Cross-linguistic Variation in Sentence Processing
Evidence From R C Attachment Preferences in Greek

DESPINA PAPADOPOULOU
CROSS-LINGUISTIC VARIATION IN SENTENCE PROCESSING
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CROSS-LINGUISTIC VARIATION IN SENTENCE PROCESSING

Evidence from RC Attachment Preferences in Greek

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CHAPTER 1

INTRODUCTION

The central question that I will pursue in this study concerns the universality of the human sentence processing mechanism. It will be explored whether there are cross-linguistic differences in parsing by presenting psycholinguistic evidence from Greek. Empirical data collected from both native speakers and second language learners of Greek will be used to assess various parsing models and to investigate parsing mechanisms employed in Greek. The results from the L2 learners will be additionally used to shed light on the nature of sentence processing in a second language. Moreover, a supplementary objective of this study is to provide insights into the question of whether discourse biases guide initial parsing choices.

The goal of any theory of sentence processing is to determine how people arrive at the desired interpretation of a given sentence, attempting thus to investigate the very nature of the human language processor. Sentence processing is a rapid and automatic process, one which ‘is closely linked in time to the input’ (Garrett, 1990: 136, Pickering, 1999). This means that sentence processing proceeds in an incremental fashion, once each word is encountered, it is integrated to the sentence analysis. Sentence processing necessarily involves a syntactic analysis of the sentence, usually referred to as parsing, which allows the reader or listener to identify the syntactic role of words within each sentence, and an analysis which involves the use of semantic and pragmatic information to arrive at a plausible interpretation. Whether these two analyses are two distinct processes in terms of when they occur during sentence comprehension and the information they have access to is a controversial issue and one that has given rise to different theoretical proposals.
Central issues investigated in the area of sentence processing are the following:

- what is the architecture of the parser,
- what biases people use to compute the structural analysis of the sentence,
- whether there is a distinct syntactic processor,
- how and when non-grammatical factors enter into play in sentence comprehension,
- whether the human processor is universal.

An answer to these questions can be provided by observing how the parser behaves when faced with temporal syntactic ambiguity. A word string is temporally ambiguous when it is compatible with more than one structural analysis, though subsequent lexical material within the sentence resolves the ambiguity. In sentence (1), the word string *I knew the solution* is ambiguous, in that the DP *the solution* can be analysed as the direct object of the verb or as the subject of a following complement clause:

(1) I knew the solution was wrong.

This ambiguity results from the fact that the verb *know* can be subcategorised by either a simple DP or a complement clause and the verb can be viewed as the onset of the ambiguity. However, the verb *was*, provides disambiguating information and resolves the ambiguity towards the complement clause interpretation. In the famous example from Bever (1970), the verb *raced* is ambiguous in that it can be either a past tense or a past participle form:

(2) The horse raced past the barn fell.

Thus, when the verb *raced* is encountered, the parser can pursue two analyses, a main clause analysis or a reduced relative clause analysis, as shown in (2a) and (2b) respectively:

(2a) [IP [DP [D the] [NP horse]] [I’ [I ] [VP raced]]]
(2b) [IP [DP [D the] [NP [NP horse] [IP [PRO] [I’ [I ] [VP raced]]]]]]

The disambiguating information comes only at the end of the sentence with the verb *fell* which forces the reduced relative clause analysis in (2b). Most readers experience a feeling of surprise when they reach the end of sentence (2), because they initially construct the wrong analysis – the main clause interpretation – and subsequently they have to reanalyse the
sentence. Such cases are called garden-path sentences and provide evidence for the rapid, automatic and incremental nature of sentence processing (Garrett, 1990). Moreover, their careful experimental examination can inform us about whether people consider all alternative structures when faced with structural ambiguity and what determines their choice if they pursue a single analysis. Therefore, structural ambiguity provides insights on the nature of the parser.

Parsing models can be categorized according to different factors, such as (a) the procedures employed by the parser when faced with sentence fragments that are compatible with more than one analysis (serial vs. parallel parsers), (b) the type of information that determines initial parsing decisions (modular vs. interactive parsers), (c) the relation between the grammar and the parser and (d) the universality of the strategies employed by the human sentence processor (cf. Mitchell, 1994, Pickering, 1999).

One of the core questions in sentence processing concerns the universality of the parser or, to put it differently, whether there is a universal human processing mechanism or whether it is based on cross-linguistic differences. The models for sentence processing do not provide a uniform answer to this question. In fact, three broad types of models can be distinguished with respect to the way they handle cross-linguistic variation in parsing (see also Cuetos et al., 1996). First, there are universalist models of parsing, which assume that the human sentence processor is universal and its decisions are guided by universal principles (Abney, 1989, Crocker, 1996, Frazier, 1978, 1985, 1987, Frazier and Clifton, 1996, 1997, Frazier and Fodor, 1978, Frazier and Rayner, 1982, Philips, 1996, Weinberg, 2001). The second class of models, referred to as ‘parameterised’, suppose that the parsing machinery as well as the strategies the parser uses to process sentences vary from language to language in accordance with specific grammatical properties (Bates and MacWhinney, 1982, 1987, Gibson et al., 1996a, Gibson et al., 1999, Hemforth et al., 1998, MacWhinney, 1987, 1997, MacWhinney and Bates, 1989, Mazuka and Lust, 1990). The third class of models, known as experience-based, presume that parsing choices are totally based on and determined by experience considerations (MacDonald, 1993, 1994, 1997, MacDonald et al., 1994a, 1994b, Mitchell et al., 1995,

In 1988, Cuetos and Mitchell seriously questioned the universality of the parser when they showed that speakers of different languages do not employ the same parsing routines to process sentences. They examined an attachment ambiguity, in which a relative clause (RC) can be attached to either of two preceding nouns as illustrated below:

(3) The woman looked at the psychiatrist of the actress who was having a cup of coffee.

In (3) the RC who was having a cup of coffee can either refer to the actress or the psychiatrist. In off-line and on-line studies, Cuetos and Mitchell found that English speakers exhibit a preference to attach the RC to the second DP, the actress, whereas Spanish speakers preferred to attach the RC to the first DP, the psychiatrist. After these findings were brought to light, many researchers further investigated this particular ambiguity in a number of different languages. Nevertheless, the issue of cross-linguistic variation in parsing is far from being resolved, rather, it is still controversial and an open debate among researchers in the field of sentence processing.

The aim of this thesis is to contribute to the on-going debate concerning the universality of the parser by providing evidence from Greek. More specifically, I will present off-line and on-line experiments investigating the RC attachment ambiguity illustrated in (3) with native speakers and second language learners of Greek. The reason for focusing on the structure exemplified in (3) is that the RC attachment ambiguity occurs in a variety of languages and, thus, constitutes an ideal test case for investigating whether the human sentence processor varies from language to language (Cuetos et al., 1996: 148). Moreover, this particular ambiguity has been tested in many languages, which makes it possible to compare the Greek findings with the results obtained from other languages.

Data on RC attachment preferences from Greek might be attractive and revealing in several respects. First, Greek is a language that has not been widely studied, at least with respect to the parsing routines
adopted. In addition, Greek, though it is an Indo-European language, ‘forms an independent branch of the Indo-European family’ (Comrie, 1981: 198) in the sense that it does not belong to a subgroup inside the Indo-European language family as the Slavonic, the Romance and the Germanic languages do. Nevertheless, Greek shares certain characteristics with other languages spoken in the Balkan area, such as Albanian, Bulgarian, Macedonian, Romanian and Serbo-Croatian, due to the geographical closeness and contact rather than to a common ancestor (Comrie, 1981: 197–201). Thus, data from Greek might be interesting per se. Finally, the morphological and structural properties of Greek that are related to the RC attachment ambiguity provide a neat and clear example for examining the predictions of the various models that have been put forward to account for the cross-linguistic variation found in RC attachment preferences, as will be shown in chapter 3.

Moreover, chapter 4 will illustrate that the various proposals put forward to account for attachment preferences in sentences such as (4) make divergent predictions for Greek:

(4) Kapjos pirovolise ton ipireti tis ithopiu pu itan sto balkoni.

‘Someone shot the servant of the actress who was on the balcony.’

More precisely, models such as Anaphor Resolution (Hemforth et al., 1998) predict that the RC will be preferably attached low. On the contrary, the Recency/Predicate Proximity (Gibson et al., 1996a) model predicts a preference pattern for high-attachment, whereas Construal predicts divergent attachment preferences in regard to the form of the complex DP that precedes the RC. This theoretical controversy will be discussed in relation to the data obtained by speakers of Greek and it will be shown that the form of the complex DP is indeed a significant determinant of RC attachment preferences. Moreover, it will be argued that parsing mechanisms depend on language-specific properties and it will be proposed that the ‘richness’ of inflectional morphology affects the processing routines adopted in various languages.

Furthermore, part of the empirical evidence presented is collected from L2 learners of Greek with different language backgrounds. The research conducted with L2 learners will be particularly fruitful in further evaluating parsing theories and more specifically exposure-based models
for sentence processing, such as the Tuning theory (Mitchell et al., 1995), which suppose that the parser is statistically-driven and that attachment preferences are determined by the frequency with which particular ambiguities have been resolved in the past. The first languages of the participants in this study manifest the same patterns of attachment preferences as Greek. This means that these subjects are exposed to languages in which the RC attachment ambiguity is resolved in the same way. Therefore, if attachment preferences were based on experience facts, as Tuning suggests, one would expect the L2 learners not to differ from native speakers. It will be shown that the present findings point to the direction that frequency records are not the sole predictor of parsing choices.

In addition, the L2 data also shed light on the way second language learners process L2 input, an issue, which, though it has recently attracted a lot of attention, is far from being resolved. The findings to be presented suggest that (a) L2 sentence processing presents certain differences from L1 parsing, (b) there is a dissociation between grammatical knowledge of the constructions and processing routines and (c) L2 learners do not transfer parsing mechanisms directly from their first languages.

An additional aim of the experiments with native speakers is to test whether discourse factors affect parsing choices. This question arises from the controversial issue of modularity of the human sentence processor (Fodor, 1983). Modular theories assume that the parser forms the initial syntactic analysis of the sentence by making use of strictly syntactic information, whereas other factors are ignored at this initial stage (Frazier and Fodor, 1978, Frazier and Rayner, 1982). On the contrary, interactive models suppose that discourse considerations have an immediate effect on parsing decisions (Altmann and Steedman, 1988, Altmann et al., 1992, Crain and Steedman, 1985, Sedivy and Spivey-Knowlton, 1994, Spivey-Knowlton and Tanenhaus, 1994, Steedman and Altmann, 1989). In the present research, this issue is further explored by looking at whether and how discourse factors influence RC attachment preferences in Greek. It will be argued that the human sentence processor is multiple-stage, in that initial parsing decisions are determined by grammatical and lexical cues, whereas discourse-level biases are restricted by lexical/thematic information.
The structure of this book is as follows. Chapter 2 outlines and evaluates universal, parameterised and experience-based models for sentence processing. In this chapter, the postulations of the various models are described and their predictions are assessed in relation to the empirical evidence obtained from numerous languages. Chapter 3 presents and analyses the grammatical phenomena investigated in Greek. More precisely, relative clauses, genitives and prepositional phrases will be considered and discussed. In chapters 4 and 5, the experiments on RC attachment preferences with native speakers of Greek will be described and the results will be used to evaluate various parsing models. In chapter 6, previous studies that have dealt with L2 processing will be summarised and some conclusions about the nature of L2 parsing will be drawn. Furthermore, the experiments carried out with L2 learners will be described in detail and the results will be discussed in relation to sentence processing and L2 acquisition issues. In chapter 7, the implications of the findings presented in Chapters 4, 5 and 6 for parsing theories will be discussed.

NOTES

1 Throughout the book, I will refer to the attachment of the RC to the first noun as N1- or high-attachment, whereas the attachment of the RC to the second noun will be ascribed as N2- or low-attachment.
In this Chapter I will describe various parsing models and their predictions and claims will be analysed in relation to the findings obtained from studies on RC attachment preferences in different languages. As already discussed in Chapter 1, the existing sentence processing models make different postulations for the architecture of the parser. Namely, the human sentence processor might be serial or parallel, modular or interactive and the strategies it employs might be universal, parameterised or purely based on frequency records. Since the investigation of cross-linguistic effects in sentence processing is among the central aims of this book, the discussion presented in the following sections will focus on the issue of the universality of the parser. However, other issues regarding the architecture of the parser will also be touched when necessary. In addition, as the experiments reported here tested the RC attachment ambiguity, the predictions of the parsing theories will be assessed with respect to the results found from RC attachment preferences in different languages.

This chapter is divided into three sections, in which universal parsing, parameterized models and exposure-based accounts are discussed in turn.

2.1. UNIVERSAL SENTENCE PROCESSING MODELS

The belief that the human parsing mechanism is universal has dominated research in the area of sentence processing. Universal models of sentence processing assume that the architecture of the human sentence processor is the same across different languages and the parsing routines are determined by constraints posited by the Grammar (cf. Abney, 1989; Crocker, 1996; Gorrell, 1995; Philips, 1996; Pritchett, 1988, 1992;
Weinberg, 2001), by phrase-structure information (cf. Frazier, 1978, 1987; Frazier and Fodor, 1978) as well as the capacity of working memory. These assumptions make the strong prediction, also known as the ‘Representational Hypothesis’ (Frazier, 1985), that the same processing theory is adequate for all languages on the condition that language-specific characteristics are made accessible to the parser directly by the grammar.

Moreover, most universal parsing theories maintain that parsing choices are determined by a locality principle which requires new material to be attached to the phrase currently being processed and which is assumed to originate from grammatical (cf. Philips, 1996; Weinberg, 2001) or computational constraints (cf. Abney, 1989; Crocker, 1996; Frazier, 1978, 1987; Frazier and Fodor, 1978; Gorrell, 1995).

For example, consider the principle-based model postulated by Philips (1996), according to which the grammar and the parser are the same system. The only difference between the two lies in that the parser is the grammar working under limited resources, e.g. memory constraints and expectations. Philips attributes all the structural considerations involved in ambiguity resolution to a single universal principle, termed Branch Right, which is motivated by grammatical phenomena and is in fact an economy principle of the grammar. The Branch Right principle states that grammatical derivations proceed in a strictly left-to-right fashion. In the same way, the parser uses the Branch Right principle – similar to Right Association (Kimball, 1973), Late Closure (Frazier, 1978) and Recency (Gibson et al., 1996a, 1999) strategies – which favours attachments to the most right constituent. This model advocates a parsimonious system – and thus is theoretically attractive-, as there is no need to postulate a human sentence processor, namely a system that operates in addition to the grammar and is responsible for the structure building of the sentences in real time and all the structural factors that might play a role in parsing are reduced to a unique principle, namely Branch Right. Nevertheless, as will be shown later in this chapter, such a locality principle fails to explain a vast majority of cross-linguistic experimental findings (cf. Philips, 1996: 164). Such findings have prompted certain amendments of some universal parsing models, which will be the focus of Sections 2.1.1 and 2.1.2.
2.1.1. The Garden Path model

The Garden Path model (Frazier, 1978, 1987; Frazier and Fodor, 1978; Frazier and Rayner, 1982) is one of the most prominent universal theories of sentence processing. This model assumes a serial, modular and phrase-structure-driven4 parser. When faced with ambiguous material, the parser opts for one analysis rather than pursuing multiple syntactic analyses or delaying analyses of the input (cf. Clifton et al. 1991; Frazier, 1987; Frazier and Rayner, 1988: 263; and the ‘First Analysis Constraint’ proposed by Fodor, 1998). In cases where the initial preferred analysis turns out to be incorrect, the parser is led down the garden path and reanalyses the sentence. In addition, sentence comprehension consists of two distinct stages: the parsing and the interpretation stage. During the parsing phase, which is purely syntactic, the parser assigns an initial structural analysis to the input based on phrase structure rules. Moreover, during this stage the parser consults and uses solely syntactic information to arrive at the initially preferred analysis. This means that the initial syntactic analysis is pursued by an autonomous syntactic component which is insensitive to either non-syntactic information sources, such as semantic and thematic, pragmatic, discourse and general world-knowledge information (Frazier, 1987; Ferreira and Clifton, 1986). Lexical information is assumed to play a role in constructing the final interpretation of the sentence. For example, Mitchell (1987b) proposed that lexical preferences filter initial analyses and guide the reanalysis procedure. Similarly, other researchers have suggested that the thematic processor, operating in parallel with the syntactic processor, examines the alternative thematic structures and guides the parser to reanalyse the sentence and arrive at the intended interpretation (Ferreira and Henderson, 1991a, 1991b; Rayner et al., 1983). Notice that such a claim implies the sensitivity of the syntactic processor to thematic information even during the reanalysis stage (Clifton et al., 1991: 257) and the existence of ‘an interface system which operates in tandem with the language input system proper’ (Frazier, 1987: 581).

