measurable at the critical region and quickly recovered by the time the eyes move on to the following region. In contrast, the effect of PR-availability surfaced later on in total reading time. No effect of disambiguation seemed to happen at the first reading of the sentence, and only latterly did readers seem to become aware of the anomaly and start to show integration costs only when sentences were low-attached under perceptual verbs.

One way of looking at the results is to consider the hypothesis that the eventive reading might already be preferred at the matrix verb level. The higher skipping rates at the 'que' complementizer region following perceptual verbs, and the longer reading times in the condition with non-perceptuals, support this interpretation of the data. It seems that readers initially overlooked disambiguating information, which was only latterly accessible for the parser. Future experiments might explore the effect of the addition of questions after target items directly tackling at the resolution of the ambiguity (e.g. Who was reading the newspaper?) to direct participant's attention. Alternatively, a visual world experiment could help us shed light on whether there is anticipation. In an experiment with two figures corresponding to the two DPs and two distractors, more fixation on the picture representing DP1 in comparison to figure representing DP2 would be expected from the start of the embedded clause and before disambiguating information.

Finally, the second eye-tracking experiment provides preliminary results. This experiment is designed to provide a more direct test of PR-first avoiding (high-/low) attachment ambiguities. The experiment also attempts to improve previous experiments by employing aspectual disambiguation of the embedded predicate instead of tense. The results showed longer reading times in the condition with perceptuals in comparison to non-perceptuals. Looking at the numbers and plots, longer times in perceptuals seem to be explained by disruption when aspectual information is incompatible with PR-interpretation, although the interaction at this point is not significant. The results of this pilot study, although not conclusive at this stage, point towards a selective disruption of perfective aspect (incompatible with PRs but compatible with RCs) exclusively in the environment with perceptual verbs in line with PR-first predictions.

This has important implications at different levels. First and foremost, the results are relevant for theories of sentence comprehension. Although more research

needs to be done to fully validate the PR-first Hypothesis, it seems that its predictions can accurately predict the results reported so far. An important implication of this is to reinstate principles of locality as potential parsing universals, with RC attachment not to be considered an exception any longer. As mentioned before, future research on RC attachment might benefit from the description about PR-licensing and not licensing contexts offered in Chapter 3 and Chapter 5 to avoid the PR confound.

Looking ahead, the present results are also relevant for research on bilingualism. An important number of studies on the influence of L1 on L2, and viceversa, have been performed in English and Spanish, especially research carried out in the United States given the demographics of the country. The phenomenon of attrition has also been widely studied in these two languages. Some of this research (Dussias, 2004; Dussias et al., 2007; Fernández, 2003; Jegerski, Keating, et al., 2016; Jegerski, VanPatten, et al., 2016) builds on the assumption, justified by earlier findings in the RC-attachment literature, that there are fundamental differences in parsing strategies across languages, when in fact, these differences appear to be reducible to a grammatical factor (i.e. PR availability) that was previously neglected. If this factor continuous to be ignored, and thus not controlled in the design of the experiments, that would lead to biased conclusions in the bilingual literature. Nevertheless, as discussed in Chapter 3, PR-availability is not a unitary phenomenon and much variation is often observed even within the same language. Add to this that much less is known about PR-availability in the rich varieties of Latin American Spanish and it becomes clear that it is highly desirable i. to determine the status of PRs in different varieties of Spanish (using, for instance, grammaricality or acceptability judgements) and ii. to test the predictions of PR-first for these varieties while also comparing the processing of RC-attachment in (Latin American) Spanish and (North American) English. Preliminary data from a questionnaire we performed with Costa Rican native Spanish speakers seem to indicate PRs are also available in this language (albeit perhaps less commonly used than in European Spanish), but further research is needed both at the grammatical and processing level.

A wider question that we have just started to answer asks where the PR/RC disambiguation takes place. The results of this work suggest the PR is already projected at the matrix verb level. The question we raise is whether, more generally, translating this discussion to the semantics, the choice at the perceptual verb is to opt for an event. This hypothesis would explain results in Grillo et al. (2015a) where the PR-first was extended to SC-first following the results found in English SCs. Initial preference for the selection of an event would later move into the specific syntactic form of a PR. This makes sense considering the incremental nature of parsing. As words are incrementally integrated into the parse, there is a choice

to be made after the encounter of a perceptual matrix verb. Perceptual verbs can take entities (e.g. I saw the man) or events (e.g. I saw the man running). If anticipation takes place at this point, that is, if there is a choice to be made between the projection of an entity or an event, events should be preferred for semantic and pragmatic reasons.

One of the reasons why events should be preferred is because, out of a licensing context, the perception of a definite (e.g. I saw the man), or indefinite (e.g. I saw a man) entity it is not felicitous. In the former case a previous referent in the discourse is needed, the second case implies that for some reason, it is remarkable to see a man (e.g. in a situation of lockdown where the streets are supposed to be empty). In comparison, a sentence such as e.g. *I saw a man running*, is more informative and should be more easily accepted. The PR-first Hypothesis made the claim that, other factors being equal, PRs should be preferred, but it does not specify where this preference should take place. The results of this thesis suggest that PRs (or events) are preferred at the matrix verb level.

There are some limitations of this work. For instance, the potential advantages of simultaneous versus shifted construals applicable to experiments where tense/aspect of the embedded clause is manipulated to allow/disallow the PR-reading (Chapter 7) is avoided in this experiment. Simultaneity might be easier to parse provided that the event time of the embedded predicate is anchored in the event time of the main predicate and thus, it happens locally in the domain of the sentence, while in the case of non-simultaneity it may require further contextual information.

Another potential limitation concerns the assumption that high attachment in PR-compatible contexts responds to a preference for a PR-parse. The materials used in the experiments presented in this dissertation, following standards in the literature, compare PR/RC ambiguous sentences with RC sentences. In a strict latin square design, differences between conditions should be reducible to just the manipulation carried out (i.e. in most cases the option of a perceptual or a non-perceptual matrix verb). In such a situation, differences between both conditions can be ascribed to the effects of the manipulation, in this case, the availability of PRs. However, it is important to notice that high attachment in a PR/RC context does not have to necessarily correspond to a PR parse, as RCs are also allowed in this context. Since a basic difference between a condition with perceptual verbs and a condition with non-perceptual verbs is the availability of PRs in the former, it is licit to assume the effect is due to the availability of PRs.

Finally, as already pointed out in Chapter 6, the fact that the experimental design used in the experiments presented in this thesis contrasts ambiguous PR/RC

condition versus unambiguous[1] RC condition, which leaves room for *Unrestricted Race Models* to offer an alternative explanation based on the global or temporal ambiguity of each condition. Whereas the condition with perceptual verbs was three times ambiguous (a globally PR/RC ambiguity, and also an attachment temporal ambiguity, eventually resolved), the condition with non-perceptual verbs was just two times ambiguous (i.e. only contains a temporal attachment ambiguity). The Unrestricted Race Models predicts an ambiguity advantage in cases of balanced ambiguity, provided that any interpretation is free to be adopted in globally ambiguous sentences. In contrast, disambiguated sentences might require several reanalyses, which computes as processing difficulty. Therefore, the degree of processing difficulty depends on how often the initial analysis had to be revised: the more often the reanalysis, the greater the processing difficulty. In the cases of unbalanced ambiguities, the model predicts no difference between the globally ambiguous condition and disambiguated conditions toward the preferred structure, and both of them would differ from the disambiguated condition toward the dispreferred structure. In cases of balanced ambiguities (as is the case of PR/RCs), Unrestricted Race Model predicts an ambiguity advantage of the condition with globally ambiguous sentences (i.e. the condition with perceptual verbs and high attachment), because a high attachment resolution is compatible with both a PR and an RC parse, whereas in the condition with perceptual verbs and low attachment, the PR/RC ambiguity is resolved toward RC-parse. Therefore, the advantage in the former could be explained as a result of an ambiguity advantage. It is important to notice, however, that since we do not have an unambiguous PR-only condition, the predictions of the Unrestricted Race Model cannot be fully tested. A potential solution to this in future research might be to include an additional condition with pseudo-clefts that can only introduce PRs (e.g. Lo que vi fue a la chica que estaba corriendo/What I saw was the girl that was running) or RCs (e.g. A quien vi fue a la chica que estaba corriendo/Who I saw was the girl that was running).

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[1]This condition is just ambiguous in terms of high/low attachment, but unambiguous as PR/RC are concerned

Bibliography

Abdelghany, H., & Fodor, J. D. (1999). Low attachment of relative clauses in Arabic, In *Poster presented at AMLaP (Architectures and Mechanisms of Language Processing)*.

Abusch, D. (1997). Sequence of tense and temporal de re. *Linguistics and philosophy*, 1–50.

Acuña-Fariña, C., Fraga, I., García-Orza, J., & Piñeiro, A. (2009). Animacy in the adjunction of Spanish RCs to complex NPs. *European Journal of Cognitive Psychology*, *21*(8), 1137–1165.

Acuña-Fariña, J. C., Meseguer, E., & Carreiras, M. (2014). Gender and number agreement in comprehension in Spanish. *Lingua*, *143*, 108–128.

Albrecht, J. E., & O'Brien, E. J. (1993). Updating a mental model: Maintaining both local and global coherence. *Journal of experimental psychology: Learning, memory, and cognition*, *19*(5), 1061.

Aldama, N. (2018). The object-gap pseudorelative generalization. *Borealis–An International Journal of Hispanic Linguistics*, *7*(1), 169–179.

Aldama, N., & Moreno, A. (2017). Spanish (proper noun-head) pseudorelatives: A corpus-based study of frequency. *Research in Corpus Linguistics*.

Almor, A. (1999). Noun-phrase anaphora and focus: The informational load hypothesis. *Psychological review*, *106*(4), 748.

Altmann, G., Garnham, A., & Dennis, Y. (1992). Avoiding the garden path: Eye movements in context. *Journal of Memory and Language*, *31*(5), 685–712.

Altmann, G., & Steedman, M. (1988). Interaction with context during human sentence processing. *Cognition*, *30*(3), 191–238.

Angelopoulos, N. (2015). *Explorations of (Greek) pseudo-relatives* (Master's thesis). UCLA.

Anwyl-Irvine, A., Massonnié, J., Flitton, A., Kirkham, N., & Evershed, J. (2019). Gorilla in our Midst: An online behavioral experiment builder. *bioRxiv*, https://www.biorxiv.org/content/early/2019/02/25/438242.full.pdf. https://doi.org/10.1101/438242

Baayen, R. H., Davidson, D. J., & Bates, D. M. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of memory and language*, *59*(4), 390–412.

Bader, M. (1998). Prosodic influences on reading syntactically ambiguous sentences, In *Reanalysis in sentence processing*. Springer.

Barwise, J. (1981). Scenes and other situations. *The journal of Philosophy*, *78*(7), 369–397.

Barwise, J., & Perry, J. (1983). Situations and attitudes. 1983. MIT Press, Cambridge, MA.

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models using lme4. *Journal of Statistical Software*, *67*(1), 1–48. https://doi.org/10.18637/jss.v067.i01

Bergmann, A., Armstrong, M., & Maday, K. (2008). Relative clause attachment in English and Spanish: A production study, In *Proceedings of speech prosody*. Citeseer.

Bever, T. G. (1970). The cognitive basis for linguistic structures. *Cognition and the development of language*, *279*(362), 1–61.

Binder, K. S., Duffy, S. A., & Rayner, K. (2001). The effects of thematic fit and discourse context on syntactic ambiguity resolution. *Journal of Memory and Language*, *44*(2), 297–324.

Bock, J. K. (1986). Syntactic persistence in language production. *Cognitive psychology*, *18*(3), 355–387.

Bock, K., & Loebell, H. (1990). Framing sentences. *Cognition*, *35*(1), 1–39.

Brito, A. M. B. d. (1995). Sobre algumas construções pseudorelativas em Português.

Brugè, L., & Brugger, G. (1996). On the accusative a in Spanish. *Probus*, *8*(1), 1–52.

Brysbaert, M., & Mitchell, D. C. (1996a). Modifier attachment in sentence parsing: Evidence from dutch. *The Quarterly Journal of Experimental Psychology Section A*, *49*(3), 664–695.

Brysbaert, M., & Mitchell, D. C. (1996b). Modifier attachment in sentence parsing: Evidence from dutch. *The Quarterly Journal of Experimental Psychology Section A*, *49*(3), 664–695.

Burzio, L. (1986). *Italian syntax: A government-binding approach* (Vol. 1). Springer Science & Business Media.

Carlson, G. (2012). Habitual and generic aspect (R. I. Binnick, Ed.). In R. I. Binnick (Ed.), *The oxford handbook of tense and aspect*. OUP.

Carlson, G. (2019). Genericity (P. Portner, K. Heusinger, & C. Maienborn, Eds.). In P. Portner, K. Heusinger, & C. Maienborn (Eds.), *Semantics – noun phrases and verb phrases*. Walter de Gruyter GmbH & Co KG.

Carreiras, M. (1992). Estrategias de análisis sintáctico en el procesamiento de frases: Cierre temprano versus cierre tardío. *Cognitiva*, *4*(1), 3–27.

Carreiras, M., & Clifton, C. (1993). Relative clause interpretation preferences in Spanish and English. *Language and speech*, *36*(4), 353–372.

Carreiras, M., & Clifton, C. (1999). Another word on parsing relative clauses: Eyetracking evidence from Spanish and English. *Memory & Cognition*, *27*(5), 826–833.

Carreiras, M., Salillas, E., & Barber, H. (2004). Event-related potentials elicited during parsing of ambiguous relative clauses in Spanish. *Cognitive Brain Research*, *20*(1), 98–105.

Casalicchio, J. (2013). *Pseudorelative, gerundi e infiniti nelle varietà romanze: Affinità (solo) superficiali e corrispondenze strutturali* (PhD dissertation). Università degli Studi di Padova.

Chang, F., Dell, G. S., Bock, K., & Griffin, Z. M. (2000). Structural priming as implicit learning: A comparison of models of sentence production. *Journal of psycholinguistic research*, *29*(2), 217–230.

Chomsky, N. (1957). Syntactic structures (The Hague: Mouton, 1957). *Review of Verbal Behavior by BF Skinner, Language*, *35*, 26–58.

Christensen, R. H. B. (2019). Ordinal—Regression Models for Ordinal Data [R package version 2019.4-25. http://www.cran.r-project.org/package=ordinal/].

Christianson, K., Hollingworth, A., Halliwell, J. F., & Ferreira, F. (2001). Thematic roles assigned along the garden path linger. *Cognitive psychology*, *42*(4), 368–407.

Chun, E. (2018). *The role of prediction in adaptation: An evaluation of error-based learning accounts* (Doctoral dissertation). University of Florida.

Cinque, G. (1992). The Pseudo-Relative and Acc-*ing* constructions after verbs of perception, In *University of venice working papers in linguistics*. Università di Venezia.

Cinque, G. (1995). *The pseudo-relative and ACC-ing constructions after verbs of perception*. Università degli studi di Venezia.

Clifton Jr, C., & Staub, A. (2011). Syntactic influences on eye movements during reading. *eye*, *3*(2).

Clifton Jr, C., Staub, A., & Rayner, K. (2007). Eye movements in reading words and sentences, In *Eye movements*. Elsevier.

Clifton Jr, C., Traxler, M. J., Mohamed, M. T., Williams, R. S., Morris, R. K., & Rayner, K. (2003). The use of thematic role information in parsing: Syntactic processing autonomy revisited. *Journal of Memory and Language*, *49*(3), 317–334.

Cohen, J., MacWhinney, B., Flatt, M., & Provost, J. (1993). Psyscope: An interactive graphic system for designing and controlling experiments in the psychology laboratory using Macintosh computers. *Behavior Research Methods, Instruments, & Computers, 25*(2), 257–271.

Connine, C., Ferreira, F., Jones, C., Clifton, C., & Frazier, L. (1984). Verb frame preferences: Descriptive norms. *Journal of psycholinguistic research, 13*(4), 307–319.

Costa, J., Vaz, S., Fernandes, B., & Grillo, N. (2016). Pseudo-relatives and PIC in the parsing and acquisition of European Portuguese. *Probus, 28*, 119–143.

Crain, S., & Steedman, M. (1985). On not being led up to garden path: The use of context by the psychological parser (D. Dowty, L. Karttunen, & A. Zwicky, Eds.). In D. Dowty, L. Karttunen, & A. Zwicky (Eds.), *Natural language processing: Psychological, computational, and theoretical perspectives.* Cambridge University Press.

Cuetos, F., Mitchell, D., & Corley, M. (1996). Parsing in different languages (M. Carreiras, J. García-Albea, & N. S. Gallés, Eds.). In M. Carreiras, J. García-Albea, & N. S. Gallés (Eds.), *Language processing in Spanish*, Mahwah, N.J., Lawrence Erlbaum.

Cuetos, F., & Mitchell, D. C. (1988). Cross-linguistic differences in parsing: Restrictions on the use of the Late Closure strategy in Spanish. *Cognition, 30*(1), 73–105.

de la Cruz-Pavia, I., & Elordieta, G. (2015). Prosodic phrasing of relative clauses with two possible antecedents in Spanish: A comparison of Spanish native speakers and L1 Basque bilingual speakers. *Folia Linguistica, 49*(1), 185–204.

De Vincenzi, M., & Job, R. (1995). An investigation of late closure: The role of syntax, thematic structure, and pragmatics in initial interpretation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*(5), 1303.

De Vincenzi, M. (1991). *Syntactic parsing strategies in Italian: The minimal chain principle* (Vol. 12). Springer Science & Business Media.

De Vincenzi, M., & Job, R. (1993). Some observations on the universality of the late-closure strategy. *Journal of Psycholinguistic Research, 22*(2), 189–206.

Deevy, P. L. (2000). Agreement checking in comprehension: Evidence from relative clauses. *Journal of Psycholinguistic Research, 29*(1), 69–79.

Dell, G. S. (1986). A spreading-activation theory of retrieval in sentence production. *Psychological review, 93*(3), 283.

Dell, G. S., & Chang, F. (2014). The p-chain: Relating sentence production and its disorders to comprehension and acquisition. *Philosophical Transactions of the Royal Society B: Biological Sciences, 369*(1634), 20120394.

Demestre, J., & García-Albea, J. E. (2004). The on-line resolution of the sentence complement/relative clause ambiguity: Evidence from Spanish. *Experimental Psychology*, *51*(1), 59–71.

Desmet, T., & Gibson, E. (2003). Disambiguation preferences and corpus frequencies in noun phrase conjunction. *Journal of Memory and Language*, *49*(3), 353–374.

Dickey, M. W. (2001). *The processing of tense: Psycholinguistic studies on the interpretation of tense and temporal relations* (Vol. 28). Springer Science & Business Media.

Duchon, A., Perea, M., Sebastián-Gallés, N., Martı, A., & Carreiras, M. (2013). EsPal: One-stop shopping for Spanish word properties. *Behavior research methods*, *45*(4), 1246–1258.

Dussias, P. E. (2004). Parsing a first language like a second: The erosion of L1 parsing strategies in Spanish-English bilinguals. *International Journal of Bilingualism*, *8*(3), 355–371.

Dussias, P. E., & Sagarra, N. (2007). The effect of exposure on syntactic parsing in Spanish–English bilinguals. *Bilingualism: Language and Cognition*, *10*(1), 101–116.

Ehrlich, K. F. (1999). Low attachment of relative clauses: New data from swedish, norwegian and romanian, In *Poster presented at the 12th Annual CUNY Conference on Human Sentence Processing*, *New York, NY, March*.

Enç, M. (1987). Anchoring conditions for tense. *Linguistic inquiry*, 633–657.

Fábregas, A. (2013). Differential object marking in spanish: State of the art. *Borealis–An International Journal of Hispanic Linguistics*, *2*(2), 1–80.

Fernandes, B. (2012). *Attachment Preferences in Prepositional Infinitive Constructions* (Master's thesis). Centro de Linguística da Universidade Nova de Lisboa.

Fernandes, B., Alexiadou, A., Chow, W.-Y., Santi, A., & Grillo, N. (2018). Adaptation to complex cues in sentence comprehension, In *31st CUNY Conference on Human Sentence Processing*.

Fernandes, E., Luegi, P., Soares, E. C., Fuente, I., & Hemforth, B. (2016). Relative clause-attachment in European (EP) and Brazilian Portuguese (BP): Effects of verb type, tense and variety.

Fernández, E. M. (2003). *Bilingual sentence processing: Relative clause attachment in English and Spanish* (Vol. 29). John Benjamins Publishing.

Fernández, E. M., & Bradley, D. (1999). Length effects in the attachment of relative clauses in english, In *Poster presented at the 12th annual CUNY Conference on Human Sentence Processing*, *New York*.

Ferreira, F., Bailey, K. G., & Ferraro, V. (2002a). Good-enough representations in language comprehension. *Current directions in psychological science*, *11*(1), 11–15.

Ferreira, F., Bailey, K. G., & Ferraro, V. (2002b). Good-enough representations in language comprehension. *Current directions in psychological science*, *11*(1), 11–15.

Ferreira, F., & Clifton Jr, C. (1986). The independence of syntactic processing. *Journal of memory and language*, *25*(3), 348–368.

Ferreira, F., & Lowder, M. W. (2016). Prediction, information structure, and good-enough language processing, In *Psychology of learning and motivation*. Elsevier.

Ferreira, F., & Patson, N. D. (2007). The 'good enough'approach to language comprehension. *Language and Linguistics Compass*, *1*(1-2), 71–83.

Ferreira, F., & Stacey, J. (2000). The misinterpretation of passive sentences. *Manuscript submitted for publication*.

Ferretti, T. R., & McRae, K. (1999). Modeling the role of plausibility and verb-bias in the direct object/sentence complement ambiguity, In *Proceedings of cogsci*.

Fine, A. B., Jaeger, T. F., Farmer, T. A., & Qian, T. (2013). Rapid expectation adaptation during syntactic comprehension. *PLoS ONE*, *8*(10).

Fodor, J. D. (1998). Learning to parse? *Journal of psycholinguistic research*, *27*(2), 285–319.

Fodor, J. D. (2002). Prosodic disambiguation in silent reading. *NELS 32 North East Linguistics Society, 2002*.

Fodor, J. A. (1983). *The modularity of mind*. MIT press.

Forster, K., & Forster, J. (1999). DMDX [computer software]. *Tucson: University of Arizona*.

Fraga, I., García-Orza, J., & Acuña, J. C. (2005). La desambiguación de oraciones de relativo en gallego: Nueva evidencia de adjunción alta en lenguas romances. *Psicológica*, *26*(2), 243–260.

Fraga, I., Piñeiro, A., Acuña-Fariña, C., Redondo, J., & García-Orza, J. (2012). Emotional nouns affect attachment decisions in sentence completion tasks. *The Quarterly Journal of Experimental Psychology*, *65*(9), 1740–1759.

Frazier, L., & Fodor, J. D. (1987). *Cognition*.

Frazier, L. (1978). *On comprehending sentences: Syntactic parsing strategies* (Doctoral dissertation). U. of Connecticut.

Frazier, L. (1990). Exploring the architecture of the language-processing system.

Frazier, L. (1995). Constraint satisfaction as a theory of sentence processing. *Journal of psycholinguistic research*, *24*(6), 437–468.

Frazier, L., & Clifton, C. (1996). *Construal*. Mit Press.

Frazier, L., & Rayner, K. (1982). Making and correcting errors during sentence comprehension: Eye movements in the analysis of structurally ambiguous sentences. *Cognitive psychology*, *14*(2), 178–210.

Fromkin, V. A. (1971). The non-anomalous nature of anomalous utterances. *Language*, 27–52.

Fromont, L. A., Soto-Faraco, S., & Biau, E. (2017). Searching high and low: Prosodic breaks disambiguate relative clauses. *Frontiers in Psychology*, *8*, 96.

García-Orza, J., Gavilán, J. M., Fraga, I., & Ferré, P. (2017). Testing the online reading effects of emotionality on relative clause attachment. *Cognitive processing*, *18*(4), 543–553.

Garnsey, S. M., Pearlmutter, N. J., Myers, E., & Lotocky, M. A. (1997). The contributions of verb bias and plausibility to the comprehension of temporarily ambiguous sentences. *Journal of Memory and Language*, *37*(1), 58–93.

Garrett, M. F. (1975). The analysis of sentence production, In *Psychology of learning and motivation*. Elsevier.

Gehrke, B. (2019). Event kinds (R. Truswell, Ed.). *The Oxford handbook of event structure*, 205–233.

Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. *Cognition*, *68*(1), 1–76.

Gibson, E. (2000). The dependency locality theory: A distance-based theory of linguistic complexity. *Image*, *language*, *brain*, *2000*, 95–126.

Gibson, E., Pearlmutter, N. J., & Torrens, V. (1999). Recency and lexical preferences in Spanish. *Memory & Cognition*, *27*(4), 603–611.

Gibson, E., Pearlmutter, N., Canseco-Gonzalez, E., & Hickok, G. (1996). Recency preference in the human sentence processing mechanism. *Cognition*, *59*(1), 23–59.

Gibson, E., & Schütze, C. T. (1999). Disambiguation preferences in noun phrase conjunction do not mirror corpus frequency. *Journal of Memory and Language*, *40*(2), 263–279.

Gilboy, E., & Sopena, J. (1996). Segmentation effects in the processing of complex NPs with relative clauses. *Language processing in Spanish*, 191–206.

Gilboy, E., Sopena, J. M., Clifton, C., & Frazier, L. (1995). Argument structure and association preferences in Spanish and English complex NPs. *Cognition*, *54*(2), 131–167.

Graffi, G. (1980). Su alcune costruzioni "pseudorelative". *Rivista di Grammatica Generativa*, *vol. 5 (1980)*, *p. 115-139*.

Green, M. J., & Mitchell, D. C. (2006). Absence of real evidence against competition during syntactic ambiguity resolution. *Journal of Memory and Language*, *55*(1), 1–17.

169

Grillo, N. (2012). Local and Universal (V. Bianchi & C. Chesi, Eds.). In V. Bianchi & C. Chesi (Eds.), *Enjoy Linguistics! Papers offered to Luigi Rizzi on the occasion of his 60th birthday*. Siena, Italy, CISCL Press.

Grillo, N., & Costa, J. (2014). A novel argument for the universality of parsing principles. *Cognition*, *133*(1), 156–187.

Grillo, N., Costa, J., Fernandes, B., & Santi, A. (2015a). Highs and lows in English attachment. *Cognition*, *144*, 116–122.

Grillo, N., Fernandes, B., & Costa, J. (2012a). Attachment preferences in Prepositional Infinitive Constructions in European Portuguese, In *Amlap (architectures and mechanisms for language processing)*, Riva del Garda, Italy.

Grillo, N., Fernandes, B., & Costa, J. (2012b). Universally Local Attachment: New evidence from PIC., In *ERP experimental psycholinguistics conference*, Madrid, Spain.

Grillo, N., Habboub, S., & Lungu, O. (2015b). Canonicity effects are modulated by matrix verb type, In *28th CUNY Conference on Human Sentence Processing*. York.

Grillo, N., & Moulton, K. (2015). Event kinds and the pseudo-relative, In *46th annual meeting of the north east linguistic society*. York.

Grillo, N., & Moulton, K. (2016a). Clausal Determiners and Long Distance AGREE in Italian. *39th Generative Linguistics in the Old World*.

Grillo, N., & Moulton, K. (2016b). Sorting out Pseudo Relatives: Clausal Determiners and mediated AGREE. *Under revision for Natural Language and Linguistic Theory*.

Grillo, N., & Moulton, K. (2017). Sorting out pseudo relatives: Clausal determiners and AGREE. *ms. University of York and Simon Fraser University*.

Grillo, N., & Spathas, G. (2014). Tense and Aspect modulate RC attachment: Testing the PR hypothesis in Greek. *DGfS 2016 – 36 Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft*.

Grillo, N., & Turco, G. (2016). Prosodic disambiguation and Attachment Height. *Speech Prosody 2016*, 1176–1180.

Guasch, M., Boada, R., Ferré, P., & Sánchez-Casas, R. (2013). NIM: A web-based swiss army knife to select stimuli for psycholinguistic studies. *Behavior research methods*, *45*(3), 765–771.

Guasti, M. T. (1988). La pseudorelative et les phénomènes d'accord. *Rivista di Grammatica Generativa*, *vol. 13 (1988), p. 35-57*.