When the parser has to decide between alternative choices, as in the case of structural ambiguities, the selection of this first analysis is determined by two principled strategies, Late Closure and Minimal
Attachment (Frazier, 1987; Frazier and Fodor, 1978):

- Late Closure requires that new incoming elements be attached to the phrase currently being processed.
- Minimal Attachment requires that new incoming material be attached in a way that the fewest necessary phrase structure nodes are used in accordance with the well-formedness of language rules.

These structural principles serve to increase the speed and efficiency with which new material can be incorporated into the ongoing analysis. In addition, they are dictated by the limits of human working memory capacity and they prevent overload processing effects. Fodor (1998: 291–293), assuming that the human sentence processor is a ‘least effort’ design and its aim is to parse as quickly as possible, merges the aforementioned principles into one, the First Analysis Constraint (construct the simplest analysis), which actually results directly from the very ‘laziness’ property of the parser. Therefore, the human parser is assumed to be universal and all parsing differences observed cross-linguistically have to be attributed to specific grammatical differences between different languages.

The Late Closure principle applies when processing sentences such as (1) and it predicts that the constituent to Mary is preferably attached to the last DP constituent (the letter) rather than to the higher DPs (the memo, the note) or to the VP (read):

(1) John read the note, the memo, and the letter to Mary.

This prediction has been confirmed in several studies (Ferreira and Henderson, 1991a; Frazier and Rayner, 1982; Kennedy and Murray, 1984; Mitchell, 1987a).

However, the universal applicability of Late Closure has been challenged by Cuetos and Mitchell’s seminal study (1988), which examined RC attachment preferences in English and Spanish. The Garden Path model supposes that parsing strategies are universal and apply across languages. In sentences like (2), Late Closure predicts that people will preferably attach the RC low to the second DP, the actress:

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

Indeed, this prediction has been confirmed by empirical findings in languages like English (Cuetos and Mitchell, 1988; Frazier and Clifton,
1996; Gilboy et al., 1995; off-line studies carried out by Traxler et al., 1998), Swedish (Ehrlich et al., 1999), Norwegian (Ehrlich et al., 1999), Romanian (Ehrlich et al., 1999), Brazilian Portuguese (Miyamoto, 1998), and Arabic (Abdelghany and Fodor, 1999), where the RC is preferably attached low, to the second DP. However, the traditional Garden Path model fails to explain the preference for N1-attachment obtained in Spanish by Cuetos and Mitchell (1988) and also by subsequent studies in Spanish (Carreiras and Clifton, 1993, 1999; Gilboy et al., 1995) but also in a number of other languages. One way to interpret this result, in the Garden Path framework, is to assume that the Late Closure strategy is overridden by a discourse based strategy at the reanalysis stage of parsing. More specifically, Frazier (1990) argued that RCs are initially attached low to the second DP in accordance with Late Closure. However, a revised analysis occurs very quickly dictated by a device termed Relativized Relevance, which requires a phrase to be construed ‘as being relevant to the main assertion of the sentence’ (Frazier, 1990: 321). In the case of the RC attachment ambiguity, the main assertion of the sentence is the first DP, which is the direct object of the main verb.

DeVincenzi and Job (1993, 1995) further elaborated on the Relativized Relevance principle by postulating that this discourse based principle plays a role in attachment preferences and can force the RC to be attached to the first DP, only when the RC is within the thematic domain9 of the first DP. To test these predictions, DeVincenzi and Job (1993, 1995) conducted a self-paced reading task on RC attachment preferences in Italian under two conditions. In the first condition, they used a non-theta assigning preposition (di = of), whereas in the second condition they used a theta-assigning preposition (con = with). The disambiguation towards high- or low-attachment was rendered by gender information on the past participle inside the RC.:

- DP1 – di (of) – DP2 – RC

(3) L’ avvocato diffida /10 del padre / della ragazza / che si e tradit\-a-o / al processo.
‘The lawyer suspects the father of the girl who betrayed herself/himself at the trial.’
DP1 – con (with) – DP2 – RC

(4) Nessuno invito / il regista / con la bella amica / che era rimasta-o / a bere.

“Nobody invited the movie director with the beautiful girlfriend who remained-fem/masc to drink.”

The sentences were followed by a comprehension question about the attachment of the RC. The results showed an initial low RC attachment preference on the disambiguating segment across conditions, whereas the answers to the comprehension questions revealed a low-attachment preference for the condition with the preposition con and a high-attachment preference for the sentences with the preposition di. DeVincenzi and Job suggested that this finding is the result of the Relativized Relevance principle, which is constrained by thematic information. In the di-sentences, both nouns are available hosts for the RC, because the second DP belongs to the same thematic domain as the first DP. Thus, Relativized Relevance can operate and override the initial low-attachment preference, since the first DP is accessible for the attachment of the RC. In contrast, in the con-sentences, only the second DP belongs to the last thematic domain, because the lexical preposition con instantiates a new thematic domain. Therefore, the first DP is not an available host for the RC and the Relativized Relevance principle cannot enter into play. The same findings have been obtained in a French study by Baccino et al. (2000). These results support the Garden Path model, as Late Closure was found to determine initial parsing decisions, whereas thematic and pragmatic considerations affected only the final interpretations. Notice, however, that there are three potential problems with the studies conducted by DeVincenzi and Job (1993, 1995) and Baccino et al. (2000), which might have affected the findings: (a) in both studies different nouns for the of- and the with-condition have been used (cf. (3) and (4)), (b) the accuracy rates for the critical sentences in the French study were very low, probably because the masculine and the feminine forms of the disambiguating participle coincide phonologically, and (c) erroneous responses were not excluded from the RT analyses in the French study. Nonetheless, similar results, namely a low-attachment preference on
the disambiguating segment and a high-attachment preference in later segments and comprehension questions, have also been found for complex DPs with genitives in a typologically different language, Japanese (Kamide and Mitchell, 1997).

Nevertheless, though the Garden Path model accounts for the data from some languages, it cannot explain the initial overwhelming high-attachment preference obtained in a number of different languages, like Afrikaans (Mitchell et al., 2000), Dutch (Brysbaert and Mitchell, 1996; Mitchell and Brysbaert, 1998; Mitchell et al., 2000; Wijnen, 1998), French (Frenck-Mestre and Pynte, 2000; Zagar et al., 1997), German (Hemforth et al., 1996; Hemforth et al., 1998, 1999; Walter et al., 1999), Russian (Kempe and Radach, 1993) and Spanish (Carreiras and Clifton, 1993, 1999; Gilboy et al., 1995). The suggestion that the high-attachment preference could reflect final rather than initial attachment preferences is questioned by the fact that most studies have used on-line techniques, such as self-paced reading tasks and eye-tracking experiments, which are supposed to be sensitive enough to capture initial parsing preferences (Zagar et al., 1997). In addition, experiments on Dutch (Brysbaert and Mitchell, 1996; Mitchell and Brysbaert, 1998) that used materials with early disambiguation13 failed to provide support of an initial low-attachment preference for the RC, which would be overridden by a final high-attachment preference. This means that the high-attachment preference for the RC observed in a variety of languages must be the result of initial parsing and that Late Closure fails to adequately account for this fact.

However, in more recent studies it has been argued that the initial high-attachment preference observed in languages such as Spanish is due to the use of gender disambiguation. For example, Fernández (2003) investigated RC-attachment preferences for complex DPs involving non theta-assigning prepositions with native speakers of English and Spanish using number instead of gender disambiguation, as shown in (5) and (6) below:

- High-attachment

(5) … the nephew of the teachers that was divorced
(5’) … el sobrino de los maestros que estaba divorciado14
• Low-attachment

(6) … the daughter of the hostages that were waiting
(6’) … la hija de los rehenes que estaban esperando

In an off-line attachment judgment experiment, she found low and high-attachment preferences for English and Spanish respectively, as has been attested in previous studies. On the other hand, in the self-paced reading task, she found that both language groups behaved uniformly manifesting a low-attachment preference. These findings have been replicated by Carreiras et al. (2001) in a Spanish eye-tracking study with materials disambiguated either via gender or via number disambiguation, as illustrated below:

• Gender disambiguation – high-attachment:

(7a) Raúl castigó al criado de la actriz que estaba divorciado y contento.
     ‘Raúl punished the butler of the actress who was divorced-M and pleased.’

• Gender disambiguation – low-attachment:

(7b) Raúl castigó a la criada del actor que estaba divorciado y contento.
     ‘Raúl punished the maid of the actor who was divorced-M and pleased.’

• Number disambiguation – high-attachment:

(8a) Raúl castigó al criado de los actores que estaba divorciado y contento.
     ‘Raul hit the butler of the actors who was divorced-M and pleased.’

• Number disambiguation – low-attachment:

(8b) Raúl castigó a los criados del actor que estaba divorciado y contento.
     ‘Raul hit the butlers of the actor who was divorced-M and pleased.’

Sentences disambiguated via gender yielded high-attachment preference as in other studies in Spanish. However, the sentences disambiguated via number showed a low-attachment preference. Fernández and Carreiras et al. maintain that number information is purely syntactic and, thus,
controlled by Late Closure, whereas gender information may also be accessed via semantic and pragmatic correlates and, hence, is influenced by extra-syntactic factors. Notice, however, that according to certain syntactic accounts Gender is assumed to be a formal feature of nouns and determines relationships between elements within and between phrases via the configurational operation of feature checking Agree\textsuperscript{15} (cf. Carstens, 2000; Jakubowicz and Faussart, 1998; Jakubowicz and Roulet, to appear; Tsimpili, 2003). If this is so, then the concord between a noun and an adjective is a purely syntactic operation of the computational component of the language faculty as conceived by Chomsky (2001). In any case, the divergent results between number- and gender-disambiguated sentences have interesting implications for the effects of morphological cues on sentence processing and require further investigation.

2.1.2. Construal theory

Another universal parsing account – which is a more radically refined version of the Garden Path model – is Construal (Frazier and Clifton, 1996, 1997). The main difference between the Garden Path model and the Construal theory is that the latter assumes different parsing mechanisms for different constructions. More specifically, syntactic constructions are divided into two sets: primary and non-primary phrases. Primary relations or primary phrases include the subject and main predicate of any finite clause as well as the complements and obligatory constituents of primary phrases (Frazier and Clifton, 1996: 41). All other kinds of relations are termed non-primary relations. Construal theory postulates that only primary relations are parsed in a deterministic way, as specified by the Garden Path model, and along with Late Closure and Minimal Attachment. Non-primary relations, instead of being processed by the use of the universal parsing principles, are parsed in a non-deterministic way and they are associated to, instead of being attached to, one domain in terms of the Construal principle, which includes thematic and interpretation processes. Construal hypothesis (Frazier and Clifton, 1997: 279) states:

(9a) Analyse an input, X, as instantiating a primary phrase if possible.
(9b) Otherwise associate X into the current thematic processing domain (the extended projection of the last theta-assigner).
Thus, an underspecified analysis is assigned only to non-primary relations; in that respect, Construal is a theory of syntactic underspecification and can be seen as a development of parsing proposals that emphasised the distinction between argument and adjunct attachment (Igoa et al., 1998). For example, Crocker (1996: 220–221) also considers modifier attachment as an instance of local reanalysis rather than simple attachment, since modifiers are not predicted. He further suggests that ‘statistical or interpretative knowledge might be used in such cases to facilitate and guide reanalysis’ (Crocker, 1996: 221), though he does not provide a detailed or specific account for modifier attachment ambiguities. In the Construal framework, the distinction between primary and non-primary phrases is motivated by the fact that non-primary relations are optional (Frazier and Clifton, 1996: 46–47, 1997: 285–286). In its attempt to rapidly construct an analysis, the parser can initially ignore the non-primary relations. On the other hand, underspecification of primary relations may result in inconsistent analyses of the sentence and delays in disambiguating the input material. As Traxler et al. (1998: 586) note, mis-attachment of a modifier has no implications for the global grammatical analysis of the rest of the sentence.

According to Construal, relative clauses belong to non-primary phrases, since they are nominal modifiers. This means that, when a RC can be attached to two heads, it will not be immediately attached to the most recent constituent (the second DP), as Late Closure would require, but rather it will be associated to the extended maximal projection of the last theta-role assigner. When more than one potential head is available within the current thematic domain, interpretative principles determine the attachment preferences for the RC. Reanalysis occurs only when the processor rejects all sites within the current thematic domain (Frazier and Clifton, 1997). For example, in a sentence such as (10), the last thematic domain is defined by the lexical preposition with:

(10) Someone was looking at the servant with the actress who was on the balcony.

In examples like (10) only the second DP is inside the last theta-domain and thus, it is the only available host for the RC and, hence, a low-attachment preference is predicted. This prediction has been confirmed
in a number of studies and languages (Gilboy et al., 1995; Traxler et al., 1998, 2000 for English, Gilboy et al., 1995 for Spanish, Hemforth et al., 1996, 1998 for German and Frenck-Mestre and Pynte, 2000 for French). The consideration of thematic cues for the construction of initial input analyses – even for primary phrases – has also been a component of earlier parsing models (cf. Pritchett, 1988, 1992). This is formulated in the following constraint\(^{17}\):

- **Theta Reanalysis Constraint**: Syntactic reanalysis which reinterprets a $\theta$-marked constituent as outside of its current $\theta$-domain renders a sentence unacceptable (Pritchett, 1992: 326).

In sentences like (10), the Theta Reanalysis Constraint, as the Construal theory, predicts that the RC will be preferably attached to the second noun, because the noun *the servant* is outside of the current thematic domain defined by the preposition *with*\(^{18}\).

On the other hand, in a sentence like (2) repeated here as (11), the last thematic domain includes both DPs because the preposition *of* being functional does not instantiate a new thematic domain:

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

In (11) the RC will be associated to the extended maximal projection of the last theta-assigner (the first DP) and, therefore both DPs should be equally available hosts for the RC. Notice that the Garden Path model and its refinements also make use of thematic information to explain processing routines found in various languages. However, the difference between Construal and Garden Path is that the former assumes such effects to emerge even in initial parsing choices for non-primary phrases.