Gutierrez-Ziardegi, E., Carreiras, M., & Laka, I. (2004). Bilingual sentence processing: Relative clause attachment in Basque and Spanish, In *CUNY Conference on Human Sentence Processing*, *University of Maryland*.

Hemforth, B., Colonna, S., Petrone, C., & D'Imperio, M. (2013). Length matters: Informational load in ambiguity resolution. discours. *Revue de linguistique, psycholinguistique et informatique.,(12)*.

Hemforth, B., Konieczny, L., & Scheepers, C. (2000). Syntactic attachment and anaphor resolution: Two sides of relative clause attachment (M. Crocker, M. Pickering, & C. Clifton, Eds.). In M. Crocker, M. Pickering, & C. Clifton (Eds.), *Architectures and mechanisms for language processing*. Cambridge, UK, Cambridge University Press.

Hemforth, B., Fernandez, S., Clifton, C., Frazier, L., Konieczny, L., & Walter, M. (2015). Relative clause attachment in German, English, Spanish and French: Effects of position and length. *Lingua*, *166*, 43–64.

Hemforth, B., Konieczny, L., Scheepers, C., & Strube, G. (1998). Syntactic ambiguity resolution in German. *Syntax and semantics*, 293–312.

Hernanz Carbó, M. (1988). En torno a la sintaxis y la semántica de los complementos predicativos en español. *Estudi General*, *1988, núm. 8, p. 7-29*.

Hockett, C. F. (1961). Grammar for the hearer, In *Proceedings of symposia in applied mathematics*.

Holmes, V. M., Stowe, L., & Cupples, L. (1989). Lexical expectations in parsing complement-verb sentences. *Journal of Memory and Language*, *28*(6), 668–689.

Igoa, J., Carreiras, M., & Meseguer, E. (1998). A study on Late Closure in Spanish: Principle-grounded vs. frequency-based accounts on attachment preferences. *Quarterly Journal of Experimental Psychology*, *51A*(3), 561–592.

Jaeger, T. F. (2008). Categorical data analysis: Away from ANOVAs (transformation or not) and towards logit mixed models. *Journal of memory and language*, *59*(4), 434–446.

Jegerski, J., Keating, G. D., & VanPatten, B. (2016). On-line relative clause attachment strategy in heritage speakers of Spanish. *International Journal of Bilingualism*, *20*(3), 254–268.

Jegerski, J., VanPatten, B., & Keating, G. (2016). Relative clause attachment preferences in early and late Spanish-English bilinguals. *Advances in Spanish as a heritage language*, *49*, 81–99.

Jun, S.-A. (2010). The implicit prosody hypothesis and overt prosody in english. *Language and Cognitive Processes*, *25*(7-9), 1201–1233.

Jun, S.-A., & Koike, C. (2003). Prosody and attachment preference in japanese: Production and perception, In *Proceedings of the international workshop on prosodic interfaces*.

Just, M. A., & Carpenter, P. A. (1980). A theory of reading: From eye fixations to comprehension. *Psychological review*, *87*(4), 329.

Kayne, R. (1975). *French syntax: The transformational cycle*. Cambridge, MA, MIT Press.

Kempen, G., & Hoenkamp, E. (1987). An incremental procedural grammar for sentence formulation. *Cognitive science*, *11*(2), 201–258.

Kimball, J. (1973). Seven principles of surface structure parsing in natural language. *Cognition*, *2*(1), 15–47.

Kjelgaard, M. M., & Speer, S. R. (1999). Prosodic facilitation and interference in the resolution of temporary syntactic closure ambiguity. *Journal of Memory and Language*, *40*(2), 153–194.

Koenig, J.-P., & Lambrecht, K. (1999). French relative clauses as secondary predicates: A case study in construction theory. Thesus.

Koopman, H., & Sportiche, D. (2008). The que/qui alternation: New analytical directions. *Functional Structure from Top to Toe. Available at: http://ling. auf. net/lingBuzz/000638.*

Kutas, M., Van Petten, C. K., & Kluender, R. (2006). Psycholinguistics electrified ii (1994–2005), In *Handbook of psycholinguistics*. Elsevier.

Labelle, M. (1996). Remarques sur les verbes de perception et la sous-catégorisation. *Recherches linguistiques de Vincennes*, *25*, 83–106.

Laca, B. (1995). Sobre el uso del acusativo personal en español. In. C. Pensado, ed. *El acusativo Personal*.

Leonetti, M. (2004). Specificity and differential object marking in spanish. *Catalan journal of linguistics*, *3*(1), 75–114.

Levelt, W. (1989). Speaking: From intention to articulation. Cambridge, MA: Bradford Books/MIT Press.

Lovric, N. (2004). *Implicit prosody in silent reading: Relative clause attachment in croatian.* (PhD thesis). City University of New York.

MacDonald, M. C. (2013). How language production shapes language form and comprehension. *Frontiers in Psychology*, *4*, 226.

MacDonald, M. C., Pearlmutter, N. J., & Seidenberg, M. S. (1994). The lexical nature of syntactic ambiguity resolution. *Psychological review*, *101*(4), 676–703.

Maia, M., Fernández, E. M., Costa, A., & Lourenco-Gomes, M. D. C. (2007). Early and late preferences in relative clause attachment in Spanish and Portuguese. *Journal of Portuguese linguistics*, *5*, 203–226.

Marslen-Wilson, W. D. (1975). Sentence perception as an interactive parallel process. *Science*, *189*(4198), 226–228.

Mayberry, M. R., Crocker, M. W., & Knoeferle, P. (2009). Learning to attend: A connectionist model of situated language comprehension. *Cognitive science*, *33*(3), 449–496.

McRae, K., Spivey-Knowlton, M. J., & Tanenhaus, M. K. (1998). Modeling the influence of thematic fit (and other constraints) in on-line sentence comprehension. *Journal of Memory and Language*, *38*(3), 283–312.

Merlo, P. (1994). A corpus-based analysis of verb continuation frequencies for syntactic processing. *Journal of Psycholinguistic Research*, *23*(6), 435–457.

Miller, G. A., & Chomsky, N. (1963). Finitary models of language users.

Miller, G. A., & Isard, S. (1964). Free recall of self-embedded english sentences. *Information and Control*, *7*(3), 292–303.

Mitchell, D. C., & Brysbaert, M. (1998). Challenges to recent theories of crosslinguistic variation in parsing: Evidence from dutch. *Syntax and semantics: A crosslinguistic perspective*, 313–335.

Mitchell, D. C., Brysbaert, M., Grondelaers, S., & Swanepoel, P. (2000a). Modifier attachment in dutchdutch: Testing aspects of construal theory, In *Reading as a perceptual process*. Elsevier.

Mitchell, D. C., Brysbaert, M., Grondelaers, S., & Swanepoel, P. (2000b). Modifier attachment in dutchdutch: Testing aspects of construal theory, In *Reading as a perceptual process*. Elsevier.

Mitchell, D. C., Corley, M., & Garnham, A. (1992). Effects of context in human sentence parsing: Evidence against a discourse-based proposal mechanism. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *18*(1), 69.

Mitchell, D. C., & Cuetos, F. (1991). The origins of parsing strategies. *Current issues in natural language processing*, 1–12.

Mitchell, D. C., Cuetos, F., Corley, M. M., & Brysbaert, M. (1995). Exposure-based models of human parsing: Evidence for the use of coarse-grained (nonlexical) statistical records. *Journal of Psycholinguistic Research*, *24*(6), 469–488.

Mitchell, D. C., Cuetos, F., & Zagar, D. (1990). Reading in different languages: Is there a universal mechanism for parsing sentences? In *Comprehension processes in reading*. Lawrence Erlbaum Associates, Inc.

Mitchell, D. C., & Green, D. W. (1978). The effects of context and content on immediate processing in reading. *Quarterly Journal of Experimental Psychology*, *30*(4), 609–636.

Miyamoto, E. T. (2005). Orações relativas ambıguas e a homogeneidade do processamento de sentenças (M. I. Finger, Ed.). In M. I. Finger (Ed.), *Processamento da linguagem*. Pelotas:EDUCAT.

Miyamoto, E. T., Gibson, E., Pearlmutter, N. J., Aikawa, T., & Miyagawa, S. (1999). A U-shaped relative clause attachment preference in Japanese. *Language and Cognitive Processes*, *14*(5-6), 663–686.

Momma, S., & Phillips, C. (2018). The relationship between parsing and generation. *Annual Review of Linguistics*, *4*, 233–254.

Moulton, K., & Grillo, N. (2014). Pseudo relatives: Big but transparent, In *45th annual meeting of the north east linguistic society*. York.

Moulton, K., & Grillo, N. (2015a). Pseudo relatives: Big and direct. (T. Bui & D. Özyıldız, Eds.). In T. Bui & D. Özyıldız (Eds.), *Nels 45*, GLSA (Graduate Linguistics Student Association).

Moulton, K., & Grillo, N. (2015b). Pseudo relatives: Big but Transparent (T. Bui & D. Ozyildiz, Eds.). In T. Bui & D. Ozyildiz (Eds.), *Nels 45: Proceedings of the forty-fifth annual meeting of the north east linguistic society*, MIT Cambridge, MA.

O'Brien, E. J., Rizzella, M. L., Albrecht, J. E., & Halleran, J. G. (1998). Updating a situation model: A memory-based text processing view. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *24*(5), 1200.

Ogihara, T. (1994). Adverbs of quantification and sequence-of-tense phenomena, In *Semantics and linguistic theory*.

Ormazabal, J., & Romero, J. (2013). Differential object marking, case and agreement. *Borealis*, *2*(2), 221.

Papadopoulou, D., & Clahsen, H. (2003). Parsing strategies in l1 and l2 sentence processing: A study of relative clause attachment in greek. *Studies in Second Language Acquisition*, *25*(4), 501–528.

Pearlmutter, N. J., Garnsey, S. M., & Bock, K. (1999). Agreement processes in sentence comprehension. *Journal of Memory and language*, *41*(3), 427–456.

Pickering, M. J., & Ferreira, V. S. (2008). Structural priming: A critical review. *Psychological bulletin*, *134*(3), 427.

Pickering, M. J., & Garrod, S. (2013a). An integrated theory of language production and comprehension. *Behavioral and brain sciences*, *36*(4), 329–347.

Pickering, M. J., & Garrod, S. (2013b). How tightly are production and comprehension interwoven? *Frontiers in Psychology*, *4*, 238.

Portner, P. (1991). Gerunds and types of events, In *Semantics and linguistic theory*.

Pozniak, C., Hemforth, B., Haendler, Y., Santi, A., & Grillo, N. (2019). Seeing events vs. entities: The processing advantage of pseudo relatives over relative clauses. *Journal of Memory and Language*, *107*, 128–151.

Pynte, J., & Colonna, S. (2000). Decoupling syntactic parsing from visual inspection: The case of relative clause attachment in french, In *Reading as a perceptual process*. Elsevier.

Quinn, D., Abdelghany, H., & Fodor, J. D. (2000). More evidence of implicit prosody in silent reading: French, english and arabic relative clauses, In *Poster presented at the 13th Annual CUNY Conference*, *La Jolla, CA*.

R Core Team. (2018). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. Vienna, Austria. https://www.R-project.org/

Radford, A. (1975a). Pseudo-relatives and the unity of subject-raising. *Archivum Linguisticum*, 6, 32–64.

Radford, A. (1975b). Pseudo-relatives and the unity of subject raising. *Archivum linguisticum*, 6(32-64).

Rafel, J. (1999). *Complex Small Clauses* (Doctoral dissertation). Universitàt Autonoma de Barcelona.

Rayner, K., Carlson, M., & Frazier, L. (1983). The interaction of syntax and semantics during sentence processing: Eye movements in the analysis of semantically biased sentences. *Journal of verbal learning and verbal behavior*, 22(3), 358–374.

Rayner, K., & Duffy, S. A. (1988). On-line comprehension processes and eye movements in reading. *Reading research: Advances in theory and practice*, 6, 13–66.

Rayner, K., Kambe, G., & Duffy, S. A. (2000). The effect of clause wrap-up on eye movements during reading. *The Quarterly Journal of Experimental Psychology: Section A*, 53(4), 1061–1080.

Rayner, K., Sereno, S. C., Morris, R. K., Schmauder, A. R., & Clifton Jr, C. (1989). Eye movements and on-line language comprehension processes. *Language and Cognitive Processes*, 4(3-4), SI21–SI49.

Rizzi, L. (1992). Direct Perception, Government and Thematic Sharing. *Geneva Generative Papers*, 1, 39–52.

Rohde, H., Levy, R., & Kehler, A. (2011). Anticipating explanations in relative clause processing. *Cognition*, 118(3), 339–358.

Roland, D., & Jurafsky, D. (2002). Verb sense and verb subcategorization probabilities. *The lexical basis of sentence processing: Formal, computational, and experimental issues*, 4, 325–45.

Rothstein, S. (1983). *Predication* (Doctoral dissertation). Doctoral dissertation, MIT, Cambridge.

Salcedo, E. T. (1999). El complemento directo preposicional. *Gramática descriptiva de la lengua española*, 1779–1805.

Schotter, E. R., Bicknell, K., Howard, I., Levy, R., & Rayner, K. (2014). Task effects reveal cognitive flexibility responding to frequency and predictability: Evidence from eye movements in reading and proofreading. *Cognition*, 131(1), 1–27.

Sharvit, Y. (2014). On the universal principles of tense embedding: The lesson from before. *Journal of Semantics*, 31(2), 263–313.

Shen, X. (2006). *Late assignment of syntax theory: Evidence from chinese and english* (PhD dissertation). University of Exeter.

Slattery, T. J., Sturt, P., Christianson, K., Yoshida, M., & Ferreira, F. (2013). Lingering misinterpretations of garden path sentences arise from competing syntactic representations. *Journal of Memory and Language*, *69*(2), 104–120.

Spivey, M. J., & Tanenhaus, M. K. (1998). Syntactic ambiguity resolution in discourse: Modeling the effects of referential context and lexical frequency. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *24*(6), 1521.

Spivey-Knowlton, M. (1994). Quantitative predictions from a constraint-based theory of syntactic ambiguity resolution, In *Proceedings of the 1993 connectionist models summer school*. Erlbaum Hillsdale, NJ.

Staub, A. (2007). The parser doesn't ignore intransitivity, after all. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*(3), 550.

Staub, A., Foppolo, F., Donati, C., & Cecchetto, C. (2018). Relative clause avoidance: Evidence for a structural parsing principle. *Journal of Memory and Language*, *98*, 26–44.

Staub, A., & Rayner, K. (2007). Eye movements and on-line comprehension processes. *The Oxford handbook of psycholinguistics*, *327*, 342.

Stowell, T. (2007). The syntactic expression of tense. *Lingua*, *117*(2), 437–463.

Sturt, P., Sanford, A. J., Stewart, A., & Dawydiak, E. (2004). Linguistic focus and good-enough representations: An application of the change-detection paradigm. *Psychonomic bulletin & review*, *11*(5), 882–888.

Swets, B., Desmet, T., Clifton, C., & Ferreira, F. (2008). Underspecification of syntactic ambiguities: Evidence from self-paced reading. *Memory & Cognition*, *36*(1), 201–216.

Tabor, W., Juliano, C., & Tanenhaus, M. K. (1997). Parsing in a dynamical system: An attractor-based account of the interaction of lexical and structural constraints in sentence processing. *Language and Cognitive Processes*, *12*(2-3), 211–271.

Tanenhaus, M. K., & Seidenberg, M. S. (1980). Discourse context and sentence perception. *Center for the Study of Reading Technical Report; no. 176*.

Tanenhaus, M. K., Spivey-Knowlton, M. J., & Hanna, J. E. (2000). Modeling thematic and discourse context effects with a multiple constraints approach: Implications for the architecture of the language comprehension system. *Architectures and mechanisms for language processing*, 90–118.

Tanenhaus, M. K., & Trueswell, J. C. (1995). Sentence comprehension.

Taraban, R., & McClelland, J. L. (1988). Constituent attachment and thematic role assignment in sentence processing: Influences of content-based expectations. *Journal of memory and language*, *27*(6), 597–632.

Teira, C., & Igoa, J. M. (2007). The prosody-syntax relationship in sentence processing. *Anuario de Psicología/The UB Journal of Psychology*, *38*(1), 45–69.

Tomaz, M., Lourenço Gomes, M., Santi, A., & Grillo, N. (2014). A concordância de número em construçoes relativas e pseudorelativas em Português europeu, In *Textos Selecionados do XXIX Encontro Nacional da Associaçao Portuguesa de Linguística*.

Tooley, K. M., & Bock, K. (2014). On the parity of structural persistence in language production and comprehension. *Cognition*, *132*(2), 101–136.

Traxler, M. J., Pickering, M. J., & Clifton Jr, C. (1998). Adjunct attachment is not a form of lexical ambiguity resolution. *Journal of Memory and Language*, *39*(4), 558–592.

Trueswell, J. C., Tanenhaus, M. K., & Garnsey, S. M. (1994). Semantic influences on parsing: Use of thematic role information in syntactic ambiguity resolution. *Journal of memory and language*, *33*(3), 285–318.

Trueswell, J. C., Tanenhaus, M. K., & Kello, C. (1993). Verb-specific constraints in sentence processing: Separating effects of lexical preference from garden-paths. *Journal of Experimental psychology: Learning, memory, and Cognition*, *19*(3), 528.

Tyler, L. K., & Marslen-Wilson, W. D. (1977). The on-line effects of semantic context on syntactic processing. *Journal of Verbal Learning and Verbal Behavior*, *16*(6), 683–692.

Van Gompel, R. P., Pickering, M. J., & Traxler, M. J. (2000). Unrestricted race: A new model of syntactic ambiguity resolution, In *Reading as a perceptual process*. Elsevier.

Van Gompel, R. P., Pickering, M. J., & Traxler, M. J. (2001). Reanalysis in sentence processing: Evidence against current constraint-based and two-stage models. *Journal of Memory and Language*, *45*(2), 225–258.

Vasishth, S., Agnihotri, R. K., Fernández, E. M., & Bhatt, R. (2004). Relative clause attachment in hindi: Effects of rc length and rc placement, In *Poster presented at the 10th Annual Conference on Architectures and Mechanisms for Language Processing (AMLaP), Aix-en-Provence, France*.

Vasishth, S., von der Malsburg, T., & Engelmann, F. (2013). What eye movements can tell us about sentence comprehension. *Wiley Interdisciplinary Reviews: Cognitive Science*, *4*(2), 125–134.

Wagner, M., & Watson, D. G. (2010). Experimental and theoretical advances in prosody: A review. *Language and cognitive processes*, *25*(7-9), 905–945.

Warren, P., Grabe, E., & Nolan, F. (1995). Prosody, phonology and parsing in closure ambiguities. *Language and cognitive processes*, *10*(5), 457–486.

Watson, D., & Gibson, E. (2005). Intonational phrasing and constituency in language production and comprehension. *Studia linguistica*, *59*(2-3), 279–300.

Wellwood, A., Pancheva, R., Hacquard, V., & Phillips, C. (2018). The anatomy of a comparative illusion. *Journal of Semantics*, *35*(3), 543–583.

Wijnen, F. (2004). The implicit prosody of jabberwocky and the relative clause attachment riddle. *LOT Occasional Series*, *2*, 169–178.

Zagar, D., Pynte, J., & Rativeau, S. (1997). Evidence for early closure attachment on first pass reading times in french. *The Quarterly Journal of Experimental Psychology Section A*, *50*(2), 421–438.

ACCEPTABILITY JUDGEMENT AVERAGE RATES (CHAPTER IV)

Table I.1: Mean acceptability rates across items and conditions (condition a = simple active + imperfective, condition b = simple active + progressive, condition c = RC + imperfective, condition d = RC + progressive)

Item	Condition	Sentence
1	a	El médico leía el periódico.
1	b	El médico estaba leyendo el periódico.
1	c	Santiago confía en el médico que leía el periódico.
1	d	Santiago confía en el médico que estaba leyendo el periódico.
2	a	La estudiante bailaba flamenco.
2	b	La estudiante estaba bailando flamenco.
2	c	Vicente coopera con la estudiante que bailaba flamenco.
2	d	Vicente coopera con la estudiante que estaba bailando flamenco.
3	a	El bombero corría descalzo.
3	b	El bombero estaba corriendo descalzo.
3	c	Ana desconfía del bombero que corría descalzo.
3	d	Ana desconfía del bombero que estaba corriendo descalzo.
4	a	El jugador hablaba demasiado.
4	b	El jugador estaba hablando demasiado.
4	c	Jose entrena con el jugador que hablaba demasiado.
4	d	Jose entrena con el jugador que estaba hablando demasiado.
5	a	El profesor cenaba pescado.
5	b	El profesor estaba cenando pescado.
5	c	Daniela trabaja con el profesor que cenaba pescado.
5	d	Daniela trabaja con el profesor que estaba cenando pescado.
6	a	El chico fumaba tabaco de liar.
6	b	El chico estaba fumando tabaco de liar.

6	c	Andrea estudiaba con el chico que fumaba tabaco de liar.
6	d	Andrea estudiaba con el chico que estaba fumando tabaco de liar.
7	a	El inquilino silbaba saetas.
7	b	El inquilino estaba silbando saetas.
7	c	Luis sale con el inquilino que silbaba saetas.
7	d	Luis sale con el inquilino que estaba silbando saetas.
8	a	El biólogo salía tarde.
8	b	El biólogo estaba saliendo tarde.
8	c	Rafael entrena con el biólogo que salía tarde.
8	d	Rafael entrena con el biólogo que estaba saliendo tarde.
9	a	El instructor discutía por todo.
9	b	El instructor estaba discutiendo por todo.
9	c	Isabel sale con el instructor que discutía por todo.
9	d	Isabel sale con el instructor que estaba discutiendo por todo.
10	a	El dentista jugaba al ajedrez.
10	b	El dentista estaba jugando al ajedrez.
10	c	Manolo coopera con el dentista que jugaba al ajedrez.
10	d	Manolo coopera con el dentista que estaba jugando al ajedrez.
11	a	El carnicero cocinaba pasta.
11	b	El carnicero estaba cocinando pasta.
11	c	Lara vive con el carnicero que cocinaba pasta.
11	d	Lara vive con el carnicero que estaba cocinando pasta.
12	a	El policía paseaba solo.
12	b	El policía estaba paseando solo.
12	c	Ricardo trabaja con el policía que paseaba solo.
12	d	Ricardo trabaja con el policía que estaba paseando solo.
13	a	El joven cantaba fados.
13	b	El joven estaba cantando fados.
13	c	Eduardo vive con el joven que cantaba fados.
13	d	Eduardo vive con el joven que estaba cantando fados.
14	a	El abogado andaba con muletas.
14	b	El abogado estaba andando con muletas.
14	c	Magdalena se fía del abogado que andaba con muletas.
14	d	Magdalena se fía del abogado que estaba andando con muletas.
15	a	La cantante pintaba gatitos.
15	b	La cantante estaba pintando gatitos.
15	c	Juan sale con la cantante que pintaba gatitos.
15	d	Juan sale con la cantante que estaba pintando gatitos.
16	a	El barbero escribía con pluma.
16	b	El barbero estaba escribiendo con pluma.
16	c	Colaboré con el barbero que escribía con pluma.
16	d	Colaboré con el barbero que estaba escribiendo con pluma.
17	a	El concejal entrenaba al fútbol.
17	b	El concejal estaba entrenando al fútbol.
17	c	Alejandro se fía del concejal que entrenaba al fútbol.
17	d	Alejandro se fía del concejal que estaba entrenando al fútbol.
18	a	El bandido conducía un Ferrari.
18	b	El bandido estaba conduciendo un Ferrari.

18	c	Pedro convive con el bandido que conducía un Ferrari.
18	d	Pedro convive con el bandido que estaba conduciendo un Ferrari.
19	a	El viejito conversaba locuazmente.
19	b	El viejito estaba conversando locuazmente.
19	c	Teresa está casada con el viejito que conversaba locuazmente.
19	d	Teresa está casada con el viejito que estaba conversando locuazmente.
20	a	El ingeniero bebía aguardiente.
20	b	El ingeniero estaba bebiendo aguardiente.
20	c	Bea colabora con el ingeniero que bebía aguardiente.
20	d	Bea colabora con el ingeniero que estaba bebiendo aguardiente.
21	a	El escritor lloraba sus penas.
21	b	El escritor estaba llorando sus penas.
21	c	Cristina desconfía del escritor que lloraba sus penas.
21	d	Cristina desconfía del escritor que estaba llorando sus penas.
22	a	El diputado comía espaguetis.
22	b	El diputado estaba comiendo espaguetis.
22	c	Raquel está casada con el diputado que comía espaguetis.
22	d	Raquel está casada con el diputado que estaba comiendo espaguetis.
23	a	La señora cosía puntillas.
23	b	La señora estaba cosiendo puntillas.
23	c	Carlota convive con la señora que cosía puntillas.
23	d	Carlota convive con la señora que estaba cosiendo puntillas.
24	a	El niño gritaba excesivamente.
24	b	El niño estaba gritando excesivamente.
24	c	Federico convive con el niño que gritaba excesivamente.
24	d	Federico convive con el niño que estaba gritando excesivamente.

First force-choice attachment questionnaire (Chapter IV)

Table II.1: Mean High Attachment proportions across items and conditions in the first questionnaire (condition a = perceptual + imperfective, condition b = perceptual + progressive, condition c = stative + imperfective, condition d = stative + progressive)

Item	Condition	Sentence	Mean HA
1	a	Juan vio al hijo del médico que tosía.	0.55
1	b	Juan vio al hijo del médico que estaba tosiendo.	0.67
1	c	Juan comparte piso con el hijo del médico que tosía.	0.25
1	d	Juan comparte piso con el hijo del médico que estaba tosiendo.	0.08
2	a	Celia oyó a la abuela de la niña que gritaba.	0.45
2	b	Celia oyó a la abuela de la niña que estaba gritando.	0.30
2	c	Celia trabajó con la abuela de la niña que gritaba.	0.10
2	d	Celia trabajó con la abuela de la niña que estaba gritando.	0.00
3	a	Jaime oyó al maestro del chico que cantaba.	0.11
3	b	Jaime oyó al maestro del chico que estaba cantando.	0.36
3	c	Jaime corre con el maestro del chico que cantaba.	0.00
3	d	Jaime corre con el maestro del chico que estaba cantando.	0.10
4	a	El escritor miró a la tía de la niña que danzaba.	0.20
4	b	El escritor miró a la tía de la niña que estaba danzando.	0.22
4	c	El escritor está casado con la tía de la niña que danzaba.	0.00
4	d	El escritor está casado con la tía de la niña que estaba danzando.	0.00
5	a	María escuchó a la hija del policía que protestaba.	0.60
5	b	María escuchó a la hija del policía que estaba protestando.	0.50
5	c	María trabaja para la hija del policía que protestaba.	0.33
5	d	María trabaja para la hija del policía que estaba protestando.	0.00
6	a	Mireia observó al amigo del político que patinaba.	0.27