With respect to RC attachment preferences, the non-deterministic processing of modifiers in sentences like (11) has been verified in some studies and has been manifested either as no preference for either attachment site (see Carreiras and Clifton, 1993; Frazier and Clifton, 1996; Traxler et al., 1998, 2000 for English) or else, in cases where such sentences yielded high-attachment preference, this preference was found to not be fixed but rather was susceptible to factors such as the order of material presentation (see Frenck-Mestre and Pynte, 2000 for French). Notice that such factors did not have an effect on
RC attachment preferences when the complex DP involved a lexical preposition.

However, a great number of studies have revealed clear attachment preferences even for sentences like (11). For example, a low-attachment preference has been attested in English (Cuetos and Mitchell, 1988; Frazier and Clifton, 1996; Gilboy et al., 1995; off-line studies carried out by Traxler et al., 1998) and an overwhelming high-attachment preference for languages such as Spanish, French, German, Dutch, Afrikaans and Russian (for references see section 2.1.1 pages 12–13). According to Construal, a pragmatic factor that could incur the high-attachment preference for sentences like (11) in many languages is Relativized Relevance, which requires a new phrase to be construed as relevant to the first noun, as it is a verb complement (see also section 2.1.1). On the other hand, the low-attachment preference found in some English studies is attributed to the conversational maxim of Quantity (Grice, 1975), which is a discourse principle and assumes that writers/speakers make their contributions as informative as is required for the current purposes of exchange. In English, two genitive forms are available: the pre-nominal Saxon (the actress’ servant) and the post-nominal Norman (the servant of the actress) genitive. In a sentence such as (12), in which the Saxon genitive is used, the RC is unambiguously attached to the DP the servant:

(12) Someone shot the actress’ servant who was in the balcony.

Thus, the low-attachment preference for the RC with the Norman genitive can be explained by the fact that the readers/listeners assume that if the writer/speaker wanted the RC to modify the first DP, (s)he would use the unambiguous Saxon genitive. Evidence in support of this claim comes from a paper-and-pencil study conducted by Merino et al. (2000), in which English subjects were found to preferably use the Saxon genitive to modify the head noun, though they more frequently used the Norman form to modify the complement of the preposition. Notice, however, that the Conversational maxim of Quantity cannot account for the data obtained in languages, which either exhibit low-attachment preference without having a pre-nominal genitive (cf. Miyamoto, 1998 for Brazilian Portuguese and Ehrlich et al., 1999 for Romanian), or they pattern with English in the availability of genitive

In its current form, Construal does not specify the exact time course for the processing of non-primary phrases. For example, it is not clear whether the indeterministic parsing, namely no attachment preferences for either site, of some non-primary phrases should be evident during early stages of sentence processing or alternatively whether semantic and pragmatic biases come into play very early and mask this effect. Moreover, Construal does not specify how the parser evaluates the potential attachment sites for non-primary phrases and how it proceeds to the sentence analysis after this evaluation (Traxler et al., 1998, 2000). Traxler and collaborators propose two alternative solutions for how the parser proceeds to the evaluation of potential attachment sites in the Construal framework. More specifically, after the parser evaluates all attachment sites in the current thematic domain, either the ambiguity is resolved only when disambiguating material is encountered – otherwise the modifier is not attached to either site – or one analysis wins the race due to plausibility factors. This issue awaits further investigation in more studies and in languages other than English.

An additional issue that requires further research in the framework of Construal is the distinction of primary vs. non-primary phrases. For example, it is not clear whether PPs are primary or non-primary phrase. Frazier and Clifton (1996) suggest that PPs modifying VPs should be considered as primary phrases, whereas PPs modifying nouns should be considered as non-primary phrases. However, if primary phrases are defined as obligatory constituents, whereas non-primary phrases are adjuncts, then the distinction between verb- and noun-attachment is not relevant, as PPs might modify VPs but function as adjuncts or nouns and serve as complements. In addition, according to (9a), which states that phrases should initially be processed as being primary, one would expect to find a difference in the attachment of arguments vs. adjuncts irrespectively of the type of constituent they are attached to (see also Traxler et al., 1998: 562–563). For example, in an English study
Thornton et al. (1998, 1999) treated PPs as primary and compared them with RCs, which are an instance of non-primary phrases, to test the predictions of Construal. The failure to find any differences in the attachment preferences of PPs vs. RCs is taken as evidence against Construal. Nonetheless, the PPs tested were not arguments but rather adjuncts of the nouns; in other words, the PPs used were not primary phrases and, therefore, the way they are processed should not differ from that of RCs\(^20\). In English off-line tasks and an eye-tracking study, Traxler et al. (1998) also compared the parsing mechanisms used in RC- vs. PP-attachment. The results indicated more deterministic processing routines for the PPs than for the RCs. Similar findings have also been obtained by Hemforth et al. (1996, 1998, 1999) in German. Even though such results are interesting, as they point to the fact that different parsing strategies might be involved for different constructions, I think they are not easy to interpret for the very reason that the PPs used in both the English and the German study were modifying adjuncts of nouns:

(13) The son of the driver with the moustache was pretty cool.

(14) Der Autor des Bestsellers mit der klangvollen Stimme war beim Publikum beliebt.

‘The author of the best-seller with the sonorous voice enjoyed popularity.’

Therefore, further work is needed to compare the parsing routes used in complements vs. adjuncts in order to clarify the distinction between primary and non-primary phrases in the Construal framework.

The results on the RC attachment ambiguity in various languages indicated that general parsing principles, like Late Closure or Branch Right, do not offer an adequate account for all types of constructions and for all languages. Such findings led to slight or more radical ramifications of universal parsing theories. For example, De Vincenzi and Job’s account is close to the original Garden Path model postulating that Late Closure guides early parsing decisions whereas thematic considerations only affect later processing stages. On the other hand, the Construal theory distinguishes between primary and non-primary phrases and maintains that only primary phrases are parsed deterministically and according to
the predictions of Garden Path. By contrast, non-primary phrases are sensitive to thematic as well as semantic and pragmatic effects.

In any case, the cross-linguistic variation in parsing observed in a variety of studies has given rise to models, which argue in favour of ‘parameterised’ parsing mechanisms. The predictions of such models will be the focus of the next section.

2.2. PARAMETERISED MODELS OF PARSING

Initial research on the area of sentence processing has focused on English and it has been assumed that the parsing principles that apply for English also hold cross-linguistically\textsuperscript{21}. However, studies on languages other than English have not always produced results that point towards a universal parsing system. Rather, cross-linguistic findings on sentence processing have suggested that speakers of different languages might rely on distinct parsing strategies to process sentences on-line.

For example, Mazuka and Lust (1990) argued that a top-down parser, which creates a tree from the topmost node and works its way down, does not operate in Japanese. Japanese is a head-final and left-branching language and, thus, ‘is indeterminate in the amount and the type of left-ward embedding it allows’ (Mazuka and Lust, 1990: 168). This means that if the parser makes quick decisions in a left-to-right fashion, in many cases it will have to go back and reanalyse the word string it encountered. However, this would result in an inefficient and disrupted parsing. If, on the other hand, the Japanese parser delays any parsing decisions until it receives concrete and unambiguous information, this would result in an enormous burden in terms of working memory capacity. To overcome this problem Mazuka and Lust proposed that the parsing mechanism is parameterised for right-and left-branching languages. More specifically, they suggested that the Japanese parser operates according to bottom-up\textsuperscript{22} instead of top-down procedures. According to Mazuka and Lust (1990: 179), bottom-up procedures require that the tree is built from the lower node up and ‘in particular, clauses are built from the lowest one and a new clause is placed above the previous clause’. In addition, the parameterisation of the parser is viewed as ‘a deductive consequence of parameter setting in Universal
Grammar’ (Mazuka and Lust, 1990: 179). Namely, the use of bottom-up vs. top-down parsing mechanisms derives from the parameterisation of specific languages to either left-or right-branching languages respectively. Frazier and Rayner (1988) also underlined the partial failure of top-down parsing strategies in Japanese but contrary to Mazuka and Lust did not question the universality of the parser. Rather, they came up with the suggestion that, though the architecture of the human parsing mechanism is universal, the branch direction in different languages can determine the use of particular parsing routines. Despite the different formulations of the two proposals they both emphasise the importance of cross-linguistic research on sentence processing.

In what follows, I will discuss ‘parameterised’ accounts23 of sentence processing in the light of findings from attachment ambiguities.

2.2.1. The Modifier-straddling strategy

The Modifier-straddling strategy has been proposed by Cuetos and Mitchell (1988) and has been motivated by the divergent parsing routines employed by Spanish and English readers to parse ambiguous RCs in sentences like (2) and (11). Cuetos and Mitchell speculated that the preferences for N1 attachment in Spanish can be explained by the application of another parsing principle which competes with Late Closure and favours high-attachment of incoming elements. This speculative parsing strategy has been named Modifier-straddling and its operation varies from language to language. The reason for this cross-linguistic variation is ‘parameter-based linguistic properties of the languages under analysis’ (Cuetos et al., 1996: 153). More specifically, the Modifier-straddling strategy operates when a modifier has to be attached to one from an array of potential preceding nouns in post-modifying but not in pre-modifying languages. The Modifier-straddling strategy works only in post-modifying languages because these languages have post-nominal adjectives and, hence, in sequences of the form DP-Adjective-RC, the RC is unambiguously attached to the noun. According to Cuetos and Mitchell (1988: 93), a special-routine strategy, which establishes the connection between the noun and the RC when an adjective intervenes between them, also operates in a wider class of constructions such as DP1-DP2-RC, resulting in the high-attachment preference obtained in Spanish.
Though this proposal was a plausible explanation of the results at that time, it was not further supported by subsequent data. For example, as already noted in section 2.1, RC attachment preferences are divergent not only across different languages but also across different structures in a single language. For example, the type of the preposition that links the two antecedents of the RC has been found to determine the interpretation of the RC (Baccino et al., 2000; De Vincenzi and Job, 1993, 1995; Gilboy et al., 1995). Even in Spanish the RC is preferentially attached to the second DP when a contentful preposition, like *con* (with), is involved in the complex DP, which undermines the predictions of Modifier-straddling. Besides, as Cuetos et al. (1996) note, the predictions of this parameter-based parsing strategy were not verified by the findings from a number of languages. Italian, though being a post-modifying language like Spanish, exhibits a low-attachment preference (DeVincenzi and Job, 1993, 1995). On the other hand, German (Hemforth et al., 1996, 1998, 1999) and Dutch (Brysbaert and Mitchell, 1996; Mitchell and Brysbaert, 1998; Mitchell et al., 2000), though being pre-modifying languages, manifest a high-attachment preference. Therefore, the Modifier-straddling strategy cannot be considered as a viable explanation of the whole set of the data, though it has to be noted that it drew the researchers’ attention to the fact that parsing principles might stem from language-specific properties.

2.2.2. The Anaphor Resolution model

Another parameterised account has been provided in the framework of the Head Attachment model\(^2\) (Hemforth et al., 1998; Konieczny et al., 1997). The Head Attachment model is a ‘serial garden-path variant of lexicalist\(^2\) models’ (Konieczny et al., 1997: 312), in the sense that a single structural analysis is constructed in an incremental fashion. However, Head Attachment differs from Garden Path in that the parser, based on lexical properties of the words encountered, can assign an alternative syntactic analysis very early; in other words, ‘processing is assumed to be semantics oriented’ (Konieczny et al., 1997: 312). The model integrates three parsing principles, which follow from the assumed properties of the parser:

- the Head Attachment principle which predicts that a constituent will be preferably attached to a phrase whose lexical head has already been encountered;
• the Preferred Role Attachment principle which requires that a constituent is attached to a phrase whose head assigns a theta-role to this constituent;
• the most Recent Head Attachment principle which is similar to Late Closure and requires that a new constituent is attached to the phrase whose head was encountered most recently (Hemforth et al., 1998: 305; Konieczny et al., 1997: 312).

As far as the RC attachment ambiguity is concerned, the Head Attachment model predicts a low-attachment preference for the RC, because the only strategy that operates in the case of RC-attachment ambiguity is the most Recent Head Attachment principle. The Head Attachment principle does not differentiate between the two DPs that precede the RC, since both DPs include lexical heads encountered before the RC is processed, thus equally available hosts for the RC. In addition, the Preferred Role attachment principle does not operate in the case of RC-attachment ambiguity, because the RC, being a modifier, cannot be assigned a thematic role.

In order to accommodate the results from RC attachment ambiguity with their model, Hemforth and her colleagues extended the Head Attachment model, by assuming that the processing of RCs involves the binding of the relative pronoun, by which the RC is introduced, to its antecedent. This means that RC attachment is a case of anaphor resolution and RC attachment preferences are accounted for by a strategy called Anaphoric Binding. Anaphors tend to be attached to the most salient discourse entities. In the case of RC attachment, the most salient discourse entity is the first DP, since the first DP is the internal argument of the verb. RC attachment preferences cross-linguistically are determined by language-specific properties and, more specifically, by the way relative clauses are introduced in different languages. Languages in which RCs are headed by a relative pronoun (such as German) are sensitive to the anaphoric binding submodule and they require the RC to be attached to the most salient host, which is the first DP, hence the high-attachment preference for the RC in German. However, languages (such as English) in which the RC can be introduced with a complementizer (that) or the relativized element can even be omitted in certain contexts, are not sensitive to the anaphoric binding process. In such languages, the requirements of anaphor resolution are not strong and,
hence, the RC is solely processed on the basis of structural considerations, which demand the RC to be attached to the most recent host, the second DP; hence, the low-attachment preference obtained in English.

The predictions of the anaphoric resolution process have been verified by studies in German, Dutch, Russian, English, Swedish and Norwegian. More specifically, the low-attachment preference obtained in English, Swedish and Norwegian could be attributed to the fact that in all these languages RCs are not necessarily introduced by relative pronouns. Similarly, the obligatory introduction of the RCs by a relative pronoun could result in the high-attachment preference found in studies carried out in German, Dutch and Russian. In addition, the predictions of Anaphoric Binding were verified by the results of PP-attachment in German. If Anaphoric Binding is the factor that is responsible for the RC high-attachment preference in German, then it should not be operative in the attachment of PPs. Indeed, Hemforth et al. (1996) found a low-attachment preference for PPs in German in both off-line and on-line studies.

Nevertheless, anaphoric binding processes, though they could account for the data from English, Swedish, Norwegian, German, Dutch and Russian, cannot offer an adequate explanation for the data in languages such as Italian (De Vincenzi and Job, 1993, 1995), Brazilian Portuguese (Miyamoto, 1998), Romanian (Ehrlich et al., 1999) and Croatian (Lovrič and Fodor, 2000) on one side and Spanish (Cuetos and Mitchell, 1988; Carreiras and Clifton 1993, 1999) on the other. Although RCs in Romanian are obligatorily introduced by a relative pronoun (Ehrlich et al., 1999), they are initially attached to the most recent DP and not to the most salient one, which is the first DP, as anaphor resolution procedures would require. Croatian also uses two kinds of relativising elements, a relative complementizer, *sto* (that), as well as a relative pronoun, *koji* (which) (Lovrič and Fodor, 2000). In a questionnaire study, Lovrič et al. examined RC attachment preferences with both types of relativiser elements. The Anaphoric Binding strategy predicts that sentences with *sto* (that) should manifest a low-attachment preference, whereas sentences with *koji* (which) should yield a high-attachment preference. However, a low-attachment preference was obtained across the two conditions, which does not support the predictions of Anaphor Binding.
Furthermore, Spanish, Italian and Brazilian Portuguese seem to have similar ways to introduce RCs. More precisely, all three languages use a complementizer; *que* (that) for Spanish (Fernández, 2003) and Brazilian Portuguese (Thomas, 1987), *che* (that) for Italian (Maiden and Robustelli, 2000), when the relativized constituent is the subject or the object of the embedded clause for both animate and inanimate referents. In addition, all three languages have relative pronouns marked for gender and case that can be used to introduce RCs (Fernández, 2003; Maiden and Robustelli, 2000; Thomas, 1987). Yet a high-attachment preference has been found in Spanish and a low-attachment preference in Italian and Brazilian Portuguese.