6	b	Mireia observó al amigo del político que estaba patinando.	0.60
6	c	Mireia está prometida con el amigo del político que patinaba.	0.20
6	d	Mireia está prometida con el amigo del político que estaba patinando.	0.44
7	a	Isabel pilló a la criada de la actriz que robaba.	0.22
7	b	Isabel pilló a la criada de la actriz que estaba robando.	0.64
7	c	Isabel entrena con la criada de la actriz que robaba.	0.40
7	d	Isabel entrena con la criada de la actriz que estaba robando.	0.30
8	a	El abogado pilló al chófer del vecino que nadaba.	0.30
8	b	El abogado pilló al chófer del vecino que estaba nadando.	0.33
8	c	El abogado entrena con el chófer del vecino que nadaba.	0.09
8	d	El abogado entrena con el chófer del vecino que estaba nadando.	0.20
9	a	Lorena observó al hijo de la sirvienta que entrenaba.	0.60
9	b	Lorena observó al hijo de la sirvienta que estaba entrenando.	0.60
9	c	Lorena está divorciada del hijo de la sirvienta que entrenaba.	0.33
9	d	Lorena está divorciada del hijo de la sirvienta que estaba entrenando.	0.18
10	a	Alberto observó al sobrino de la enfermera que pintaba.	0.36
10	b	Alberto observó al sobrino de la enfermera que estaba pintando.	0.40
10	c	Alberto está emparentado con el sobrino de la enfermera que pintaba.	0.20
10	d	Alberto está emparentado con el sobrino de la enfermera que estaba pintando.	0.11
11	a	Pedro fotografió al empleado del carnicero que corría.	0.56
11	b	Pedro fotografió al empleado del carnicero que estaba corriendo.	0.55
11	c	Pedro entrena con el empleado del carnicero que corría.	0.60
11	d	Pedro entrena con el empleado del carnicero que estaba corriendo.	0.60
12	a	Carlos miró al amigo del juez que regaba.	0.70
12	b	Carlos miró al amigo del juez que estaba regando.	0.67
12	c	Carlos sale con el amigo del juez que regaba.	0.09
12	d	Carlos sale con el amigo del juez que estaba regando.	0.90
13	a	Laura imaginó al amigo de la florista que rapeaba.	0.70
13	b	Laura imaginó al amigo de la florista que estaba rapeando.	0.80
13	c	Laura sale de fiesta con el amigo de la florista que rapeaba.	0.33
13	d	Laura sale de fiesta con el amigo de la florista que estaba rapeando.	0.45
14	a	Raquel soñó con el amigo del hermano que bebía.	0.27
14	b	Raquel soñó con el amigo del hermano que estaba bebiendo.	0.80
14	c	Raquel está casada con el amigo del hermano que bebía.	0.50
14	d	Raquel está casada con el amigo del hermano que estaba bebiendo.	0.22
15	a	José dibujó al nieto de la mujer que fumaba.	0.11
15	b	José dibujó al nieto de la mujer que estaba fumando.	0.00
15	c	José está contratado por el nieto de la mujer que fumaba.	0.20
15	d	José está contratado por el nieto de la mujer que estaba fumando.	0.50
16	a	Felipe grabó al agente del jugador que roncaba.	0.70
16	b	Felipe grabó al agente del jugador que estaba roncando.	0.56
16	c	Felipe se reunió con el agente del jugador que roncaba.	0.27
16	d	Felipe se reunió con el agente del jugador que estaba roncando.	0.20
17	a	El bombero grabó al primo del abogado que silbaba.	0.60
17	b	El bombero grabó al primo del abogado que estaba silbando.	0.80
17	c	El bombero está contratado por el primo del abogado que silbaba.	0.33
17	d	El bombero está contratado por el primo del abogado que estaba silbando.	0.55
18	a	Miguel vio al amigo del zapatero que bailaba.	0.45

18	b	Miguel vio al amigo del zapatero que estaba bailando.	0.70
18	c	Miguel sale con el amigo del zapatero que bailaba.	0.40
18	d	Miguel sale con el amigo del zapatero que estaba bailando.	0.22
19	a	Sara fotografió al hermanastro de la enfermera que estudiaba.	0.00
19	b	Sara fotografió al hermanastro de la enfermera que estaba estudiando.	0.27
19	c	Sara colabora con el hermanastro de la enfermera que estudiaba.	0.40
19	d	Sara colabora con el hermanastro de la enfermera que estaba estudiando.	0.50
20	a	El cantante miró al hermano del jefe que maldecía.	0.50
20	b	El cantante miró al hermano del jefe que estaba maldiciendo.	0.44
20	c	El cantante vive con el hermano del jefe que maldecía.	0.09
20	d	El cantante vive con el hermano del jefe que estaba maldiciendo.	0.60
21	a	El policía grabó a la amiga de la hermana que cosía.	0.40
21	b	El policía grabó a la amiga de la hermana que estaba cosiendo.	0.60
21	c	El policía está casado con la amiga de la hermana que cosía.	0.00
21	d	El policía está casado con la amiga de la hermana que estaba cosiendo.	0.36
22	a	El arquitecto imaginó a la hermana del socio que recitaba.	0.36
22	b	El arquitecto imaginó a la hermana del socio que estaba recitando.	0.40
22	c	El arquitecto está divorciado de la hermana del socio que recitaba.	0.30
22	d	El arquitecto está divorciado de la hermana del socio que estaba recitando.	0.11
23	a	Daniel vio al profesor del amigo que cojeaba.	0.22
23	b	Daniel vio al profesor del amigo que estaba cojeando.	0.36
23	c	Daniel sale de fiesta con el profesor del amigo que cojeaba.	0.30
23	d	Daniel sale de fiesta con el profesor del amigo que estaba cojeando.	0.30
24	a	El vecino escuchó al hijo del portero que tarareaba.	0.70
24	b	El vecino escuchó al hijo del portero que estaba tarareando.	0.89
24	c	El vecino va a la universidad con el hijo del portero que tarareaba.	0.18
24	d	El vecino va a la universidad con el hijo del portero que estaba tarareando.	0.70

Attachment questionnaire with length control (Chapter IV)

Table III.1: Mean High Attachment proportions across items and conditions in the second questionnaire condition a = perceptual + imperfective, condition b = perceptual + progressive, condition c = stative + imperfective, condition d = stative + progressive)

Item condition	Sentence	Mean HA
1a	Santiago miró al auxiliar del médico que leía el periódico.	0.76
1b	Santiago miró al auxiliar del médico que estaba leyendo.	0.81
1c	Santiago discrepa del auxiliar del médico que leía el periódico.	0.52
1d	Santiago discrepa del auxiliar del médico que estaba leyendo.	0.56
2a	Vicente imaginó a la madrina de la estudiante que bailaba flamenco.	0.50
2b	Vicente escuchó a la madrina de la estudiante que estaba bailando.	0.47
2c	Vicente coopera con la madrina de la estudiante que bailaba flamenco.	0.30
2d	Vicente coopera con la madrina de la estudiante que estaba bailando.	0.22
3a	Matilde imaginó al ahijado del bombero que corría descalzo.	0.71
3b	Matilde imaginó al ahijado del bombero que estaba corriendo.	0.48
3c	Matilde desconfió del ahijado del bombero que corría descalzo.	0.72
3d	Matilde desconfió del ahijado del bombero que estaba corriendo .	0.53
4a	Fernando oyó al agente del jugador que hablaba demasiado.	0.70
4b	Fernando oyó al agente del jugador que estaba hablando.	0.78
4c	Fernando entrena con el agente del jugador que hablaba demasiado.	0.41
4d	Fernando entrena con el agente del jugador que estaba hablando.	0.43
5a	Daniela vio al alumno del profesor que cenaba pescado.	0.35
5b	Daniela vio al alumno del profesor que estaba cenando.	0.62
5c	Daniela concuerda con el alumno del profesor que cenaba pescado.	0.39
5d	Daniela concuerda con el alumno del profesor que estaba cenando.	0.39
6a	Andrea pilló al primo del chico que fumaba tabaco de liar.	0.50

6b	Andrea pilló al primo del chico que estaba fumando.	0.59
6c	Andrea estudia con el primo del chico que fumaba tabaco de liar.	0.33
6d	Andrea estudia con el primo del chico que estaba fumando.	0.17
7a	Alejandro oyó al propietario del inquilino que silbaba saetas.	0.52
7b	Alejandro oyó al propietario del inquilino que estaba silbando.	0.52
7c	Alejandro sale con el propietario del inquilino que silbaba saetas.	0.28
7d	Alejandro sale con el propietario del inquilino que estaba silbando.	0.18
8a	Rafael pilló al criado del biólogo que salía tarde.	0.70
8b	Rafael pilló al criado del biólogo que estaba saliendo.	0.83
8c	Rafael entrena con el criado del biólogo que salía tarde.	0.47
8d	Rafael entrena con el criado del biólogo que estaba saliendo.	0.43
9a	Isabel escuchó al compadre del instructor que discutía por todo.	0.59
9b	Isabel escuchó al compadre del instructor que estaba discutiendo.	0.43
9c	Isabel sale con el compadre del instructor que discutía por todo.	0.22
9d	Isabel sale con el compadre del instructor que estaba discutiendo.	0.33
10a	Manolo vio al colega del dentista que jugaba al ajedrez.	0.72
10b	Manolo vio al colega del dentista que estaba jugando.	0.53
10c	Manolo vive con el colega del dentista que jugaba al ajedrez.	0.57
10d	Manolo vive con el colega del dentista que estaba jugando.	0.17
11a	Vanesa imaginó al cuñado del carnicero que cocinaba pasta.	0.52
11b	Vanesa imaginó al cuñado del carnicero que estaba cocinando.	0.48
11c	Vanesa coopera con el cuñado del carnicero que cocinaba pasta.	0.44
11d	Vanesa coopera con el cuñado del carnicero que estaba cocinando.	0.35
12a	Ricardo miró al hijastro del policía que paseaba solo.	0.65
12b	Ricardo miró al hijastro del policía que estaba paseando.	0.67
12c	Ricardo trabaja con el hijastro del policía que paseaba solo.	0.41
12d	Ricardo trabaja con el hijastro del policía que estaba paseando.	0.48
13a	Eduardo oyó al hermano del joven que cantaba fados.	0.41
13b	Eduardo oyó al hermano del joven que estaba cantando.	0.30
13c	Eduardo vive con el hermano del joven que cantaba fados.	0.08
13d	Eduardo vive con el hermano del joven que estaba cantando.	0.06
14a	Magdalena miró al asociado del abogado que andaba con muletas.	1.00
14b	Magdalena miró al asociado del abogado que estaba andando.	0.53
14c	Magdalena trabaja para el asociado del abogado que andaba con muletas.	0.43
14d	Magdalena trabaja para el asociado del abogado que estaba andando.	0.70
15a	Guillermo vio a la sobrina de la cantante que pintaba gatitos.	0.48
15b	Guillermo vio a la sobrina de la cantante que estaba pintando.	0.57
15c	Guillermo se fía de la sobrina de la cantante que pintaba gatitos.	0.67
15d	Guillermo se fía de la sobrina de la cantante que estaba pintando.	0.47
16a	Antonio vio al aprendiz del barbero que escribía con pluma.	0.74
16b	Antonio vio al aprendiz del barbero que estaba escribiendo.	0.89
16c	Antonio colabora con el aprendiz del barbero que escribía con pluma.	0.53
16d	Antonio colabora con el aprendiz del barbero que estaba escribiendo.	0.57
17a	Alejandro observó al asesor del concejal que entrenaba al fútbol.	0.59
17b	Alejandro observó al asesor del concejal que estaba entrenando.	0.62
17c	Alejandro se fía del asesor del concejal que entrenaba al fútbol.	0.22
17d	Alejandro se fía del asesor del concejal que estaba entrenando .	0.78
18a	Pedro observó al cómplice del bandido que conducía un Ferrari.	0.56

18b	Pedro observó al cómplice del bandido que estaba conduciendo.	0.41
18c	Pedro convive con el cómplice del bandido que conducía un Ferrari.	0.43
18d	Pedro convive con el cómplice del bandido que estaba conduciendo.	0.35
19a	Teresa escuchó al heredero del viejito que conversaba locuazmente.	0.57
19b	Teresa escuchó al heredero del viejito que estaba conversando.	0.44
19c	Teresa estudia con el heredero del viejito que conversaba locuazmente.	0.44
19d	Teresa estudia con el heredero del viejito que estaba conversando.	0.18
20a	Gustavo pilló al secretario del ingeniero que bebía aguardiente.	0.61
20b	Gustavo pilló al secretario del ingeniero que estaba bebiendo.	0.94
20c	Bea colabora con el secretario del ingeniero que bebía aguardiente.	0.41
20d	Gustavo colabora con el secretario del ingeniero que estaba bebiendo.	0.20
21a	Vicente escuchó al empleado del escritor que lloraba sus penas.	0.63
21b	Vicente imaginó al empleado del escritor que estaba llorando.	0.48
21c	Vicente desconfía del empleado del escritor que lloraba sus penas.	0.33
21d	Vicente desconfía del empleado del escritor que estaba llorando .	0.48
22a	Raquel miró al asistente del diputado que comía espaguetis.	0.72
22b	Raquel miró al asistente del diputado que estaba comiendo.	0.53
22c	Raquel confió en el asistente del diputado que comía espaguetis.	0.57
22d	Raquel confió en el asistente del diputado que estaba comiendo.	0.43
23a	Carlota observó a la amiga de la señora que cosía puntillas.	0.24
23b	Carlota observó a la amiga de la señora que estaba cosiendo.	0.30
23c	Carlota convive con la amiga de la señora que cosía puntillas.	0.11
23d	Carlota convive con la amiga de la señora que estaba cosiendo.	0.18
24a	Federico oyó al vecino del niño que gritaba excesivamente.	0.22
24b	Federico oyó al vecino del niño que estaba gritando.	0.22
24c	Federico confió en el vecino del niño que gritaba excesivamente.	0.06
24d	Federico confía en el vecino del niño que estaba gritando.	0.10

Completion task (Chapter V)

Table IV.1: Mean PR-compatible proportions in the Spanish completion task across items and conditions in the completion task condition a = perceptual + present, condition b = perceptual + past, condition c = stative + present, condition d = stative + past)

Item condition	Sentence	Mean PR-compatibility
1a	Federico oye al niño que...	0.091
1b	Federico oyó al niño que...	0.444
1c	Federico confía en el niño que...	0.000
1d	Federico confió en el niño que...	0.100
2a	Vicente escucha a la estudiante que...	0.600
2b	Vicente escuchó a la estudiante que...	0.545
2c	Vicente coopera con la estudiante que...	0.000
2d	Vicente cooperó con la estudiante que...	0.000
3a	Ana mira al bombero que...	0.222
3b	Ana miró al bombero que...	0.300
3c	Ana desconfía del bombero que...	0.000
3d	Ana desconfió del bombero que...	0.091
4a	Fernando oye al jugador que...	0.700
4b	Fernando oyó al jugador que...	0.400
4c	Fernando entrena con el jugador que...	0.000
4d	Fernando entrenó con el jugador que...	0.000
5a	Daniela ve al profesor que...	0.364
5b	Daniela vio al profesor que...	0.556
5c	Daniela trabaja con el profesor que...	0.000
5d	Daniela trabajó con el profesor que...	0.200
6a	Andrea oye al chico que...	0.600
6b	Andrea oyó al chico que...	0.727
6c	Andrea estudia con el chico que...	0.000

6d	Andrea estudió con el chico que...	0.200
7a	Alejandro oye al inquilino que...	0.333
7b	Alejandro oyó al inquilino que...	0.400
7c	Alejandro sale con el inquilino que...	0.100
7d	Alejandro salió con el inquilino que...	0.091
8a	Rafael observa al biólogo que...	0.600
8b	Rafael observó al biólogo que...	0.400
8c	Rafael entrena con el biólogo que...	0.182
8d	Rafael entrenó con el biólogo que...	0.000
9a	Isabel escucha al instructor que...	0.727
9b	Isabel escuchó al instructor que...	0.556
9c	Isabel sale con el instructor que...	0.000
9d	Isabel salió con el instructor que...	0.000
10a	Manolo ve al dentista que...	0.500
10b	Manolo vio al dentista que...	0.182
10c	Manolo vive con el dentista que...	0.000
10d	Manolo vivió con el dentista que...	0.000
11a	Vanesa ve al carnicero que...	0.556
11b	Vanesa vio al carnicero que...	0.700
11c	Vanesa coopera con el carnicero que...	0.100
11d	Vanesa cooperó con el carnicero que...	0.091
12a	Ricardo mira al policía que...	0.300
12b	Ricardo miró al policía que...	0.600
12c	Ricardo trabaja con el policía que...	0.000
12d	Ricardo trabajó con el policía que...	0.000
13a	Eduardo oye al joven que...	0.636
13b	Eduardo oyó al joven que...	0.667
13c	Eduardo vive con el joven que...	0.100
13d	Eduardo vivió con el joven que...	0.100
14a	Magdalena mira al abogado que...	0.500
14b	Magdalena miró al abogado que...	0.182
14c	Magdalena trabaja para el abogado que...	0.111
14d	Magdalena trabajó para el abogado que...	0.000
15a	Guillermo ve a la cantante que...	0.333
15b	Guillermo vio a la cantante que...	0.300
15c	Guillermo se fía de la cantante que...	0.200
15d	Guillermo se fió de la cantante que...	0.000
16a	Antonio ve al barbero que...	0.300
16b	Antonio vio al barbero que...	0.400
16c	Antonio colabora con el barbero que...	0.182
16d	Antonio colaboró con el barbero que...	0.222
17a	Juan observa al concejal que...	0.364
17b	Juan observó al concejal que...	0.667
17c	Juan se fía del concejal que...	0.100
17d	Juan se fió del concejal que...	0.000
18a	Pedro observa al bandido que...	0.600
18b	Pedro observó al bandido que...	0.727
18c	Pedro convive con el bandido que...	0.000

Item condition	Sentence	Mean PR-compatibility
18d	Pedro convivió con el bandido que...	0.000
19a	Teresa escucha al viejito que...	0.556
19b	Teresa escuchó al viejito que...	0.400
19c	Teresa estudia con el viejito que...	0.200
19d	Teresa estudió con el viejito que...	0.000
20a	Santiago mira al médico que...	0.500
20b	Santiago miró al médico que...	0.500
20c	Santiago discrepa del médico que...	0.000
20d	Santiago discrepó del médico que...	0.111
21a	Gustavo mira al ingeniero que...	0.455
21b	Gustavo miró al ingeniero que...	0.556
21c	Gustavo colabora con el ingeniero que...	0.000
21d	Gustavo colaboró con el ingeniero que...	0.200
22a	Cristina escucha al escritor que...	0.500
22b	Cristina escuchó al escritor que...	0.455
22c	Cristina desconfía del escritor que...	0.125
22d	Cristina desconfió del escritor que...	0.000
23a	Raquel mira al diputado que...	0.889
23b	Raquel miró al diputado que...	0.800
23c	Raquel confía en el diputado que...	0.000
23d	Raquel confió en el diputado que...	0.000
24a	Carlota observa a la señora que...	0.800
24b	Carlota observó a la señora que...	1.000
24c	Carlota convive con la señora que...	0.182
24d	Carlota convivió con la señora que...	0.444

Table IV.2: Mean PR-compatible proportions in the English completion task across items and conditions in the completion task condition a = perceptual + present, condition b = perceptual + past, condition c = stative + present, condition d = stative + past)

Item condition	Sentence	Mean PR-compatibility
1a	James looks at the doctor that...	0.20
1b	James looked at the doctor that...	0.00
1c	James disagrees with the doctor that...	0.00
1d	James disagreed with the doctor that...	0.00
2a	Vincent listens to the student that...	0.10
2b	Vincent listened to the student that...	0.20
2c	Vincent cooperates with the student that...	0.00
2d	Vincent cooperated with the student that...	0.00
3a	Anna looks at the fireman that...	0.11
3b	Anna looked at the fireman that...	0.20
3c	Anna mistrusts the fireman that...	0.11
3d	Anna mistrusted the fireman that...	0.00
4a	Jasper hears the player that...	0.11
4b	Jasper heard the player that...	0.10
4c	Jasper trains with the player that...	0.00

4d	Jasper trained with the player that...	0.00
5a	Danielle sees the professor that...	0.00
5b	Danielle saw the professor that...	0.00
5c	Danielle works with the professor that...	0.10
5d	Danielle worked with the professor that...	0.00
6a	Andrea hears the boy that...	0.20
6b	Andrea heard the boy that...	0.20
6c	Andrea studies with the boy that...	0.00
6d	Andrea studied with the boy that...	0.00
7a	Alex hears the tenant that...	0.00
7b	Alex heard the tenant that...	0.00
7c	Alex hangs out with the tenant that...	0.10
7d	Alex hung out with the tenant that...	0.00
8a	Raphael hears the biologist that...	0.10
8b	Raphael heard the biologist that...	0.33
8c	Raphael trains with the biologist that...	0.10
8d	Raphael trained with the biologist that...	0.00
9a	Isobel listens to the instructor that...	0.33
9b	Isobel listened to the instructor that...	0.30
9c	Isobel hangs out with the instructor that...	0.20
9d	Isobel hung out with the instructor that...	0.00
10a	Michael sees the dentist that...	0.00
10b	Michael saw the dentist that...	0.00
10c	Michael lives with the dentist that...	0.10
10d	Michael lived with the dentist that...	0.00
11a	Vanessa sees the butcher that...	0.10
11b	Vanessa saw the butcher that...	0.00
11c	Vanessa cooperates with the butcher that...	0.44
11d	Vanessa cooperated with the butcher that...	0.13
12a	Richard looks at the policeman that...	0.30
12b	Richard looked at the policeman that...	0.20
12c	Richard works with the policeman that...	0.00
12d	Richard worked with the policeman that...	0.10
13a	Edward hears the young man that...	0.00
13b	Edward heard the young man that...	0.11
13c	Edward lives with the young man that...	0.10
13d	Edward lived with the young man that...	0.00
14a	Martha looks at the lawyer that...	0.30
14b	Martha looked at the lawyer that...	0.00
14c	Martha works with the lawyer that...	0.10
14d	Martha worked with the lawyer that...	0.00
15a	William sees the singer that...	0.10
15b	William saw the singer that...	0.10
15c	William trusts the singer that...	0.22
15d	William trusted the singer that...	0.00
16a	Anthony sees the barber that...	0.20
16b	Anthony saw the baber that...	0.00
16c	Anthony collaborates with the barber that...	0.38

16d	Anthony collaborated with the barber that...	0.00
17a	John hears the city councillor that...	0.22
17b	John heard the city councillor that...	0.20
17c	John trusts in the city councillor that...	0.20
17d	John trusted in the city councillor that...	0.25
18a	Peter sees the bandit that...	0.20
18b	Peter saw the bandit that...	0.00
18c	Peter lives with the bandit that...	0.10
18d	Peter lived with the bandit that...	0.00
19a	Theresa listens to the old man that...	0.30
19b	Theresa listened to the old man that...	0.10
19c	Theresa studies with the old man that...	0.00
19d	Theresa studied with the old man that...	0.00
20a	Martin looks at the engineer that...	0.11
20b	Martin looked at the engineer that...	0.20
20c	Martin works with the engineer that...	0.10
20d	Martin worked with the engineer that...	0.10
21a	Christine listens to the writer that...	0.30
21b	Christine listened to the writer that...	0.00
21c	Christine mistrusts the writer that...	0.30
21d	Christine mistrusted the writer that...	0.00
22a	Rachel looks at the deputy that...	0.00
22b	Rachel looked at the deputy that...	0.00
22c	Rachel trusts the deputy that...	0.00
22d	Rachel trusted in the deputy that...	0.00
23a	Charlotte sees the woman that...	0.00
23b	Charlotte saw the woman that...	0.00
23c	Charlotte lives with the woman that...	0.10
23d	Charlotte lived with the woman that...	0.00
24a	Felix hears the boy that...	0.30
24b	Felix heard the boy that...	0.10
24c	Felix trusts the boy that...	0.22
24d	Felix trusted in the boy that...	0.17

V

Lexical-semantic variables control (Chapter VI)

Lexical-semantic variables were controlled in this experiment to prevent any potential confound. The two antecedent DPs (DP1 and DP2) and the disambiguating words were matched for length, frequency, concreteness, arousal and valence. The values for length and frequency were obtained from EsPal database (Duchon et al., 2013). The rest of values (concreteness, arousal and valence), not available in the database, were obtained from a series of questionnaires designed for this purpose. Sixty-three Spanish native speakers (mean= 19.44, sd= 3.13, 60 women) participated in the questionnaire survey voluntarily. Participants had to rate the concreteness of the words in a scale ranging from 1 to 7, and arousal and valence in a scale ranging from 1 to 9. A series of analyses were performed to compare these values in DP1 versus DP2, in masculine versus femenine disambiguating words, and in high-attaching versus low-attaching disambiguating words. The results did not show any statistical difference (all ps>.05). Final values for each variable are represented in table V.1 for DP1 and DP2, table V.2 for critical word disambiguated toward DP1 (High) and critical word disambiguated toward DP2 (Low), and table V.3 for masculine and feminine critical disambiguation word.

Table V.1: Mean (sd) values for words in DP1 and DP2

	DP1	DP2
Length	8.63 (2.09)	8.88 (2.49)
Frequency	3.38 (0.78)	3.32 (0.73)
Concreteness	5.62 (0.65)	5.84 (0.43)
Arousal	4.11 (0.55)	4.03 (0.50)
Valence	5.04 (0.53)	4.96 (0.50)

Table V.2: Mean (sd) values for the disambiguating word in high and low attachment conditions.

	High	Low
Length	8.90 (1.84)	8.90 (1.84)
Frequency	3.48 (0.81)	3.43 (0.79)
Concreteness	3.41 (0.88)	3.47 (0.92)
Arousal	5.44 (1.60)	5.40 (1.67)
Valence	4.50 (2.34)	4.44 (2.32)

Table V.3: Mean (sd) values for masculine and feminine disambiguating word.

	Masc	Fem
Length	8.91 (1.84)	8.91 (1.84)
Frequency	3.59 (0.80)	3.33 (0.79)
Concreteness	3.43 (0.94)	3.45 (0.86)
Arousal	5.35 (1.62)	5.50 (1.64)
Valence	4.35 (2.30)	4.60 (2.35)

Materials eye-tracking study on attachment (Chapter VI)

Table VI.1: Target items across conditions employed in the first eye-tracking study (condition a = perceptual + high attachment, condition b = perceptual + low attachment, condition c = stative + high attachment, condition d = stative + low attachment)

Item		Sentence
1	a	Ángel vio al monaguillo de la sacerdotisa que rezaba arrodillado en el banco.
	b	Ángel vio al monaguillo de la sacerdotisa que rezaba arrodillada en el banco.
	c	Ángel conocía al monaguillo de la sacerdotisa que rezaba arrodillado en el banco.
	d	Ángel conocía al monaguillo de la sacerdotisa que rezaba arrodillada en el banco.
2	a	Jesús oyó al fontanero de la arrendataria que dialogaba entretenido con los vecinos.
	b	Jesús oyó al fontanero de la arrendataria que dialogaba entretenida con los vecinos.
	c	Jesús trabajó con el fontanero de la arrendataria que dialogaba entretenido con los vecinos.
	d	Jesús trabajó con el fontanero de la arrendataria que dialogaba entretenida con los vecinos.
3	a	Marina miró a la interlocutora del rabino que pactaba inquieto el nuevo horario.
	b	Marina miró a la interlocutora del rabino que pactaba inquieta el nuevo horario.
	c	Marina colaboró con la interlocutora del rabino que pactaba inquieto el nuevo horario.
	d	Marina colaboró con la interlocutora del rabino que pactaba inquieta el nuevo horario.
4	a	Teresa escuchó al adjunto de la funcionaria que telefoneaba preocupado al centro deportivo.
	b	Teresa escuchó al adjunto de la funcionaria que telefoneaba preocupada al centro deportivo.
	c	Teresa se casó con el adjunto de la funcionaria que telefoneaba preocupado al centro deportivo.
	d	Teresa se casó con el adjunto de la funcionaria que telefoneaba preocupada al centro deportivo.
5	a	Marisa oyó al técnico de la subdirectora que respondía dudoso a las preguntas.
	b	Marisa oyó al técnico de la subdirectora que respondía dudosa a las preguntas.
	c	Marisa conocía al técnico de la subdirectora que respondía dudoso a las preguntas.
	d	Marisa conocía al técnico de la subdirectora que respondía dudosa a las preguntas.
6	a	Montse observó al confesor de la monja que paseaba taciturno por los pasillos.