Also notice that, the Head Attachment model, though it predicts thematic effects on sentence processing (cf. the Preferred Role Attachment principle illustrated above), does not explicitly postulate attachment to the currently processed thematic domain, and, therefore, the divergent RC attachment preferences for thematic vs. non-thematic prepositions cannot be explained straightforwardly.

### 2.2.3. The Recency/Predicate Proximity model

The Recency/Predicate Proximity model has been put forward by Gibson et al. (1996a), who suggest that parsing choices are the result of the competition between two factors. This account forms part of the more general framework of Syntactic Prediction Locality (SPL)\(^\text{27}\) postulated by Gibson (1998).

The Recency/Predicate Proximity account has been motivated by evidence from Spanish and English data on relative clause attachment ambiguities that involve three possible attachment sites, as shown below (Gibson et al., 1996a):

- **Attachment to the third noun:**

  (15a) the lamps near the paintings of the *house* that *was* damaged in the flood

  (15b) las lámparas cerca de las pinturas de la *casa* que *fue* dañada en la inundación\(^\text{28}\)

- **Attachment to the second noun:**

  (16a) the lamps near the *painting* of the houses that *was* damaged in the flood
The results of the experiments with sentences like (15–17) conducted by Gibson et al. (1996a) show that in both languages the most preferred site for the RC is the lowest DP and the least preferred one is the middle DP. These findings suggest that the ordering of the available sites does not depend on one factor that operates in a monotonic fashion. Instead, Gibson et al. (1996a) suggest that there are two factors that compete with each other, one favouring low-attachment (Recency Preference) and the other favouring high-attachment (Predicate Proximity).

Both Recency and Predicate Proximity are motivated by structural integration and working memory considerations. Recency requires new elements to be attached to the most recently built structures and is similar to locality principles postulated by other parsing theories. However, Recency is assumed to operate in a parallel fashion and ‘applies to all potential attachment sites and can interact with other preference factors to determine attachment preferences’ (Gibson et al., 1996a: 26). In (15)–(17), Recency predicts low-attachment preferences. On the other hand, according to Predicate Proximity, modifying constituents are preferably attached to a verb argument, under the assumption that incoming material should be attached as close as possible to the IP node, and that phrases associated with the main predicate are important in sentence comprehension. In (15)–(17), Predicate Proximity dictates high-attachment, since the first DP is the direct object of the verb.

Recency and Predicate Proximity are defined in terms of an abstract cost unit, the Processing Load Unit, applied against sites that are not favoured by these principles. More specifically, in cases of three potential attachment sites, the middle DP is the least preferred one, because it is associated with processing loads resulting from the employment of both Recency and Predicate Proximity. Moreover, Gibson et al. (1996a) assume
that the processing load associated with Recency is heavier and increases more rapidly than the processing load associated with Predicate Proximity. This assumption is verified by the low-attachment preference found in Spanish for sentences incorporating three possible attachment sites.

Notice however, that the materials in Gibson et al.’s study were not controlled for thematic factors. Namely, the complex DPs used in the materials involved either lexical prepositions, like *near/cerca* or functional ones, like *of/de* (cf. (15)–(17)); this might be a confounding factor, as the form of the complex DPs has been found to affect RC attachment preferences in various languages (cf. sections 2.1.1 and 2.1.2). Nevertheless, Gibson et al. (1999) found the same results with three-site DPs in Spanish, even when the complex DPs only involved the non-thematic preposition *de* (*of*) (but see Cuetos et al., 1996 for different findings). In addition, Gibson et al.’s predictions regarding the RC attachment preferences with three preceding DP sites have been verified in other languages, as the middle DP has been found to be the least preferred host in Japanese (Miyamoto et al., 1999), German (Hemforth et al., 1996; Walter and Hemforth, 1998) and Dutch (Wijnen, 1998). More interestingly, in the German studies, N1 and N3 are significantly preferred over N2-attachment when using thematic as well as non-thematic prepositions.

According to Gibson et al. (1996a), the cross-linguistic differences in RC attachment preferences with two potential hosts should be attributed to the parameterisation of either Recency or Predicate Proximity. They suggest that Predicate Proximity is more likely to vary across languages, because Recency is the result of general requirements of working memory. More specifically, the relative weight of the Predicate Proximity strategy varies across languages and, thus, in some languages Predicate Proximity has stronger effects on parsing and can override Recency. The grammatical property that triggers the weight of Predicate Proximity cross-linguistically is associated ‘with the average distance from the head of a predicate to its arguments’ (Gibson et al., 1996a: 49). More specifically, in languages, such as Spanish, which allow relatively great distance between the predicate and its arguments, the verb complements are strongly activated and attract new elements, making the attachment to non-complement sites costly. On the other hand, in languages, such as English, that have fixed word order and require relatively low average
distance between the verb and its arguments, Predicate Proximity is not strongly activated and the cost associated with non-complement attachment sites is not very high. This explanation accounts for the high-attachment preference found in Spanish, German, French and Russian and the low-attachment preference found in English, Norwegian, Swedish, and even Brazilian Portuguese, because the former languages allow adjuncts to occur between the head of a predicate phrase and its complements and, hence, Predicate Proximity is stronger than in the latter languages which have a rigid word order and do not allow adverbs to intervene between verb and object. Italian, however, though it patterns with languages like Spanish in terms of the distance allowed between the verb and its complements, exhibits low-attachment preference. In addition, it is not entirely clear how word order interacts with the strength of Predicate Proximity; namely do more general word order constraints have an effect on this parameterisation? For instance, German, though allowing adjuncts to intervene between the verb and its complements, has strict word order constraints, like the verb second position in finite clauses and final position in embedded clauses. On the other hand, this is not the case for languages like Spanish. One could make the prediction that in the latter type of languages Predicate Proximity is stronger than in the former type. Such issues need further clarification.

As far as the way grammatical information affects parsing, Gibson et al. (1996a) propose three potential explanations bearing on the relationship between the grammar and the parser. First, the processing preferences may be directly determined by the grammar of a specific language; thus, the cross-linguistic differences observed may be dictated by the setting of a particular linguistic parameter. Notice, however, that it is not straightforward how the distance between the verb and its arguments could constitute a linguistic parameter. A second possibility is that the parser relies on the frequency with which particular ambiguities are resolved in certain languages. Under this possibility, ‘setting parameters of the grammar does not set parsing parameters’ (Gibson et al., 1996a: 47). This means that the grammar of a particular language favours or disfavours a certain ambiguity resolution and affects the frequency of this resolution type. The parser, however, is not directly associated with the grammar to resolve ambiguities, but rather ‘is sensitive to the statistical patterns in
the language’s ambiguities’ (Gibson et al., 1996a: 48). Finally, a third
explanation is that there is no close relationship between grammatical
and parsing parameterisation; rather, the parser is parameterised inde-
pendently of the grammar and relies on statistical grounds to resolve
particular ambiguities. This final option is the main assumption behind
experience-based models for sentence processing, which will be con-
sidered in the next section.

2.3. EXPERIENCE-BASED MODELS
OF SENTENCE PROCESSING

Experience-based models of sentence processing assume that parsing
decisions are based on frequency data. Such models argue for a statisti-
cally driven parser, which keeps records of the way various ambiguities
are resolved in the language. When the parser is faced with a particular
ambiguity, it uses these records and opts for the analysis that has
been most frequently encountered. One important difference between
experience-based models and the models discussed so far (but see
section 2.2.3 for the account proposed by Gibson and collaborators, in
which the alternatives are left open) in the previous chapters lies in the
relationship that is assumed to hold between the grammar and the
parser. Experience-based models assume that the parser does not have a
close relationship with the grammar but rather is an independent mech-
anism whose choices are merely determined by exposure facts.

Experience-based models of human parsing can be further categorised
in relation to the grain or specificity with which frequency information
is encoded and used by the comprehender (MacDonald, 1997; Mitchell
et al., 1995). Some models use coarser measures (coarse-grained models;
non-lexicalist models), suggesting that the frequencies are tabulated at a
syntactic level (Brysbaert and Mitchell, 1996; Mitchell et al., 1995). Other
models use very detailed records, such as context specific and
lexically specific records (fine-grained models; lexicalist models;
constraint-satisfaction models), suggesting that the frequencies are tab-
ulated at the word level (MacDonald, 1993, 1994, 1997; MacDonald
et al., 1994a, 1994b; Spivey-Knowlton and Tanenhaus, 1994; Spivey-
Knowlton et al., 1993; Taraban and McClelland, 1990; Thornton et al.,
1998, 1999; Trueswell and Tanenhaus, 1994; Trueswell et al., 1994). In this section, I will describe and evaluate one coarse-grained model, the Tuning theory, as well as Constraint-satisfaction approaches and their predictions will be juxtaposed with the studies conducted on RC attachment preferences in various languages.

2.3.1. The Tuning theory

One example of coarse-grained models that has been well documented and has testable predictions is the Tuning theory (Brysbaert and Mirtchell, 1996; Mitchell et al., 1995). The Tuning hypothesis maintains the processor keeps statistical records of the way structural ambiguities are most frequently resolved in the language and bases the initial analysis of the sentence on frequencies at a structural grain. The parsing mechanism relies on the information about the frequency distribution of different structural possibilities. This means that the parser keeps records at a purely structural level and lexical and/or pragmatic/discourse information is initially ignored and is only used during the later phase of sentence processing. Brysbaert and Mitchell (1996: 686) claim that Tuning is a variant of the Garden Path model, as, according to both accounts, the processor computes a single initial analysis based on structural considerations. The difference between the two models is that, according to Garden Path, structural decisions are determined by universal parsing principles, such as Minimal Attachment or Late Closure, whereas, according to Tuning, structural decisions are based on statistical records of the way the structural ambiguity is most frequently resolved in the language.

In the case of the RC attachment ambiguity, Tuning suggests that cross-linguistic differences in RC attachment preferences are attributable to the frequency with which alternative disambiguations have been encountered in different languages. More specifically, if the relative clause ambiguity is resolved more frequently towards high-attachment, the speakers of these languages are influenced by this experience and prefer a high-attachment disambiguation and vice versa. One question that could be raised is what it is exactly that the processor keeps count of to record the way this ambiguity is resolved. Mitchell et al. (1995) suggest that the processor uses coarse instead of fine measures, meaning that
initial parsing decisions are based on tallies that are integrated over lexical
details of the nouns that precede the RC. In other words, the item-specific
lexical properties of the two nouns and their likelihood to take modi-
fiers are excluded from the statistical records. Instead, the parser relies
on ‘the accumulated statistics for all encounters with structures of the
form NP-PP-RC’ and resolves such ambiguities ‘by referring to the
same central record’ (Mitchell et al., 1995: 480).

One way to test the predictions of experience-based models is to
compare data on the ambiguity resolution patterns found in corpora with
data from on-line studies; the observation of similar patterns in the corpora
and the experiments provides evidence in support of experience-based
models. The Tuning hypothesis has received support from studies in
English (Cuetos et al., 1996), Spanish (Cuetos et al., 1996) and French
(Baltazar and Kister, 1995; Mitchell et al., 1995; Pynte, 1998; Zagar
et al., 1997). Corpus analyses for these languages are consistent with
the type of attachment preference observed in experimental studies.
More precisely, corpus data indicate that in English the RC is more fre-
quently attached to the second DP, whereas in French and Spanish it is
more frequently attached to the first DP. Experiments conducted in
these three languages showed that English native speakers prefer to
attach the RC low, whereas Spanish and French native speakers mani-
fest a high-attachment preference. Hence, the attachment preferences
could be due to people’s previous experience. Mitchell et al. (1995)
interpret this finding as evidence supporting a coarse-grained model of
human parsing, according to which the parser pools the data for all
occurrences of DP-PP-RC structures into a single record. Moreover,
Gibson et al. (1996b) have reported English frequency data from PP and
RC attachments in three-site DPs. The results showed that the modify-
ing PPs and RCs were most frequently attached to the third noun,
whereas the least preferred host for the PP was the middle noun. These
findings go in tandem with on-line data from RC attachment in three-
site DPs and provide evidence in support of Tuning. Furthermore,
Tuning is compatible with empirical findings, which demonstrate that
there are individual differences in attachment preferences (Brysbaert
and Mitchell, 1996) and that the manipulation of the order of the materi-
als affects parsing decisions (Frenck-Mestre and Pynte, 2000).
However, a mismatch between the corpus data and the experimental findings was obtained from conjoined DP-three-site ambiguities\(^{31}\) (Gibson et al., 1996b; Schütze, 1999;) arguing against Tuning. The data analysis showed that the most preferred host for the conjoined DP is the third DP and the least preferred one is the first DP. However, on-line and off-line experiments in English (Gibson et al., 1996b; Gibson and Schütze 1999) revealed that the lowest DP is indeed the most preferred host but the least preferred one is the middle DP and not the highest one, as one would expect from the corpus analysis. Data analyses from Dutch did not give support to Tuning either, because the corpus analysis data revealed that the RC tended to be attached to the second noun, though the empirical findings showed a high-attachment preference (Brysbaert and Mitchell, 1996; Mitchell and Brysbaert, 1998; Mitchell et al., 2000). These pieces of evidence argue against a parser that is statistically driven and suggest that initial structural decisions must be determined by ‘at least some non-statistical influences’, as Mitchell and Brysbaert (1998: 324) themselves admit.

In a different study, Cuetos et al. (1996) did an off-line experiment with Spanish 7-year-old children in order to examine whether exposure to a particular type of disambiguation affects RC attachment preferences, as Tuning would expect. The study consisted of a pre- and a post-test. In the pre-test, the children’s attachment preferences for RCs with two antecedents were investigated. Then the children were divided into two groups, such that both groups had approximately the same percentage of high-and low-attachment preferences. For the following ten days, both groups of subjects had to read three texts, each of which contained two DP-DP-RC sentences that were always disambiguated towards high-attachment for one group and towards low-attachment for the other group. After an interval of one week, they re-tested both groups’ attachment preferences on DP-DP-RC constructions and they found that the two groups differed significantly in the high-attachment percentages produced; more specifically, the initial approximate 71% for N1-attachment did not significantly change in the low-attachment biased group, whereas it was magnified (92.17%) in the high-attachment biased group.

Cuetos et al. interpret these findings as evidence supporting the Tuning theory, in the sense that the group exposed to sentences disambiguated
towards high-attachment produced significantly more high-attachment responses than the group exposed to sentences disambiguated towards low-attachment. However, though the high-attachment preference increased for the group biased towards high-attachment (from 71.44% to 92.17%), the low-attachment preference did not increase for the group biased towards low-attachment, rather it slightly decreased (from 29.20% to 27.81%). This result is not consistent with Tuning, because exposure to low-attachment disambiguation did not affect parsing decisions. It seems that exposure to a specific kind of disambiguation can influence attachment preferences only when this reinforces an option already preferred in the language, as in the case of exposure to high-attachment disambiguated sentences. On the contrary, exposure to a disambiguation type that is not favoured by the language, like the low-attachment disambiguated sentences in Spanish, cannot reverse the initial choice. However, Cuetos et al. argue that the low-attachment responses did not increase for the group biased towards low-attachment, because during the testing period the children were still being exposed to the language, which favours high-attachment, and this might have resulted in not altering the initial high-attachment.