	b	Montse observó al confesor de la monja que paseaba taciturna por los pasillos.
	c	Montse escribió al confesor de la monja que paseaba taciturno por los pasillos.
	d	Montse escribió al confesor de la monja que paseaba taciturna por los pasillos.
7	a	Marga vio a la analista del diplomático que bromeaba animado en la celebración.
	b	Marga vio a la analista del diplomático que bromeaba animada en la celebración.
	c	Marga colaboró con la analista del diplomático que bromeaba animado en la celebración.
	d	Marga colaboró con la analista del diplomático que bromeaba animada en la celebración.
8	a	Judith miró a la descendiente del cónsul que caminaba armado con una pistola.
	b	Judith miró a la descendiente del cónsul que caminaba armada con una pistola.
	c	Judith trabajó con la descendiente del cónsul que caminaba armado con una pistola.
	d	Judith trabajó con la descendiente del cónsul que caminaba armada con una pistola.
9	a	David escuchó a la asistente del congresista que charlaba tranquilo en la reunión.
	b	David escuchó a la asistente del congresista que charlaba tranquila en la reunión.
	c	David se casó con la asistente del congresista que charlaba tranquilo en la reunión.
	d	David se casó con la asistente del congresista que charlaba tranquila en la reunión.
10	a	Isabel observó al preparador de la golfista que gesticulaba agitado en el campo.
	b	Isabel observó al preparador de la golfista que gesticulaba agitada en el campo.
	c	Isabel escribió al preparador de la golfista que gesticulaba agitado en el campo.
	d	Isabel escribió al preparador de la golfista que gesticulaba agitada en el campo.
11	a	Juan observó al monitor de la submarinista que fotografiaba entusiasmado estrellas de mar.
	b	Juan observó al monitor de la submarinista que fotografiaba entusiasmada estrellas de mar.
	c	Juan trabajó con el monitor de la submarinista que fotografiaba entusiasmado estrellas de mar.
	d	Juan trabajó con el monitor de la submarinista que fotografiaba entusiasmada estrellas de mar.
12	a	Arturo oyó a la asesora del fabricante que charlaba tumbado en la butaca.
	b	Arturo oyó a la asesora del fabricante que charlaba tumbada en la butaca.
	c	Arturo colaboró con la asesora del fabricante que charlaba tumbado en la butaca.
	d	Arturo colaboró con la asesora del fabricante que charlaba tumbada en la butaca.
13	a	Paco vio a la limpiadora del duque que revisaba obsesionado la previsión del tiempo.
	b	Paco vio a la limpiadora del duque que revisaba obsesionada la previsión del tiempo.
	c	Paco se casó con la limpiadora del duque que revisaba obsesionado la previsión del tiempo.
	d	Paco se casó con la limpiadora del duque que revisaba obsesionada la previsión del tiempo.
14	a	Laura vio a la nutricionista del conde que corría fatigado en la maratón.
	b	Laura vio a la nutricionista del conde que corría fatigada en la maratón.
	c	Laura conocía a la nutricionista del conde que corría fatigado en la maratón.
	d	Laura conocía a la nutricionista del conde que corría fatigada en la maratón.
15	a	Leticia miró a la becaria del funcionario que fumaba pensativo en el pasillo.
	b	Leticia miró a la becaria del funcionario que fumaba pensativa en el pasillo.
	c	Leticia escribió a la becaria del funcionario que fumaba pensativo en el pasillo.
	d	Leticia escribió a la becaria del funcionario que fumaba pensativa en el pasillo.
16	a	Pablo escuchó al hijastro de la camionera que canturreaba despreocupado en el bar.
	b	Pablo escuchó al hijastro de la camionera que canturreaba despreocupada en el bar.
	c	Pablo trabajó con el hijastro de la camionera que canturreaba despreocupado en el bar.
	d	Pablo trabajó con el hijastro de la camionera que canturreaba despreocupada en el bar.
17	a	Laura oyó a la inquilina del casero que cantaba afónico en la verbena.
	b	Laura oyó a la inquilina del casero que cantaba afónica en la verbena.
	c	Laura colaboró con la inquilina del casero que cantaba afónico en la verbena.
	d	Laura colaboró con la inquilina del casero que cantaba afónica en la verbena.
18	a	Ana observó al gestor de la empresaria que conducía estresado por la ciudad.

	b	Ana observó al gestor de la empresaria que conducía estresada por la ciudad.
	c	Ana se casó con el gestor de la empresaria que conducía estresado por la ciudad.
	d	Ana se casó con el gestor de la empresaria que conducía estresada por la ciudad.
19	a	Ángela vio a la asistenta del farmacéutico que ordenaba concentrado el nuevo pedido.
	b	Ángela vio a la asistenta del farmacéutico que ordenaba concentrada el nuevo pedido.
	c	Ángela trabajó con la asistenta del farmacéutico que ordenaba concentrado el nuevo pedido.
	d	Ángela trabajó con la asistenta del farmacéutico que ordenaba concentrada el nuevo pedido.
20	a	Elena miró al alumno de la mecánica que reposaba cansado en el taller.
	b	Elena miró al alumno de la mecánica que reposaba cansada en el taller.
	c	Elena conocía al alumno de la mecánica que reposaba cansado en el taller.
	d	Elena conocía al alumno de la mecánica que reposaba cansada en el taller.
21	a	Araceli escuchó al mensajero de la emperatriz que leia apenado la nueva noticia.
	b	Araceli escuchó al mensajero de la emperatriz que leia apenada la nueva noticia.
	c	Araceli escribió al mensajero de la emperatriz que leia apenado la nueva noticia.
	d	Araceli escribió al mensajero de la emperatriz que leia apenada la nueva noticia.
22	a	Mario oyó a la administrativa del vicepresidente que carraspeaba nervioso por la situación.
	b	Mario oyó a la administrativa del vicepresidente que carraspeaba nerviosa por la situación.
	c	Mario colaboró con la administrativa del vicepresidente que carraspeaba nervioso por la situación.
	d	Mario colaboró con la administrativa del vicepresidente que carraspeaba nerviosa por la situación.
23	a	Paloma miró al redactor de la senadora que sonreía satisfecho en el homenaje.
	b	Paloma miró al redactor de la senadora que sonreía satisfecha en el homenaje.
	c	Paloma se casó con el redactor de la senadora que sonreía satisfecho en el homenaje.
	d	Paloma se casó con el redactor de la senadora que sonreía satisfecha en el homenaje.
24	a	Jorge observó al sastre de la marquesa que lloraba afectado por la pérdida.
	b	Jorge observó al sastre de la marquesa que lloraba afectada por la pérdida.
	c	Jorge conocía al sastre de la marquesa que lloraba afectado por la pérdida.
	d	Jorge conocía al sastre de la marquesa que lloraba afectada por la pérdida.
25	a	Sergio vio a la sirvienta del archiduque que reñía indignado al personal nuevo.
	b	Sergio vio a la sirvienta del archiduque que reñía indignada al personal nuevo.
	c	Sergio se casó con la sirvienta del archiduque que reñía indignado al personal nuevo.
	d	Sergio se casó con la sirvienta del archiduque que reñía indignada al personal nuevo.
26	a	Susana miró al chófer de la duquesa que conversaba contento en el café.
	b	Susana miró al chófer de la duquesa que conversaba contenta en el café.
	c	Susana trabajó con el chófer de la duquesa que conversaba contento en el café.
	d	Susana trabajó con el chófer de la duquesa que conversaba contenta en el café.
27	a	Iván vio a la paciente del podólogo que comía desganado en el restaurante.
	b	Iván vio a la paciente del podólogo que comía desganada en el restaurante.
	c	Iván colaboró con la paciente del podólogo que comía desganado en el restaurante.
	d	Iván colaboró con la paciente del podólogo que comía desganada en el restaurante.
28	a	José escuchó al ayudante de la arqueóloga que comunicaba orgulloso el hallazgo realizado.
	b	José escuchó al ayudante de la arqueóloga que comunicaba orgullosa el hallazgo realizado.
	c	José escribió al ayudante de la arqueóloga que comunicaba orgulloso el hallazgo realizado.
	d	José escribió al ayudante de la arqueóloga que comunicaba orgullosa el hallazgo realizado.
29	a	Carlos vio a la abogada del concejal que asistía angustiado al encuentro.
	b	Carlos vio a la abogada del concejal que asistía angustiada al encuentro.
	c	Carlos conocía a la abogada del concejal que asistía angustiado al encuentro.
	d	Carlos conocía a la abogada del concejal que asistía angustiada al encuentro.
30	a	Mireia oyó al entrenador de la tenista que lamentaba decepcionado la derrota.

	b	Mireia oyó al entrenador de la tenista que lamentaba decepcionada la derrota.
	c	Mireia trabajó con el entrenador de la tenista que lamentaba decepcionado la derrota.
	d	Mireia trabajó con el entrenador de la tenista que lamentaba decepcionada la derrota.
31	a	Silvia escuchó a la psicóloga del actor que hablaba apasionado de su trabajo.
	b	Silvia escuchó a la psicóloga del actor que hablaba apasionada de su trabajo.
	c	Silvia escribió a la psicóloga del actor que hablaba apasionado de su trabajo.
	d	Silvia escribió a la psicóloga del actor que hablaba apasionada de su trabajo.
32	a	Antonio miró al manager de la pianista que reía dichoso en la fiesta.
	b	Antonio miró al manager de la pianista que reía dichosa en la fiesta.
	c	Antonio conocía al manager de la pianista que reía dichoso en la fiesta.
	d	Antonio conocía al manager de la pianista que reía dichosa en la fiesta.

VII

Supplementary information of the eye-tracking study (Chapter VI)

Table VII.1: Summary of mean reading times at the 'que' region (with standard deviations in parentheses)

Measures	mean (sd)
First Fixation duration	
Perceptual + HA	221.36 (44)
Perceptual + LA	229.84 (60)
Stative + HA	217.754 (59)
Stative + LA	212.63 (50)
First pass	
Perceptual + HA	228.73 (48)
Perceptual + LA	244.54 (72)
Stative + HA	294.86 (226)
Stative + LA	224.51 (71)
Regression Path duration	
Perceptual + HA	304.14 (185)
Perceptual + LA	345.03 (273)
Stative + HA	406.42 (430)
Stative + LA	353.82 (315)
Total times	
Perceptual + HA	291.97 (120)
Perceptual + LA	309.77 (152)
Stative + HA	361.27 (170)
Stative + LA	322.03 (154)
Regressions-out	
Perceptual + HA	0.14 (0.26)
Perceptual + LA	0.12 (0.17)
Stative + HA	0.09 (0.19)
Stative + LA	0.14 (0.24)
Skipping rates	
Perceptual + HA	0.60 (0.28)
Perceptual + LA	0.64 (0.29)
Stative + HA	0.67 (0.27)
Stative + LA	0.66 (0.28)

Table VII.2: Summary of LME analyses of log first fixation, first pass, go-past and total time, and probability of regressions-out and Skipping rates at the 'que' region

Measure and condition	Estimate	SE	t/z-value	p-value
First fixation				
Verb type	-0.03	0.03	-0.87	0.385
Attachment	0.02	-0.03	0.67	0.501
Verb type*Attachment	0.00	0.05	-0.04	0.971
First pass				
Verb type	0.05	0.04	1.12	0.264
Attachment	0.03	0.04	0.75	0.454
Verb type*Attachment	-0.08	0.06	-1.26	0.206
Regression Path duration				
Verb type	0.019	0.069	0.284	0.776
Attachment	0.011	0.068	0.165	0.868
Verb type*Attachment	0.017	0.099	0.180	0.857
Total Time				
Verb type	0.09	0.05	1.67	0.096
Attachment	0.04	0.05	0.75	0.456
Verb type*Attachment	-0.05	0.07	-0.61	0.541
Regressions-out				
Verb type	-0.44	0.42	-1.03	0.302
Attachment	-0.17	0.39	-0.44	0.663
Verb type*Attachment	0.72	0.58	1.24	0.214
Skipping rates				
Verb type	-0.40	0.18	-2.25	0.025
Attachment	-0.25	0.18	0.18	0.179
Verb type*Attachment	0.32	0.25	1.26	0.207

Table VII.3: Summary of mean reading times at the embedded verb region (with standard deviations in parentheses)

Measures	mean (sd)
First Fixation duration	
Perceptual + HA	251.78 (51)
Perceptual + LA	252.03 (57)
Stative + HA	250.61 (47)
Stative + LA	248.85 (57)
First pass	
Perceptual + HA	403.81 (157)
Perceptual + LA	413.83 (158)
Stative + HA	372.14 (94)
Stative + LA	405.14 (146)
Regression Path duration	
Perceptual + HA	585.45 (450)
Perceptual + LA	567.06 (303)
Stative + HA	721.32 (822)
Stative + LA	584.98 (329)
Total times	
Perceptual + HA	632 (215)
Perceptual + LA	674.82 (204)
Stative + HA	702.69 (271)
Stative + LA	713.80 (306)
Regressions-out	
Perceptual + HA	0.16 (0.20)
Perceptual + LA	0.19 (0.18)
Stative + HA	0.22 (0.22)
Stative + LA	0.18 (0.16)
Skipping rates	
Perceptual + HA	0.12 (0.19)
Perceptual + LA	0.14 (0.22)
Stative + HA	0.14 (0.21)
Stative + LA	0.13 (0.20)

Table VII.4: Summary of LME analyses of log first fixation, first pass, go-past and total time, and proportion of regressions-out and Skipping rates at the embedded verb region

Measure and condition	Estimate	SE	t/z-value	p-value
First fixation duration				
Effect of Verb type	0.00	0.03	0.09	0.931
Effect of Attachment	-0.02	0.03	-0.83	0.406
Verb type*Attachment	0.01	0.04	0.32	0.750
First pass				
Effect of Verb type	-0.03	0.04	-0.72	0.470
Effect of Attachment	0.02	0.04	0.61	0.542
Verb type*Attachment	0.01	0.05	0.17	0.863
Regression Path duration				
Effect of Verb type	0.10	0.05	2.05	0.041
Effect of Attachment	0.06	0.05	1.20	0.231
Verb type*Attachment	-0.09	0.07	-1.31	0.190
Total Time				
Effect of Verb type	0.06	0.04	1.42	0.153
Effect of Attachment	0.07	0.04	1.57	0.116
Verb type*Attachment	-0.06	0.06	-0.93	0.350
Regressions-out				
Effect of Verb type	0.42	0.22	1.90	0.057
Effect of Attachment	0.06	0.22	1.46	0.145
Verb type*Attachment	-0.43	0.30	-1.41	0.160
Skipping rates				
Effect of Verb type	-0.35	0.28	-1.26	0.209
Effect of Attachment	-0.32	0.28	-1.13	0.258
Verb type*Attachment	0.51	0.40	1.29	0.199

Table VII.5: Summary of mean reading times at the disambiguating region (with standard deviations in parentheses)

Measure	mean (sd)
First Fixation duration	
Perceptual + HA	265.38 (46)
Perceptual + LA	278.56 (68)
Stative + HA	287.93 (59)
Stative + LA	257.14 (44)
First pass	
Perceptual + HA	404.87 (120)
Perceptual + LA	416.211 (47)
Stative + HA	430.15 (119)
Stative + LA	383.21 (94)
Regression Path duration	
Perceptual + HA	647.81 (513)
Perceptual + LA	602.14 (13)
Stative + HA	684.62 (531)
Stative + LA	638.46 (422)
Total times	
Perceptual + HA	638.85 (207)
Perceptual + LA	737.22 (248)
Stative + HA	702.15 (225)
Stative + LA	713.42 (306)
Regressions-out	
Perceptual + HA	0.19 (0.18)
Perceptual + LA	0.13 (0.16)
Stative + HA	0.22 (0.22)
Stative + LA	0.23 (0.22)
Skipping rates	
Perceptual + HA	0.14 (0.22)
Perceptual + LA	0.14 (0.24)
Stative + HA	0.16 (0.24)
Stative + LA	0.12 (0.22)