Some researchers have criticised the Tuning theory for directing the research away from seeking for an explanation of language processing phenomena in terms of cognitive structure (Carreiras and Clifton, 1993: 365). In other words, the Tuning hypothesis does not offer an explanation for the underlying linguistic phenomena that may determine parsing preferences. In response to such criticisms, Cuetos et al. (1996: 181) argue that the Tuning hypothesis is a proposal that tries to account for the rapid mechanisms employed in real-time parsing without making any claims for the underlying grammatical properties that may be proved to dictate parsing preferences. Moreover, Cuetos et al. do not necessarily deny that there might be a relation between the grammar and the parser. However, this relation cannot be a direct one, since even if the parser consults the grammar, this is performed indirectly, in the sense that the statistical records of ambiguity resolutions are determined by grammatical properties.

2.3.2. Constraint Satisfaction approaches

Fine-grained or lexicalist models of sentence processing predict that parsing is affected not only by frequencies of structural patterns but also
by the frequency of individual lexical items. This class of models is also known as Constraint Satisfaction models, meaning that syntactic processing is achieved through the satisfaction of multiple probabilistic constraints, such as lexical, syntactic and/or discourse-level constraints. Pieces of information from different domains are activated in parallel and interact with each other to arrive at the preferred analysis. What distinguishes Constraint Satisfaction models from Tuning, for example, is that they allow for non-syntactic information to play a dominant role in parsing and not only guide the processor to choose one analysis but also to initially propose one analysis. Thus, Constraint Satisfaction models question the very existence of an autonomous syntactic processor. Syntactic information is just another type of information that affects sentence processing as lexical or discourse information does. To put it simply, constraint-satisfaction models argue for ‘parsing without a parser’ (MacDonald et al., 1994a: 697). An immediate consequence of such a claim is that sentence interpretation is a continuous process during which all kinds of information are used in parallel and an initial purely syntactic stage is not distinguished; in other words, ‘comprehension and parsing cannot be separated’ (Taraban and McClelland, 1990: 236). Though some Constraint Satisfaction models distinguish between syntactic and semantic information and claim that ‘only information that is correlated with syntactic alternatives will have effects’ (Trueswell et al., 1994: 176) in sentence processing, in one variety of constraint-satisfaction models, namely the lexicalist models proposed by MacDonald and collaborators, dominance is given to lexical constraints. They assume that syntactic processing does not differ from lexical processing and their goal is to prove that lexical and syntactic processing is unified and held within one general processing architecture (MacDonald, 1993, 1997).

Lexicalist models view lexical representations and the information they contain as the main source of syntactic disambiguation. Thus, lexical representations integrate, apart from the phonological, the orthographic form and the meaning of the word, grammatical features, such as the grammatical category of the word, morphological features, possible argument structures and possible X-bar structures. It is worthwhile noticing that syntactic constraints and representations are incorporated
in the lexicon and syntactic structures can be partially activated and not incrementally constructed, as phrase-structure and lexically-driven models assume. Moreover, all alternative representations of each component are also listed in the lexical entry of the word, carrying information about their frequency of occurrence in the language (MacDonald et al., 1994a). For example, a verb, such as *realise*, can take either a DP or a complement clause as its complement; both argument structures are included in the lexical representation of the word, with the indication that the latter is more frequent than the former. When the processor encounters a word, units or sets of units corresponding to each type of information encoded in the lexical representations are partially activated. The activation is modulated by constraints, such as frequency or discourse context and it is the strength and consistency of the constraints that determine which interpretation will finally dominate. Moreover, the relative strength of various constraints results in graded effects, that is, varying degrees of preference for one or the other alternative structure.

Constraint-satisfaction models can account for context, frequency and lexical effects that have been reported in many studies (Altmann et al., 1998; MacDonald et al., 1994a, 1994b; Spivey-Knowlton and Tanenhaus, 1994; Spivey-Knowlton et al. 1993; Taraban and McClelland, 1990; Thornton et al., 1998, 1999; Trueswell et al., 1994). However, such models fail to address the question of what kind of syntactic biases people use when faced with syntactic ambiguity where semantic or pragmatic ‘clues’ cannot help them decide between alternative interpretations (Philips, 1996: 107–108; see also Frazier, 1995).

With respect to attachment ambiguities, MacDonald et al. (1994a: 697–698) speculated that modifier attachment ambiguities would be affected by the lexical frequency preferences of the preceding attachment sites to be modified. Thus, if the first noun has a stronger lexical bias of appearing with a modifier than the second, the modifier will preferentially be attached to the first noun rather than to the second one and vice versa. Under this view, any cross-linguistic differences should be attributed to the potential different lexical biases of the two nouns. On the face of this proposal, one would expect the attachment preferences of RCs to be affected by reversing the DPs in the complex DP, because the
attachment preferences are claimed to depend on the lexical biases of the two antecedents of the RC rather than on structural considerations. However, such an effect was not obtained in an English completion task carried out by Corley and Corley (1995), who counterbalanced the position of the DPs over the experiment; rather, an overall low-attachment preference was found irrespectively of which DP occupied the second slot of the complex DP. Moreover, Gibson et al. (1999) found low-attachment preferences in three-DP-site ambiguities and high-attachment preferences in two-DP-site ambiguities, though the same DPs occupied the lowest slot in both conditions. These findings suggest that the attachment preferences might depend on the structural position of the noun that is attracting a modifier rather than on the lexical biases of the nouns to attract a modifier.

More recently, Thornton et al. (1998, 1999) have suggested that modifier attachment varies as a function of the particular discourse properties of the nouns involved. More specifically, modifier attachment depends on the degree that the nouns are available for modification; thus, if a DP has received little prior modification, it is a better candidate for additional modification than a DP that has already been extensively modified. This pragmatic information is termed by Thornton et al. ‘modifiability’ and is considered as a universal constraint on attachment preferences.

The availability of nouns for modification as a factor that determines structural ambiguity resolution has its origins in the Referential theory (RT) of sentence processing (Altmann and Steedman, 1988; Crain and Steedman, 1985). The difference between the Referential theory and the current proposal is that DPs are not classified into specific vs. non-specific or unique vs. non-unique, as in the RT framework. Rather, modifiability is considered as a continuous variable, in the sense that people expect that the more modification a DP has received at a certain point in the discourse the less additional modification it will further receive (Thornton et al., 1999: 1349). Thornton et al. (1999: 1359) point out that in other studies of attachment preferences the modifiability is confounded with attachment type, since, although the first noun is modified by the second one, the second noun has no modification, resulting in a bias towards low-attachment preference at least as far as modifiability is concerned. Even if one suggests that this could be the reason for
low-attachment preferences found in some languages, the modifiability constraint provides no explanation for the overwhelming high-attachment preference observed in a range of studies and languages.

Nevertheless, Thornton et al. (1998, 1999) found evidence in support of modifiability. They conducted completion and self-paced reading tasks in English and Spanish in order to test PP-attachment preferences in complex DPs. Their materials included two conditions, one in which the second noun did not receive sufficient modification (easy modification condition) and, thus, was likely to be further modified and one in which it was already specified (difficult modification condition) and, hence, further modification was unlikely. Examples for both conditions in the two languages are illustrated below:

- **DP2-easy modification in Spanish**
  
  (18a) La computadora de una officina con pantalla gigante fue comprada para agilizar el trabajo.
  
  ‘The computer of an office with a giant screen was bought to speed up work.’

- **DP2-difficult modification in Spanish**
  
  (18b) La computadora de mi officina con pantalla gigante fue comprada para agilizar el trabajo.
  
  ‘The computer of my office with a giant screen was bought to speed up work.’

- **DP2-easy modification in English**
  
  (19a) The computer down the only hall with expanded memory was used by the programmer.

- **DP2-difficult modification in English**
  
  (19b) The computer down my front hall with expanded memory was used by the programmer.

In Spanish, they found an overall high-attachment preference for the PP in the completion task, though the DP2-easy modification condition yielded significantly less N1 responses than the DP2-difficult modification condition. In the self-paced reading experiment, a high-attachment preference was apparent only in the DP2-difficult modification condition,
whereas no preference was obtained in the DP2-easy modification condition. In English, an overall high-attachment preference was found in the completion task, which was significantly greater in the DP2-difficult modification condition than in the DP2-easy modification one. In the English self-paced reading experiment, on the other hand, a low-attachment preference was observed in the DP2-easy modification condition, though the DP2-difficult modification condition yielded no preference for either high or low-attachment. Thornton et al. interpreted their findings as suggesting that the modifiability of the two nouns is one factor that determines PP-attachment across different languages. Notice, however, that the modifiability of the nouns, though it constrained PP-attachment preferences, did not reverse the patterns of attachment preferences in the two conditions.

The cross-linguistic differences between English and Spanish found in Thornton et al. (1999)’s study have been attributed to the availability of alternative structures that shape the distributional patterns in the two languages. Thornton et al. (1999), based on the Gricean maxim of Quantity, (similar arguments have been proposed by Construal, cf. 2.1.2), suggest that the low-attachment preference in English is due to the availability of two genitive forms (Norman and Saxon) and to the avoidance of the ambiguity depending on which form is used. This explanation has also received support from another study (Thornton et al., 1998), in which a completion task was conducted in English to test PP and RC attachment preferences in complex DPs with two antecedents under two conditions:

- Functional preposition of:

  (20) The assistant of the inspector with/who …

- Locative prepositions:

  (21) The table near the window with/that …

According to Thornton et al. (1998), (20) and (21) differ in the availability of alternative structures; namely, though an alternative construction exists for (20) *(the inspector’s assistant)*, no such choice is possible for (21). Therefore, according to Gricean maxim of Quantity, (20) should yield significantly more DP2 responses than (21). Indeed, this is what their results showed.
2.4. SUMMARY AND CONCLUSIONS

At this point it is useful to provide a summary of the sentence processing models presented and evaluated in this chapter. The postulations of all the accounts are presented schematically in Figure 2.1.

The experimental evidence discussed in chapter 2 is not compelling enough to accept or reject any particular model. Besides, the various experiments conducted in different languages are difficult to compare with each other, due to the different materials and tasks used. Nonetheless, the results are convergent in some respects. It has been shown that RC attachment preferences diverge not only from one language to another but also from one construction to another; namely, complex DPs containing lexical prepositions yield different attachment preferences.

Figure 2.1. Sentence processing models for RC attachment preferences
than complex DPs containing non-lexical prepositions. Moreover, a low-attachment preference has been reported cross-linguistically when the second DP is introduced by theta-assigning prepositions. On the other hand, cross-linguistic variation is observed, when non theta-assigning prepositions are involved in the complex DPs. Such findings question not only the universality of parsing strategies like Late Closure but also their general applicability within a certain language. In addition, the means used to disambiguate the sentences have also been found to affect attachment preferences, in that differences are observed not only between pragmatic and morphological disambiguation but also among morphological features (i.e. number versus gender). These contradictory findings clearly indicate the need for further research in different languages. This is the main motivation of the study reported in this book, namely to provide evidence from Greek, a language in which parsing routines have not been tested before, to compare the findings with those from other languages and further evaluate the predictions of sentence processing accounts. Before I proceed to the presentation of the experiments carried out, I will first describe and analyse some linguistic properties of Greek that are relevant to the RC attachment ambiguity.

NOTES

1 Evidence in support of this model comes from the matrix-relative clause ambiguity illustrated in the following example:

(i) Because Rose liked the recipe I made …

The word string (i) is ambiguous up to the verb made, because the words I made could be interpreted either as a RC modifying the DP the recipe as shown in (ib) or as the subject and the verb of the main clause as shown in (ia):

(ia) Because Rose liked the recipe I made it for her birthday as a surprise.
(ib) Because Rose liked the recipe I made for her birthday it was worth all the effort.

The Branch Right principle favours the relative clause reading since this results in the most right branching structure. As Philips (1996: 119) notes, this ambiguity is useful to test the relevance and the importance of the Branch Right principle in parsing, because all parsing principles except for Branch Right predict that subjects will read the words I made in (i) as the subject and the verb of the main clause. In a self-paced reading task, Philips and Gibson (1997) found that subjects indeed chose the RC reading and were garden-pathed when the continuation of the sentence pointed
towards the main clause interpretation. This result shows that the Branch Right strategy is ‘an extremely strong structural factor in parsing’ (Philips, 1996: 125).

Philips (1996: 164) notes that the cross-linguistic variation found for example in RC attachment preferences might be accounted for by the Case Matching Preference (CMP) constraint (Sauerland, 1996). The CMP constraint requires that a parse be preferred where the abstract Case of the head noun is a morphologically possible case of the relative pronoun (Sauerland and Gibson, 1998). According to Sauerland and Gibson, in English, *who* is unspecified for case and, thus, in a sentence such as (i), both high and low-attachment are compatible with the CMP constraint:

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

On the other hand, in (ii), the relative pronoun *die* being marked for nominative cannot introduce a genitive-RC and, therefore, CMP is satisfied only when the RC is attached to first noun, which is also marked for nominative:

(ii) Die Dienerin der Schauspielerin die auf dem Balkon war.

The CMP constraint is an interesting proposal, because a universal parsing strategy, such as locality, could be maintained and case matching considerations could account for divergent RC attachment preferences obtained in various constructions and languages. However, the contradictory findings so far as well as the lack of extended research on this issue make it impossible to further evaluate the viability of this proposal.

One interesting account of cross-linguistic variation observed in sentence processing is the ‘Implicit Prosody Hypothesis’ proposed by Fodor (1998, 2002), according to which parsing preferences might be affected by the prosodic phrasing of the sentences. Fodor makes the assumption that even in silent reading native speakers of a certain language impose the prosodic phrasing on the sentences they read. Some studies (cf. Lovrič, 2003; Lovrič and Fodor, 2000 among others) have investigated this hypothesis and have found that prosody does have an effect on processing preferences. The advantage of such a proposal is that the universality and generality of a locality principle is maintained and any variation observed is attributed to prosodic effects. However, the design of the experiments to be reported here did not manipulate the prosodic phrasing of the sentences under investigation and therefore this model will not be further discussed.

Notice that the Garden Path model, being a rule-based model, is not really concerned with abstract grammatical principles and the way these principles constrain parsing. Rather, parsing strategies derive form phrase-structure information (see Crocker, 1996, 1999; Frazier and Clifton, 1996: 23–24; Gorrell, 1995 for a detailed discussion).

Frazier and Fodor actually built on the seven parsing principles proposed by Kimball (1973), providing a more parsimonious account.
6 Notice that the simplest analysis is the one with the fewer nodes, as expected by Minimal Attachment, and also the one in which new material will be attached to the phrase currently being processed resulting in right-branching phrase-structure trees, as predicted by Late Closure. Hence, the predictions of the ‘First Analysis Constraint’ are the same the ones derived by Minimal Attachment and Late Closure.

7 The Minimal attachment principle and its predictions will not be considered here, since it is not relevant for the RC attachment ambiguity. Minimal Attachment can be illustrated in phrases such as (i) and predicts that the word string the mayor’s position will be interpreted as the direct object of the verb argued, as in (ia) continuation of the sentence, rather than as the subject of a complement clause, as in (ib) continuation of the sentence, because the former option requires fewer nodes than the latter as illustrated in the bracketed representations (ia’) and (ib’) respectively:

(i) The city council argued the mayor’s position …
    (ia) The city council argued the mayor’s position forcefully.
    (ib) The city council argued the mayor’s position was incorrect.

(ia’) [S [NP The city council] [VP argued [NP the mayor’s position] [ADV forcefully]]]
(ii) [S [NP The city council] [VP argued [S [NP the mayor’s position] [VP was incorrect]]]] (the examples and the syntactic representations are taken from Frazier and Rayner, 1982: 180–181).

The predictions of Minimal Attachment have been supported by the empirical findings of various studies (Clifton and Ferreira, 1989; Ferreira and Clifton, 1986; Ferreira and Henderson, 1990; Frazier, 1987; Frazier and Rayner, 1982; Mitchell et al., 1992; Rayner et al., 1983, 1992). See Mitchell (1994) and Tanenhaus and Trueswell (1995) for detailed reviews.


9 The thematic processing domain is defined by ‘the extended maximal projection of the last theta assigner’ (Frazier and Clifton, 1996: 42).

10 Slashes indicate the way the sentences were segmented into fragments. Reading times were obtained for each individual fragment. Notice that the two DPs within the complex DP were presented as one chunk in De Vincenzi and Job (1995) and the results were still the same.

11 However, Zagar et al. (1997) as well as Frenck-Mestre and Pynte (2000) have found a high-attachment preference in French with non theta-assigning prepositions.

12 For example the past participles trahi (betrayed-masc) and trahie (betrayed-fem), though different in their written forms, do not differ phonologically. Only in two sentences from an overall of sixteen target sentences the past participle had different phonological forms for the masculine and the feminine gender.
Brysbaert and Mitchell (1996) carried out a self-paced reading and an eye-tracking task, in which they tested the four conditions illustrated below:

- **late disambiguation – high-attachment:**
  
  (i) De gangsters schoten op de zoon van de actrice die op het balkon zat met zijn arm in het gips.
  
  ‘The terrorists shot the son of the actress who was on the balcony with his arm in a cast.’

- **late disambiguation – low-attachment:**
  
  (ii) De gangsters schoten op de zoon van de actrice die op het balkon zat met haar arm in het gips.
  
  ‘The terrorists shot the son of the actress who was on the balcony with her arm in a cast.’

- **early disambiguation – high-attachment:**
  
  (iii) De gangsters schoten op het zoontje van de actrice dat op het balkon zat met zijn arm in het gips.
  
  ‘The terrorists shot the little son of the actress who was on the balcony with his arm in a cast.’

- **early disambiguation – low-attachment:**
  
  (iv) De gangsters schoten op het zoontje van de actrice die op het balkon zat met haar arm in het gips.
  
  ‘The terrorists shot the son of the actress who was on the balcony with her arm in a cast.’

In examples (i)–(ii) the disambiguation occurs late in the sentence, namely on the possessive pronouns *zijn* (his) and *haar* (her). In examples (iii)–(iv) the disambiguation occurs early on the relative pronouns *dat* (who) and *die* (who). *Dat* can only refer to neuter nouns in Dutch, hence it can only be associated with the first DP, *zoontje* (little son) in example (iii), whereas *die* in example (iv) can only refer to *actrice* (actress) since it cannot be used to refer to the neuter noun, *zoontje*. Brysbaert and Mitchell found a high-attachment preference on the region with the possessive pronouns, whereas no preference for either attachment type was obtained on the region with the relative pronouns.

The Spanish examples are the equivalent translations of the English examples.

See also the literature from ERPs on gender violations (van Berkum, Brown and Hagoort, 1999; Carreiras, Gillon-Dowens, Barber and Betancort, 2004; Frenck-Mestre, 2004; Gunter, Friederici and Schriefers, 2000).

Note that Late Closure has been found to apply in primary relations in Spanish. Igoa et al. (1998) conducted a questionnaire study and self-paced reading tasks on the attachment preferences of an argument-PP to two potential VPs, in sentences...
such as (i):

(i) Raul vendió el libro que había robado a su amigo.
   ‘Raul sold the book that he had stolen from/to his friend.’

The PP *a su amigo* (to/from his friend), which is a primary phrase since it is a potential argument of either the main verb *vendió* or the subordinate verb *había robado*, was found to be preferentially attached to the most recent VP *robado* (stolen).

Pritchett’s parsing model is a serial and incremental grammar-based model, in which the structural analysis built by the parser is determined by the lexical properties of heads and the satisfaction of the θ-criterion imposed by Universal Grammar. The parser’s attempt to satisfy this criterion motivates the following parsing principle:

- **Theta-attachment**: The θ-criterion attempts to be satisfied at every point during processing given the maximal θ-grid (Pritchett, 1992: 325).

According to Pritchett, this principle accounts for the parser’s initial preference to misanalyse the DP *the soup* as the direct object of the verb *ate*, since the noun receives θ-role and case from the verb in a sentence such as (i):

(i) After Steve ate the soup proved to be poisoned.

Moreover, the processing difficulty the parser faces on the verb *proved*, where the DP *the soup* has to be reanalyzed as the subject of the main verb rather than as the object of the subordinate clause, is attributed to the fact that the DP has to be reinterpreted outside the θ-domain of the verb *ate*. Notice that Pritchett’s model makes different predictions from the Garden Path model as well as the Construal theory in sentences such as (ii):

(ii) Steve knew the boy hated the sharks.

Garden Path and Construal both predict that the DP *the boy* will be initially misanalysed as the direct object of the verb *knew*, due to Late Closure, and that will result in reanalysis, though Pritchett’s model predicts no processing difficulty at the disambiguation point, since the DP, though reinterpreted as the subject of the embedded verb, remains in the θ-domain of the main verb *knew*.

Notice that Pritchett’s Theta Reanalysis Constraint does not provide an account for either the garden-path speakers of Spanish experience with sentences such as (i), or the garden-path English speakers experience when faced with sentences such as (ii), though in both cases the RC is attached to a constituent that is inside the last thematic domain:

(i) Someone shot the servants of the actress who was on the balcony.
(ii) Someone shot the servant of the actresses who was on the balcony.

Frazier and Clifton (1996) report that they obtained a low-attachment preference in English when the sentences were disambiguated via grammatical information.

See also section 2.3.2.
A great amount of cross-linguistic research has been conducted in the framework of the Competition model (Bates and MacWhinney, 1982, 1987; Bates, et al., 1999; MacWhinney, 1987; MacWhinney and Bates, 1989). The Competition model emphasises the important role of input in parsing, as this is determined by ‘the constructs of cue validity and cue strength’ (MacWhinney, 1997: 115), which vary cross-linguistically. Most studies conducted in this framework have used the ‘agent identification’ paradigm, namely the subjects are requested to find out which is the subject/agent in a sentence. Such studies have indicated that speakers of different languages use different cues, like word order, S-V agreement morphological case, to identify the agent/subject of the sentence. Such findings have been interpreted as providing evidence in support of cross-linguistic variation in sentence processing. Notice, however, that the investigation of the cues used by people to identify the subject/agent of a sentence, is not very informative about initial parsing decisions but rather examines interpretative processes used in sentence comprehension (see also Gibson, 1992). For this reason, the Competition model and the studies carried out in this framework will not be considered in this chapter.


The name ‘parameterised models of sentence processing’ is rather unfortunate for the models discussed in this chapter and is adopted here only because this is the term used in the literature. The name should not be taken as referring to the notion of ‘parameter’ as introduced by Chomsky (1981). These models do not propose that the way languages are parameterised with respect to grammatical phenomena, such as the position of heads for example, is reflected in the parsing routines these languages will apply (as Mazuka and Lust (1990) suggest). Rather, the term ‘parameterised’ should be interpreted more generally in the sense of language-specific properties and how these might affect parsing cross-linguistically.

Konieczny (1996) proposed an implemented model termed SOUL (Semantics-Oriented Unification-based Language) which makes the same predictions as the head attachment model; for this reason, I will not distinguish between the two (Konieczny et al., 1997: 314).

Lexicalist models, as phrase-structure-driven parsers, assume that the human processor builds an initial structural analysis of the sentence, however, this analysis is triggered by the lexical properties of the words that are encountered (Boland and Tanenhaus, 1991; Ferreira and Henderson, 1991a; Ford et al., 1982; Taraban and McClelland, 1990). The main difference between phrase-structure-driven and lexically-driven parsers is that the latter allow lexical information to play a role in the initial stage of sentence processing and guide the initial analysis of a sentence, though, for the former, lexical information comes into play later to filter structural analysis.
Pronoun resolution is assumed to be affected by the prominence of discourse referents (cf. Brennan et al., 1987; Grosz et al., 1995). But see Wolf et al., 2004 and references therein for alternative proposals.

The Syntactic Prediction Locality (SPL) theory seeks to explore the relationship between the human sentence processor and the available computational resources. SPL is an activation-based account for sentence comprehension in the sense that lexical, plausibility and discourse context constraints interact to arrive at the desired interpretation of the sentence. In addition, Gibson (1998) assumes a ranked parallel processor, such that a lower-rated representation can be retained at the same time with a higher-rated one, when the plausibility of the lower-rated representation is close to that of the high-rated representation.

The Spanish examples are the equivalent translations of the English ones.

According to the SPL theory (Gibson, 1998), the processing difficulty associated with specific structures is determined by two types of resources; structural integration and structural maintenance or storage (Gibson, 1998: 11–17). The component of structural integration refers to the fact that in sentence comprehension, words are put together to form the representation and the meaning of a sentence. Structural integration involves processing cost, which is induced by the complexity of the integration and the distance between the elements to be integrated. The complexity of the integration is defined by the construction of new discourse referents, such that the more discourse referents that need to be postulated the more complex and thus more costly the integration will be. Besides, the cost based on the distance between two elements that have to be linked increases as a function of the number of the new discourse referents that intervene between the two words. On the other hand, the structural storage component is associated with linguistic memory cost (Gibson, 1998: 11–17), such that the maintenance of syntactic heads other than the matrix verb in the memory results in processing difficulty which also increases as a function of the number of the intervening discourse referents.

However, a high-attachment preference has been obtained for Brazilian Portuguese in an on-line study (Finger and Zimmer, 2000).

An example of conjoined DP-three-site ambiguity is given below:

(i) The salesman ignored a customer with a child with a dirty face and a …

The conjoined DP to come might be attached to either of the three nouns, customer; child, face.

Referential theory is a discourse-driven model of sentence processing postulated by Crain and Steedman (1985) and slightly modified by Altmann and Steedman (1988), Steedman and Altmann (1989) and Altmann et al. (1992). According to this theory, three discourse properties are assumed to play a role in sentence processing: plausibility, reference and presupposition; discourse constraints following from
these properties determine the selection of one structural analysis:

- the principle of a priori plausibility which states that the most plausible reading in terms of world knowledge or knowledge about the universe of discourse will be favoured;
- the principle of referential success which states that the reading that succeeds in referring to an entity already established in the hearer’s mental model will be favoured;
- the principle of parsimony which states that the reading which carries the fewest unsatisfied presuppositions will be adopted (Crain and Steedman, 1985: 330–333).

For example in sentence (i), the PP *with the telescope* is preferably attached to the verb *saw* and not to the NP *the man* not because of syntactic considerations but because of the presuppositions that this reading makes in the hearer’s mental model:

(i) I saw the man with the telescope.

More specifically, the VP-attachment interpretation is more parsimonious from a discourse point of view, since only one entity is assumed, that of *the man*. On the other hand, the DP-attachment interpretation assumes that the hearer establishes more than one entity in his/her mental model from which one, *the man with the telescope*, is chosen. According to this model, then, the VP-attachment preference can be overridden if the above mentioned sentence is situated in an appropriate context in which more than one discourse entity for a man is mentioned.
The purpose of this chapter is to describe and analyse the grammatical properties of the linguistic phenomena to be investigated in the Greek experiments. The presentation will focus on relative clauses introduced by the complementizer *pu* (that), genitive constructions and prepositional phrases headed by the preposition *me* (with), as the experimental sentences involve such constructions.

The structure of this chapter is as follows. In Section 3.1, I will describe how the RCs are introduced and realised in Greek, as well as how their structure is represented. The genitival constructions in Greek will be presented and analysed in Section 3.2. The syntactic representation of the PPs in Greek will be provided in Section 3.3. Some concluding remarks will be offered in Section 3.3.

### 3.1. RELATIVE CLAUSES IN GREEK

According to Alexiadou et al. (2000: 2–3), RCs are characterised, first, by not being an argument of a lexical predicate and, second, by containing a dependency, which ‘serves to link a position inside the clause and an item outside that clause’ (ibid.: 2). For example, in sentence (1), the RC, *that he bought*, modifies the DP, *the house*:

(1) The house that he bought is by the sea.

In addition, the dependency between the introducing element of the RC, *that*, and the modified DP, *the house* is external in the sense that they belong to different clauses.
Greek has three types of relative clauses (Holton et al., 1997; Theophanopoulou-Kontou, 1989):

- restrictive relative clauses,
- non-restrictive or appositive relative clauses, and
- free or headless relative clauses.

The function of restrictive relative clauses is to specify the content of the noun they modify, as shown in (2):

(2) To pedhi pu efere to the-NOM-SG-N child-NOM-N that brought-3SG the-ACC-SG-N ghrama meni edho konda. letter-ACC-N lives here near
‘The child that brought the letter lives nearby.’

As shown in (3), non-restrictive relative clauses are set off by commas in the written speech and by pauses (Holton et al., 1997: 440) in the oral speech:

(3) I Ana, pu ine panda omilitiki, the-NOM-SG-F Ana- NOM-F that is always talkative-NOM-SG-F htes dhen milise katholu. yesterday not spoke-3SG at-all
‘Ann, who is always talkative, didn’t talk much yesterday.’

Lastly, the main characteristic of free or headless relative clauses is that there is no explicitly stated antecedent for the relative clause. Free-relative clauses can be either nominal or adverbial as illustrated in (4) and (5) respectively:

(4) Psifisan opji ithelan. voted-3PL whoever-NOM-PL-M wanted-3PL
‘Whoever wanted went to vote.’

(5) Ela opote thelis. come-2SG whenever want-2SG
‘Come whenever you want to.’

Since the constructions investigated in the experiments to be reported only involve restrictive relative clauses, non-restrictive and headless relative clauses will not be further analysed.
3.1.1. The relativization process in Greek

Restrictive, but also non-restrictive, relative clauses in Greek are introduced by the same relativiser elements. More specifically, there are two types of relativisers (Alexiadou, 1997; Holton et al., 1997; Joseph, 1983; Mackridge, 1985; Theophanopoulou-Kontou, 1989):

- the relative complementizer *pu* (that), and
- the wh-relative pronoun *o opios – i opia- to opio* (who, which)

*Pu* (that) is an indeclinable relative complementizer, unmarked for gender, case and number, which is also used to introduce complements of factive verbs and exclamatives (Alexiadou, 1997: 17; Hristides, 1986). *O opios* is a fully inflected wh-relative pronoun, which agrees for gender and number with its antecedent and receives case according to its syntactic position in the relative clause. The distribution of the relative complementizer and the wh-relative pronoun in Greek is defined by structural considerations as well as stylistic and pragmatic factors (Holton et al., 1997: 440; Mackridge, 1985: 249). As Mackridge (1985: 253) points out, the complementizer *pu* (that) is the relativiser element ‘par excellence’ in Greek. This means that *pu* is used much more frequently than the wh-relative pronoun at least in colloquial speech and in literary writing. Nevertheless, the wh-relative pronoun *o opios*, though it is associated with more formal speech, is also used fairly frequently in conversation and in non-literary writing (Mackridge, 1985: 249). In addition, according to Mackridge (1985: 249; 253), the use of *o opios* is rather favoured, in cases in which the use of *pu* would result in ambiguity due to its unmarkedness for gender, case and number.