Table VII.6: Summary of LME analyses of log first fixation, first pass, go-past and total time, and probability of regressions-out and Skipping rates at the disambiguating region

Measure and condition	Estimate	SE	t/z-value	p-value
First fixation duration				
Effect of Verb type	0.020	0.019	1.034	0.300
Effect of Attachment	-0.041	0.019	-2.093	0.036
Verb type*Attachment	-0.121	0.039	-3.091	0.001
First pass				
Effect of Verb type	0.016	0.025	0.672	0.501
Effect of Attachment	-0.045	0.025	-1.823	0.068
Verb type*Attachment	-0.111	0.050	-2.208	0.027
Regression Path Duration				
Effect of Verb type	0.045	0.032	1.415	0.157
Effect of Attachment	-0.059	0.031	-1.872	0.061
Verb type*Attachment	-0.037	0.064	-0.589	0.555
Total Time				
Effect of Verb type	0.009	0.028	0.340	0.733
Effect of Attachment	0.029	0.028	1.011	0.311
Verb type*Attachment	-0.117	0.057	-2.026	0.042
Regressions-out				
Effect of Verb type	0.353	0.161	2.188	0.028
Effect of Attachment	-0.204	0.161	-1.267	0.205
Verb type*Attachment	0.362	0.322	1.123	0.261
Skipping rates				
Effect of Verb type	-0.016	0.195	-0.083	0.934
Effect of Attachment	0.213	0.195	1.088	0.276
Verb type*Attachment	0.587	0.393	1.495	0.135

Table VII.7: Summary of mean reading times at the spillover region (with standard deviations in parentheses)

Measures	mean (sd)
First pass	
Perceptual + HA	586.36 (314)
Perception + LA	593.54 (259)
Stative + HA	561.99 (245)
Stative + LA	563.37 (262)
Go-past	
Perceptual + HA	2278.728 (1551)
Perceptual + LA	2816.089 (1980)
Stative + HA	2654.785 (1727)
Stative + LA	2960.721 (2539)
Total times	
Perceptual + HA	798.97 (358)
Perceptual + LA	895.58 (362)
Stative + HA	833.18 (410)
Stative + LA	877.16 (472)

Table VII.8: Summary of LME analyses of log first pass, go-past and total time at the spillover region

Measure and condition	Estimate	SE	t/z-value	p-value
First pass				
Verb type	-0.045	0.032	-1.392	0.163
Attachment	0.019	0.032	0.607	0.543
Verb type*Attachment	-0.069	0.065	-1.068	0.285
Regression Path Duration				
Verb type	0.0458	0.042	1.091	0.275
Attachment	0.105	0.041	2.513	0.011
Verb type*Attachment	-0.129	-0.129	-1.536	0.124
Total Time				
Verb type	-0.014	0.030	-0.469	0.638
Attachment	0.085	0.030	2.818	0.004
Verb type*Attachment	-0.120	0.060	-1.979	0.048

VIII

Acceptability judgements on aspect study (Chapter VII)

The following list presents materials used in Chapter VII in both the acceptability and the eye-tracking study. The numbers next to each item correspond to mean acceptability rates per item and condition.

Table VIII.1: Mean acceptability rates in a 10-point Likert scale across conditions (condition a = perceptual + imperfective, condition b = perceptual + perfective, condition c = stative + imperfective, condition d = stative + perfective)

Item		Sentence	Average rate
1	a	Santiago miró al médico que estaba leyendo en la sala.	9.13
	b	Santiago miró al médico que estuvo leyendo en la sala.	8.60
	c	Santiago fue amigo del médico que estaba leyendo en la sala.	8.80
	d	Santiago fue amigo del médico que estuvo leyendo en la sala.	8.40
2	a	Mar escuchó a la estudiante que estaba cantando en el karaoke.	9.40
	b	Mar escuchó a la estudiante que estuvo cantando en el karaoke.	8.87
	c	Mar hospedaba a la estudiante que estaba cantando en el karaoke.	8.93
	d	Mar hospedaba a la estudiante que estuvo cantando en el karaoke.	9.47
3	a	Ana miró al bombero que estaba corriendo en la maratón.	9.40
	b	Ana miró al bombero que estuvo corriendo en la maratón.	9.13
	c	Ana se casó con el bombero que estaba corriendo en la maratón.	8.93
	d	Ana se casó con el bombero que estuvo corriendo en la maratón.	8.93
4	a	La periodista oyó al jugador que estaba hablando en la gala.	8.67
	b	La periodista oyó al jugador que estuvo hablando en la gala.	8.93
	c	La periodista se casó con el jugador que estaba hablando en la gala.	9.33
	d	La periodista se casó con el jugador que estuvo hablando en la gala.	9.27
5	a	La directora vio al profesor que estaba cenando en la cantina.	8.67
	b	La directora vio al profesor que estuvo cenando en la cantina.	9.13
	c	La directora salió con el profesor que estaba cenando en la cantina.	9.40

	d	La directora salió con el profesor que estuvo cenando en la cantina.	9.00
6	a	Andrea vio al chico que estaba fumando en el callejón.	9.67
	b	Andrea vio al chico que estuvo fumando en el callejón.	9.27
	c	Andrea estudió con el chico que estaba fumando en el callejón.	9.20
	d	Andrea estudió con el chico que estuvo fumando en el callejón.	9.47
7	a	Luis oyó al inquilino que estaba silbando en la terraza.	9.47
	b	Luis oyó al inquilino que estuvo silbando en la terraza.	9.20
	c	Luis salía de fiesta con el inquilino que estaba silbando en la terraza.	9.07
	d	Luis salía de fiesta con el inquilino que estuvo silbando en la terraza.	8.60
8	a	Rafael miró al biólogo que estaba ayudando al estudiante.	9.07
	b	Rafael miró al biólogo que estuvo ayudando al estudiante.	9.27
	c	Rafael fue amigo del biólogo que estaba ayudando al estudiante.	9.07
	d	Rafael fue amigo del biólogo que estuvo ayudando al estudiante.	9.53
9	a	Isabel escuchó al instructor que estaba discutiendo con el examinador.	8.93
	b	Isabel escuchó al instructor que estuvo discutiendo con el examinador.	8.53
	c	Isabel salió con el instructor que estaba discutiendo con el examinador.	8.80
	d	Isabel salió con el instructor que estuvo discutiendo con el examinador.	8.73
10	a	Manolo vio al dentista que estaba jugando al ajedrez.	9.60
	b	Manolo vio al dentista que estuvo jugando al ajedrez.	8.80
	c	Manolo vivió con el dentista que estaba jugando al ajedrez.	9.07
	d	Manolo vivió con el dentista que estuvo jugando al ajedrez.	9.00
11	a	Lara vio al carnicero que estaba cocinando en el caserío.	9.27
	b	Lara vio al carnicero que estuvo cocinando en el caserío.	9.13
	c	Lara se prometió con el carnicero que estaba cocinando en el caserío.	8.87
	d	Lara se prometió con el carnicero que estuvo cocinando en el caserío.	8.87
12	a	Ricardo miró al policía que estaba paseando por la playa.	9.13
	b	Ricardo miró al policía que estuvo paseando por la playa.	9.60
	c	Ricardo trabajó con el policía que estaba paseando por la playa.	9.33
	d	Ricardo trabajó con el policía que estuvo paseando por la playa.	9.00
13	a	Eduardo oyó al joven que estaba cantando fados.	9.27
	b	Eduardo oyó al joven que estuvo cantando fados.	8.80
	c	Eduardo estudió con el joven que estaba cantando fados.	8.60
	d	Eduardo estudió con el joven que estuvo cantando fados.	8.93
14	a	La viejecita miró al abogado que estaba firmando los papeles.	9.73
	b	La viejecita miró al abogado que estuvo firmando los papeles.	8.67
	c	La viejecita trabajó para el abogado que estaba firmando los papeles.	9.33
	d	La viejecita trabajó para el abogado que estuvo firmando los papeles.	9.20
15	a	El reportero observó a la cantante que estaba pintando en el taller.	9.00
	b	El reportero observó a la cantante que estuvo pintando en el taller.	9.00
	c	El reportero se prometió con la cantante que estaba pintando en el taller.	8.80
	d	El reportero se prometió con la cantante que estuvo pintando en el taller.	7.87
16	a	El repartidor vio al barbero que estaba entrenando en el equipo.	8.33
	b	El repartidor vio al barbero que estuvo entrenando en el equipo.	8.93
	c	El repartidor trabajó con el barbero que estaba entrenando en el equipo.	8.20
	d	El repartidor trabajó con el barbero que estuvo entrenando en el equipo.	8.53
17	a	Álex observó al concejal que estaba escribiendo en la oficina.	9.47
	b	Álex observó al concejal que estuvo escribiendo en la oficina.	8.67
	c	Álex entrenaba con el concejal que estaba escribiendo en la oficina.	9.53

	d	Álex entrenaba con el concejal que estuvo escribiendo en la oficina.	9.13
18	a	El alguacil vio al bandido que estaba conduciendo en la carrera.	9.00
	b	El alguacil vio al bandido que estuvo conduciendo en la carrera.	8.40
	c	El alguacil era amigo del bandido que estaba conduciendo en la carrera.	8.87
	d	El alguacil era amigo del bandido que estuvo conduciendo en la carrera.	9.33
19	a	La vecina oyó al viejito que estaba conversando en el café.	8.93
	b	La vecina oyó al viejito que estuvo conversando en el café.	8.93
	c	La vecina estudió con el viejito que estaba conversando en el café.	8.93
	d	La vecina estudió con el viejito que estuvo conversando en el café.	8.13
20	a	La hija del decano observó al ingeniero que estaba bebiendo en el bar.	9.47
	b	La hija del decano observó al ingeniero que estuvo bebiendo en el bar.	9.33
	c	La hija del decano colaboró con el ingeniero que estaba bebiendo en el bar.	9.00
	d	La hija del decano colaboró con el ingeniero que estuvo bebiendo en el bar.	8.73
21	a	La chica escuchó al escritor que estaba llorando sus penas.	8.73
	b	La chica escuchó al escritor que estuvo llorando sus penas.	8.60
	c	La chica se casó con el escritor que estaba llorando sus penas.	9.33
	d	La chica se casó con el escritor que estuvo llorando sus penas.	8.60
22	a	Raquel miró al diputado que estaba comiendo en la cantina.	9.67
	b	Raquel miró al diputado que estuvo comiendo en la cantina.	8.73
	c	Raquel confió en el diputado que estaba comiendo en la cantina.	8.87
	d	Raquel confió en el diputado que estuvo comiendo en la cantina.	9.13
23	a	El viajero observó a la señora que estaba cosiendo en la estación.	9.40
	b	El viajero observó a la señora que estuvo cosiendo en la estación.	9.00
	c	El viajero convivió con la señora que estaba cosiendo en la estación.	8.80
	d	El viajero convivió con la señora que estuvo cosiendo en la estación.	8.67
24	a	Federico observó al niño que estaba jugando en el parque.	9.60
	b	Federico observó al niño que estuvo jugando en el parque.	9.53
	c	Federico era amigo del niño que estaba jugando en el parque.	9.33
	d	Federico era amigo del niño que estuvo jugando en el parque.	9.20
Grand mean			9.02

IX

Supplementary information of the eye-tracking study (Chapter VII)

Table IX.1: Linear mixed-effect model estimate of effect of verb type and effect of aspect on each dependent measure, on the auxiliary region, with SE of estimate, t or z value, and p-value.

Measure	Effect	Estimate	SE	t/z-value	p value
First Pass	Verb type	0.007	0.042	0.169	0.865
	Aspect	0.040	0.042	0.959	0.337
	Verb * Aspect	0.051	0.085	0.606	0.544
Go past time	Verb type	0.075	0.066	1.122	0.261
	Aspect	0.005	0.066	0.082	0.934
	Verb * Aspect	0.042	0.134	0.319	0.749
Total time	Verb type	0.006	0.043	0.156	0.875
	Aspect	0.875	0.043	0.863	0.387
	Verb * Aspect	0.043	0.087	0.491	0.622
Skipping rates	Verb type	0.498	0.167	2.971	0.002
	Aspect	0.070	0.167	0.419	0.675
	Verb * Aspect	0.138	0.334	0.416	0.677

Table IX.2: Linear mixed-effect model estimate of effect of verb type and effect of aspect on each dependent measure, on the verb region, with SE of estimate, t or z value, and p-value.

Measure	Effect	Estimate	SE	t/z-value	p value
First pass time	Verb type	-0.092	0.043	-2.094	0.036
	Aspect	0.058	0.044	1.316	0.188
	Verb * Aspect	0.112	0.088	-1.271	0.203
Go past time	Verb type	0.047	0.065	0.727	0.466
	Aspect	0.069	0.065	1.057	0.290
	Verb * Aspect	0.016	0.130	-0.125	0.900
Total times	Verb type	-0.043	0.050	-0.863	0.387
	Aspect	0.035	0.051	0.687	0.491
	Verb * Aspect	-0.114	0.102	-1.118	0.263
Skipping rates	Verb type	0.327	0.176	1.863	0.062
	Aspect	-0.221	0.175	-1.263	0.206
	Verb * Aspect	0.258	0.351	0.736	0.461

Table IX.3: Linear mixed-effect model estimate of effect of verb type and effect of aspect on each dependent measure, on the spillover region, with SE of estimate, t or z value, and p-value.

Measure	Effect	Estimate	SE	t/z-value	p value
First pass time	Verb type	-0.046	0.060	-0.766	0.443
	Aspect	-0.068	0.060	-1.144	0.252
	Verb * Aspect	-0.055	0.120	-0.462	0.643
Go past time	Verb type	-0.046	0.060	-0.766	0.443
	Aspect	-0.068	0.060	-1.144	0.252
	Verb * Aspect	-0.055	0.120	-0.462	0.643
Total times	Verb type	-0.027	0.055	-0.505	0.613
	Aspect	-0.040	0.055	-0.732	0.463
	Verb * Aspect	-0.095	0.110	-0.860	0.389