There are four possibilities for relativization in Greek:

(a) the use of the relative complementizer;
(b) the use of the wh-relative pronoun;
(c) the use of the relative complementizer in addition to a resumptive clitic/pronoun, which is a pronominal copy of the target for relativization;
(d) the use of the wh-relative pronoun in addition to a resumptive clitic/pronoun.

The applicability of these possibilities varies with respect to the syntactic function of the relativiser in the relative clause. When the head of the relative clause serves the function of the subject or the direct object,
strategies (a) and (b) are preferably applied, as exemplified in sentences (6) and (7), and actually the use of the relative complementizer is favoured over that of the relative pronoun:

(6) To vivlio pu/to opio
the-NOM-SG-N book-NOM-N that/the-NOM-SG-N which-NOM-SG-N
ine sto trapezi na to dhjavasis oposdhipote.
is on-the-ACC-SG-N table-ACC-N to it-read-PERF.2SG by-all-means
‘You have by all means to read the book that/which is on the
table.’

(7) To vivlio pu/to opio
dhjavasa prosfata ine sti vivliothiki.
read-PAST.1SG recently is in-the-ACC-SG-F bookcase-ACC-F
‘The book that I have recently read is in the bookcase.’

Strategies (c) and (d) are also available though not very frequent. More precisely, in subject relative clauses, the emphatic form of the personal pronoun might be present, as illustrated in sentence (8):

(8) Kalesan ton filo tus, pu/o
invited-3PL the-ACC-SG-M friend-ACC-SG-M their that/the-NOM-SG-M
opios nomizo oti mono aftos tha boresi
which-NOM-SG-M think-1SG that only he will manage-PAST.3SG
na tus voithisi\textsuperscript{5}.
to them-help-PAST.3SG
‘They invited their friend who I think is the only one that can help
them.’

Notice, however, that in sentences such as (8), the relative clause is normally interpreted as a non-restrictive relative clause (Holton et al., 1997: 444). For object relative clauses, the use of the clitic is also possible:

(9) To vivlio pu/to opio
(to) dhjavasa prosfata ine sti vivliothiki.
(read-PAST.1SG recently is in-the-ACC-SG-F bookcase-ACC-F
‘The book that I read is in the bookcase.’
When the relativiser is the indirect object of the relative clause, all four possibilities are accessible, as shown below:

(10) O ithopios pu/ston opio
    (tu) edosan to proto vrvavio
    (his)-gave-3PL the-ACC-SG-N first- acc-sg-n award- acc-n
    pezi se mia nea tenia.
    plays in a- acc-sg-f new- acc-sg-f film- acc-SGf

‘The actor who they gave the first award to is playing in a new film.’

Nonetheless, some speakers of Greek might judge *pu-indirect-object relative clauses that lack a resumptive clitic as unacceptable.

When the head of the relative clause is in genitive case, only strategies (b) to (d) are available:

(11) To pedhi pu i
    the-NOM-SG-N child-NOM-N that the-NOM-PL-M
    ghonis *(tu) ihan prosfata ena
    parents-NOM-M *(his)-had-3PL recently an-ACC-N
    atihima epathe nevriko klonismo.
    accident-ACC-N had-3SG nervous-ACC-SG-M break-down-ACC-M

‘The child whose parents recently had an accident had a nervous break-down.’

(12) To pedhi tu opiu
    the-NOM-SG-N child-NOM-N the-GEN-SG-N which-GEN-SG-N
    i ghonis (tu) ihan prosfata ena
    the-NOM-PL-M parents-NOM-M (his)-had-3PL recently an-ACC-N
    atihima epathe nevriko klonismo.
    accident-ACC-N had-3SG nervous-ACC-SG-M break-down-ACC-M

‘The child whose parents recently had an accident had a nervous break-down.’

Notice that the use of the relative complementizer without the retention of the possessive pronoun results in ungrammatical sentences, as illustrated in (11).

Finally, when the target of the relativization is a PP, strategies (a) to (c) are applicable, as illustrated in sentences (13) and (14), though the
appliance of strategy (d) results in ungrammatical sentences as shown in (15):

(13) Eki ine to dulapi pu (s’ afto) evale there is the-NOM-SG-N cupboard-NOM-N that (in it) put-PAST-3SG to ghliko.
the-ACC-SG-N cake-ACC-NEUT
‘There’s the cupboard in which (s)he put the cake.’

(14) Eki ine to dulapi sto there is the-NOM-SG-N cupboard-NOM-N in-the-ACC-SG-N opio evale to ghliko.
which-ACC-SG-N put-PAST-3SG the-ACC-SG-N cake-ACC-N
‘There’s the cupboard in which (s)he put the cake.’

(15) *Eki ine to dulapi sto there is the-NOM-SG-N cupboard-NOM-N in-the-ACC-SG-N opio s’ afto evale to ghliko.
which-ACC-SG-N in it put-PAST-3SG the-ACC-SG-N cake-ACC-N
‘There’s the cupboard in which (s)he put the cake.’

When the wh-relative pronoun is used to introduce the relative clause, it is always preceded by the equivalent preposition, as can be seen in example (14). Preposition stranding is not possible, instead the pied-piping of the preposition is obligatory in Greek. Besides, when a resumptive pronoun is used, it always has to be the strong form of the personal pronoun preceded by the preposition, as shown in example (13). Moreover, the deletion of the PP and the use of the relative complementizer may result in ungrammatical or at least not uniformly acceptable sentences. When a complex PP agrees as the target of the relativization, strategy (a) is no longer available and, instead, strategies (b) and (c) have to be applied. When strategy (c) is used, the relative complementizer is followed by the adverb of the complex PP and the resumptive clitic, which is the appropriate possessive pronoun in that case, as exemplified in (16) below:

(16) To musio pu konda tu itan ena the-NOM-SG-N museum-NOM-N that near-its was a-NOM-SG-N
When the wh-relative pronoun is employed, the preposition is pied-piped, while the adverb precedes the PP, as shown in (17):

(17) To musio konda sto the-NOM-SG-N museum-NOM-N near in-the-ACC-SG-N opio itan ena parko eklise. which-ACC-SG-N was a-NOM-SG-N park-NOM-N closed-3SG

‘The museum near which there used to be a park closed.’

The available possibilities for the relativization process in Greek are summarised in Table 3.1.

In most of the target sentences to be found in our experiments, only subject-RCs introduced with the relative complementizer *pu* were used. Notice that this is the most neutral case, in which the use of *pu* is uniformly acceptable, considered as fully grammatical and even preferred to the use of the wh-relative pronoun. In the following section, the structural representation of RCs in Greek will be presented. As the sentences used for our experiments only include RCs introduced by the complementizer *pu*, the discussion will be limited to the derivation of *pu*-RCs.

<table>
<thead>
<tr>
<th>Relativization strategies</th>
<th>Type of dependency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S</td>
</tr>
<tr>
<td>Relative complementizer</td>
<td>✓</td>
</tr>
<tr>
<td>Relative pronoun</td>
<td>✓</td>
</tr>
<tr>
<td>Relative Complementizer with Resumptive clitic/pronoun</td>
<td>✓X</td>
</tr>
<tr>
<td>Relative Pronoun with Resumptive clitic/pronoun</td>
<td>✓X</td>
</tr>
</tbody>
</table>
3.1.2. Pu-RCs in Greek

Alexiadou et al. (2000: 2) point out that RCs involve ‘non-canonical movement’. For example, the RC, *which John painted* in (18), is introduced by a wh-word, which has been moved to Spec-CP from its original position (direct object of the subordinate verb, *painted*) and forms a chain with the trace it left behind:

(18) The table, which, John painted, is in the garden.

Yet, the RC, *which John painted*, does not have an interrogative interpretation. Moreover, the wh-relative pronoun is also coindexed with the DP, *the table*. This coindexation is displayed by ‘morphosyntactic agreement’ between the noun, *table*, and the pronoun, *which*, and not *who*, which facilitates the interpretation of the construction (Alexiadou et al., 2000: 2).

*Pu*-RCs in Greek have been assumed to derive either via movement of an empty operator (Varlokosta, 1997, 1999) or via raising of the head noun (Alexiadou, 1997; Kayne, 1994).

### 3.1.2.1. Movement analysis

The movement analyses proposed for *pu*-RCs in the Government and Binding framework make the following assumptions (Alexiadou et al., 2000: 3):

- *pu*-RCs are adjoined to a higher projection of the DP they modify (adjunction hypothesis);
- the head-noun is base generated outside the RC (base-generated head hypothesis).

In example (19), the RC, *pu espase i Maria* (that Mary broke), is a sister of a higher projection of NP/DP and the head-noun, *to potiri* (the glass) is generated outside the CP (ibid.).

(19) to potiri pu espase i Maria
the-SG-N glass-N that broke-3SG the- NOM-SG-F Mary-NOM
‘the glass that Mary broke’

Varlokosta (1997, 1999) favours a movement analysis for *pu*-RCs in Greek along the lines of standard analyses for English *that*-RCs, in which an empty operator moves from its original position in the RC to Spec-CP position (cf. Haegeman, 1991; Radford, 1988, 1997; Safir,
1984). More specifically, in sentence (20) a null element has to be postulated after the verb:

(20) Idha ton fititi pu simbathis e.
     saw-1SG the-ACC-SG-M student-ACC-M that like-2SG
     ‘I saw the student that you like.’

Furthermore, the null element moves to SpecCP position as wh-elements do, as shown on the following tree diagram:

(20')

The status of the null element is that of an empty operator (O) and the antecedent of the trace (t_i). The question that is raised is why the null element has to move to SpecCP position. Varlokosta provides evidence in favour of this movement by applying diagnostic tests for movement, such as subjacency violations, weak cross over effects and parasitic
gaps as well as by reporting data from child language acquisition. With respect to subjacency violations, consider sentence (21)\textsuperscript{10}:

(21) *O anthropos\textsubscript{i} pu\textsubscript{i} mas ekseplikse
the-NOM-SG-M man-NOM-M that us-surprised-3SG
to gheghonos oti o
the-NOM-SG-N fact-NOM-N that the-NOM-SG-M Janis idhe e\textsubscript{i} ine plusios.
John-NOM saw-3SG e is rich-NOM-SG-M
‘The man that the fact that John saw surprised us is rich.’
(intended meaning)

In (21), the relativized element has to cross the DP-island\textsuperscript{11} to gheghonos (the fact) to move from its original position, the complement of the verb idhe (saw), to SpecCP position, violating thus subjacency and resulting in an ungrammatical sentence. In addition, Varlokosta assumes, following Safir (1984, 1986), that constructions involving movement show weak cross over effects and license parasitic gaps; pu-RCs seem to demonstrate all these effects, as the examples below illustrate respectively (example (23) is taken from Varlokosta 1999: 849):

(22) Sinandisa kapjon\textsubscript{i} pu\textsubscript{i} aghapai i
met-1SG someone-ACC-M that loves the-NOM-SG-F
pethera tu*\textsubscript{i}.
mother-in-low-NOM-F his
‘*I met someone that\textsubscript{i} his\textsubscript{i} mother-in-law loves.’

(23) Afta ine ta arthra\textsubscript{i} pu\textsubscript{i} arhiothetisa
these-NOM-N are the-NOM-PL-N papers-NOM-N that filed-1SG
e\textsubscript{i} horis na dhiavaso e\textsubscript{i}.
e without to read-1SG e
‘These are the papers which I filed without reading.’

Varlokosta further supports the movement analysis by providing data from child language acquisition of RCs. In a toy elicitation task, the children (age range 3–5; 6 years) were forced to use a relative clause to distinguish between two toy-figures. She found that the children tested
used gaps in all types of relative clauses (S, O, IO, PP), though they rarely used sentences such as (24) that include resumptive DPs:

(24) *I kukla pu i Maria
      the-NOM-SG-F doll-NOM-F that-the-NOM-SG-F Mary-NOM
      aghapai kukla poli.
      loves doll-NOM-F very
      ‘The doll that Mary loves a lot.’ (intended meaning)

Since the children did not repeat the relativized DP in the relative clause but instead used the relative complementizer *pu* and they omitted the relativized DP, Varlokosta interprets this finding as an indication that early relative clause formation involves movement. Moreover, in the case of simple PPs, the children were likely to omit the entire PP, though in the case of complex PPs, the children either omitted the whole PP (cf. 25) or they retained the adverbial with the presence of a resumptive clitic (cf. 26) or they only retained the adverbial (cf. 27), as shown below:

(25) To karotsaki pu kathete i Pokahontas
       the-NOM-SG-N pram-NOM-N that sits the-NOM-SG-F Pocahontas
       ‘The pram Pocahontas is sitting in.’ (intended meaning)

(26) To karotsaki pu mesa tu kathete i
       the-NOM-SG-N pram-NOM-N that inside-its sits the-NOM-SG-F
       Pocahontas.
       Pocahontas
       ‘The pram Pocahontas is sitting in.’ (intended meaning)

(27) To karotsaki pu mesa kathete i
       the-NOM-SG-N pram-NOM-N that inside sits the-NOM-SG-F
       Pocahontas.
       Pocahontas
       ‘The pram Pocahontas is sitting in.’ (intended meaning)

Varlokosta (1999: 852, footnote 7) says that this third option (illustrated in example (27)) was the most common one among children, providing, thus, evidence for a movement analysis of relative clauses in early child language acquisition.
3.1.2.2. Raising analysis Alexiadou (1997), following Kayne (1994), adopts a raising analysis for the derivation of Greek \( pu \)-RCs. She claims that the head noun of the RC is originated inside the relative clause and is subsequently raised to the spec-CP position (head-raising hypothesis) and the RC is a syntactic complement of the determiner (determiner hypothesis). The representation is depicted in the following tree diagram (Alexiadou, 1997: 19):

\[
\begin{array}{c}
\text{DP} \\
\text{CP} \\
\text{NP} \\
\text{C} \\
\text{C}_0 \\
\text{IP} \\
\text{o anthroposi pu idha [N ti]}
\end{array}
\]

In addition, she argues that the CP in Greek consists of more than one level and that the relative complementizer, \( pu \), and the relative pronoun, \( o \ opios \), occupy the highest positions in this multilayered CP\(^1\) (Alexiadou, 1997: 19).

3.2. POSSESSIVE GENITIVES

The genitive case in Greek is morphologically expressed; both the determiner and the noun are inflected for genitive and there are specific forms and endings marked for genitive according to the gender of the noun and the declination class the noun belongs to. For example, (29a) and (29b) show the determiner and the noun forms for the nominative and the genitive case respectively:

(29) a. \( o \) \( mathitis \)  
the-NOM-SG-M pupil-NOM-M  
‘the pupil’

b. \( tu \) \( mathiti \)  
the-GEN-SG-M pupil-GEN-M  
‘of the pupil’
When the genitive\textsuperscript{14} depends on a noun, it indicates a range of semantic relations\textsuperscript{15}, such as possession, quality, length, age, value among others. In this case, the DP in genitive might precede or follow the head noun it modifies (Theophanopoulou-Kontou, 1989: 190). However, for most of the types of genitives, the natural order for the genitive is to follow the noun it depends on and, when it precedes the head noun, it usually is for purposes of contrast (Holton et al., 1997: 264).

The genitives used in the experiments on RC attachment preferences in Greek were of one particular type and are illustrated below:

(30) o dhaskalos tis mathitrias
the-NOM-SG-M teacher-NOM-M the-GEN-SG-F pupil-GEN-F
‘the teacher of the pupil’

(31) o proponitis tis athlitrias
the-NOM-SG-M trainer-NOM-M the-GEN-SG-F athlete-GEN-F
‘the trainer of the athlete’

(32) i psihiatros tu ithopiu
the-NOM-SG-F psychiatrist-NOM-F the-GEN-SG-M actor-GEN-M
‘the psychiatrist of the patient’

(33) i voithos tu epistimona
the-NOM-SG-F assistant-NOM-F the-GEN-SG-M scientist-GEN-M
‘the assistant of the scientist’

The genitive in (30)–(33) is not cited as a distinct type of genitive by most Greek grammars. Tzartzanos deems it as a subcategory of the possessive\textsuperscript{16} genitive and refers to it as \textit{dependency} genitive. Gilboy et al. (1995) who also examined this type of genitive construction in their experiments classify it as \textit{functional/professional}. I will adopt the latter term and I will refer to the genitives in examples (30)–(33) as functional/professional, because this term captures the exact meaning of this genitival structure. Moreover, Gilboy et al. (1995) as well as Tzartzanos (1991) group the functional/professional genitive together with the more general category of possessive genitives. I will also consider the functional/professional genitive as an instance of possessive genitive and I will analyse it as such.
3.2.1. Syntactic analyses of possessive genitives

Horrocks and Stavrou (1987) argue that the genitives in Greek are base-generated post-nominally. Theophanopoulou-Kontou (1989) agrees with this proposal and points out that the genitive in Greek is not generated on the left of the noun, namely in SpecDP position, but rather on its right, in the complement position (Theophanopoulou-Kontou 1989: 347). Since this analysis does not make distinctions among different types of genitives, we can assume that the same derivation might also be suggested for the functional/professional genitive. Horrocks and Stavrou (1987) assume that ‘there is a post-genitival slot available in Greek DPs and that there is no pre-head subjective slot at all’ (Horrocks and Stavrou, 1987: 95). They base this assumption on the fact that pre-head genitives in Greek must precede the article and not replace it, as is the case in English (Horrocks and Stavrou, 1987: 94):

(34) a. τίνος τον  
          
    whose the-SG-N book-N  
    ‘whose book’
  b. whose book

In addition, this analysis correctly predicts that pre-head genitives, though possible in Greek, are necessarily focused, and, thus, they are adjoined to a non-argument position inside the DP. In other words, they are said to derive via A’-movement. Thus, the representation of both post- and pre-head genitives is as follows:

(35a) post-head genitive
(35b) pre-head genitive

[Diagram showing the syntactic structure of post- and pre-head genitives]
More recently, Alexiadou and Stavrou (1999) proposed an analysis for possessive genitives similar to the one suggested by Horrocks and Stavrou (1987). According to Alexiadou and Stavrou (1999), a functional projection (FP) that intervenes between the DP and the noun is postulated, mainly for adjective placement. The genitive is still base-generated post-nominally and the SpecDP position is the landing site for constituents moving there for reasons of emphasis, focus etc. i.e. for A’-movement (Alexiadou and Stavrou, 1999). Hence, the pre-head genitive also moves to the spec DP position, as in Horrocks and Stavrou’s analysis (1987). This analysis, however, differs from the previous one in that the genitive DP originates in a predicative (small clause) structure (XP) and is licensed by a PP headed by a zero P. The subject position of the small clause (spec XP) is occupied by the possessum. The structure they propose is represented in (36):

(36)  

```
DP
  Spec  D'
    D   FP
      Spec  F''
        Fo  XP
          Possessum  X'
            X°  PP
              P  Possessor
                o  dhaskalos  tis mathitrias
                the  teacher  of the pupil
```
3.3. THE PREPOSITION ME (WITH)

In this section, I will present PPs headed by *me* (with), as this type of preposition was used in our experiments. Prepositional Phrases\(^\text{18}\) in Greek are right-branching, that is the head of the prepositional phrase (the preposition) is followed by its complement, a DP. The complement of most prepositions is in the accusative case, though there are a few prepositions that require a DP in the genitive case.

The preposition *me* (with) is characterised as one of the basic and most common prepositions in Greek by Mackridge (1990: 301) and Tzartzanos (1991: 181). Holton et al. (1997: 371) regard the prepositions *se* (at, in, on etc.) and *apo* (from, since, by etc.) as the two basic prepositions in Greek and they classify the preposition *me* in a level below them, because the prepositions *se* and *apo* can cliticise on the determiner though the preposition *me* cannot. The complements of the preposition *me* are in accusative and the PPs headed by *me* mainly denote accompaniment and instrument (Holton et al., 1997: 371; Mackridge, 1990: 315), illustrated in sentences (37) and (38) respectively:

(37) Meni me ton patera tu.

lives with the-ACC-SG-M father-ACC-M his

‘(S)He lives with his father.’

(38) Ekopse to psomi me ton suja.

cut-PAST.3SG the-ACC-SG-N bread-ACC-N with the-ACC-SG-M pocket-knife-ACC-M

‘(S)He cut the bread with the pocket-knife.’

When the preposition *me* denotes accompaniment, it may be combined with the adverb *mazi* (together) and form the complex preposition *mazi me*. Tzartzanos (1991: 199–207) and Mackridge (1990: 315–316) remark that the preposition *me* may also indicate a variety of semantic distinctions, such as what someone wears or carries, what someone possesses, a characteristic of someone, time, content, manner, cause, opposition, exchange, opposite, reference. Finally, a PP introduced by the preposition *me* may be used as a complement of certain verbs, nouns, adjectives and adverbs\(^\text{19}\).
The sentences used in the experiments to be reported contained PPs that modified a DP and were introduced by the preposition *me*. The PPs denoted exclusively accompaniment or, more precisely, coexistence of persons spatially and temporally (see also Tzartzanos, 1991: 199), as illustrated below:

(39) Enas perastikos kitakse ton
    a-NOM-M passer-by-NOM-M looked-3SG the-ACC-SG-M
    kirio me to koritsi.
    man-ACC-SG-M with the-ACC-SG-N girl-ACC-M
    ‘A passer-by looked at the man with the girl.’

Thus, the PP *me to koritsi* (with the girl) modifies the DP *ton kirio* (the man) and it shows that both, the man and the girl, are in the same place at the same time and they are close to each other. Notice, also, that the PP *me to koritsi* (with the girl) could be replaced by the complex PP *mazi me to koritsi* (together with the girl) without changing the meaning of the PP. The representation of the complex DP, *ton kirio me to koritsi* (the man with the girl) is illustrated in the following tree diagram:

(40)
3.4 SUMMARY AND CONCLUSIONS

In this chapter the grammatical phenomena examined in the experiments were described and analysed. First, the relativization process in Greek was outlined with specific reference to RCs introduced by *pu* (that). The description and discussion of RCs in Greek made it clear that the use of the relative complementizer *pu* is not only possible but also preferred by the native speakers of Greek in everyday conversation. Moreover, *pu* can be employed for all kinds of syntactic dependencies, i.e. subject, direct object, indirect object etc., either with or without a resumptive clitic/pronoun. Furthermore, possessive genitives and PPs headed by the preposition *me* were analysed. This also provides the linguistic basis to evaluate parsing models, such as the Construal theory, which associate RC attachment preferences with the form of the complex DP that precedes the RC. In the following two chapters, I will present the experiments carried out with native speakers of Greek.

NOTES

1 The abbreviations used in the glossis are the following: NOM for nominative case, ACC for accusative case, GEN for genitive case, SG for singular, PL for plural, M for masculine gender, F for feminine gender, N for neuter gender, PERF for perfective and IMP for imperfective aspect.


3 The relative pronouns that introduce the free-relative clauses are different from those that introduce the restrictive and non-restrictive relative clauses. The nominal free-relative clauses are introduced by the pronouns, opjos/opjosdhipote (which), osos/ososdhipote (however many), o,ti/otidhipote (whatever) and the adverbial free relative clauses are introduced by the adverbs opos (as), opu/opudhipote (wherever), opote/opotedhipote (whenever) and oso/osodhipote (however much) (Holton et al., 1997: 445).

4 *Pu* is, unarguably, considered as a complementizer in Greek. For detailed arguments see Hristides, 1986.

5 The example is taken from Holton et al. (1997: 444).

6 For a detailed analysis of the conditions which allow the recoverability of the preposition in *pu*-RCs see Theophanopoulou-Kontou (1985).

7 Greek has complex PPs consisting of an adverbial and a PP, as shown in (i):

(i) konda sto spiti
    near in-the-ACC-SG-N house-ACC-N
    ‘near the house’
For detailed syntactic and semantic analyses on complex PPs in Greek see Terzi (2005a, 2005b) and Theophanopoulou-Kontou (2000).

8 S stands for Subject, DO for Direct Object, IO for Indirect Object, Gen. For Genitive, PP for Prepositional Phrase and CPP for complex Prepositional Phrase.

9 For the derivation of o opios-RCs see Alexiadou (1997), who actually proposes a raising analysis for both pu- and o opios-RCs.

Notice that sentence (21) is ungrammatical only when the RC is interpreted as a restrictive one (see Fabb (1990) for cross-linguistic evidence on island violations.).

10 Horrocks and Stavrou (1987) deal with subjacency violations in Greek and point out that sentences such as (21) are problematic. They suggest an alternative, according to which the moved element moves to an A’-position inside the NP. Actually, this is the same position focalised genitives occupy, as will be shown in section 3.2 (cf. 35b).

Notice, however, that the presence of a clitic makes the bound reading acceptable:

(i) Sinandisa kapjon_i pu_i ton_i aghapai
    met-1SG someone_i-NOM-M that_i him_i-loves
    i pethera tu_i,
    the-NOM-SG-F mother-in-law-NOM-F his_i
    ‘I met someone that his mother-in-law loves.’

11 The arguments Alexiadou (1997) provides in favour of this claim come from the position left-dislocated and focused phrases occupy in relative, complement and interrogative clauses. The relative complementizer pu, also, introduces complements of factive verbs, as illustrated in sentence (i):

(i) Lipame pu meteferan to aerodhromio.
    regret-1SG that moved-3PL the-ACC-SG-N airport-ACC-N
    ‘I regret that they moved the airport.’

However, two different complementizers, oti and pos, introduce the complements of declarative verbs:

(ii) Ipe oti/pos meteferan to aerodhromio.
    said-3SG that moved-3PL the-ACC-SG-N airport-ACC-N
    ‘He said that they moved the airport.’

According to Alexiadou (1997), the structural positions of pu and oti/pos are different, because left dislocated phrases can precede oti/pos-complement clauses but not pu-complement clauses:

(iii) *Lipame to aerodhromio pu to meteferan.
    regret-1SG the-ACC-SG-N airport-ACC-N that it-moved-3PL
    ‘I regret that they moved the airport.’

(iv) Ipe to aerodhromio oti/pos to meteferan.
    said-3SG the-ACC-SG-N airport-ACC-N that it-moved-3PL
    ‘He said that they moved the airport.’
Hristides (1986) also underlines the differences between *pu-* and *oti/pos-*complement clauses based on semantic grounds. Moreover, left-dislocated phrases can precede interrogative phrases but not the relativisers:

(v) Rotise ton pedhjon ti tus aghorasa.
    asked-3SG the-GEN-PL-N children-GEN-N what them-bought-1SG
    ‘He asked what I bought for the children.’

(vi) *O kirios ton pedhion
    the-NOM-SG-M man-NOM-M the-GEN-PL-N children-GEN-N
    pu tus aghorase ghlika efighe.
    that them-bought-3SG sweets-ACC-N left-3SG
    ‘The man who bought sweets for the children left.’

The distribution observed for left-dislocated phrases also holds for focused phrases. Alexiadou considers the fact that left-dislocated and focused phrases cannot precede the relativisers as evidence supporting the existence of a split CP in Greek and the occupation of the highest position in the split CP by the relativiser elements.

The genitive in Greek has two main functions (Holton et al., 1997; Mackridge, 1990; Theophanopoulou-Kontou, 1989, 1995; Tzartzanos, 1991); it may depend either on a verb or on a noun. When the genitive depends on a verb, it usually serves the function of the indirect object. Notice, however, that the genitive dependent on a verb might also be the direct object of a few verbs in Greek and it might show the ‘interested party’ (Holton et al., 1997: 263). In addition, the genitive may be the complement of a preposition, an adjective or an adverbial, it may be dependent on a pronoun or a numeral, be found in exclamations, have an adverbial and an absolute use (genitive absolute) (see Holton et al., 1997; Mackridge, 1990; Theophanopoulou-Kontou, 1989; Tzartzanos, 1991 for a detailed description and many examples).


15 Tzartzanos (1991: 84) considers the possessive genitive as the ‘pure genitive’ in Greek. Traditional grammars further describe a range of semantic relations associated with the possessive genitive (for details see Holton et al., 1997; Mackridge, 1990; Tzartzanos, 1991).

16 Alexiadou (1999) has proposed an alternative analysis for possessors in Greek, which is based on the semantic and syntactic differences that exist between alienable and inalienable genitives (cf. Heine, 1997; Seiler, 1983; Taylor, 1996). Inalienable possessors are inseparable from the possessum (cf. example (i)), whereas alienable possessors denote separable possession (cf. example (ii)):

(i) Ta matja tu Kosta ine prasina.
    the-NOM-PL-N eyes-NOM-N the-GEN-SG-M Kosta-GEN-M are green-NOM-PL-N
    ‘Kosta’s eyes are green.’
Alexiadou (ibid.) suggests that the two types of possessors have different derivations, based on a number of syntactic properties that distinguish between the two. More specifically, alienable possessors are derived inside a functional projection (FP), whereas inalienable possessors are licensed by a lexical projection (LP). She proposes an elaborated structure for DPs, in which AgrP is a nominal Agreement projection, PossP is a functional projection which licenses alienable possessors and LP is a lexical projection, in which inalienable possessors are derived (Alexiadou, 1999: 265). She argues that alienable possessors ‘must be thought as external to the possessed noun, introduced by a light functional head, while the inalienable possessor must be thought of as forming a phrase together with the possessed noun’ (Alexiadou, 1999: 256). The post-nominal possessor is obtained by movement or merger of the possessum to the head of AgrP, in order to check number and case. Both derivations are depicted in the following trees (Alexiadou, 1999: 256):

(iiiia) \[
\text{DP[}\text{D to}] \text{[AgrP[\text{Agr} o \text{ vivlio} ] [PossP[\text{Possessor tis Marias}] [P[\text{Poss} [\text{LP t}]])]])
\]

(iiiib) \[
\text{DP[}\text{D to}] \text{[AgrP[\text{Agr} o \text{ heri} ] [LP[\text{Possessum t} [L [L [\text{Possessor tis Marias})]])]
\]

As the experiments conducted in this study did not make use of alienable and inalienable possessors, I will not further discuss this syntactic analysis.

18 In addition, a PP may modify or complement a verb, a noun, a pronoun, an adjective and an adverb (Holton et al., 1997: 370).

In this chapter, I will report on two experiments conducted in Greek in order (a) to investigate the universality of the Late Closure parsing strategy postulated in the framework of the Garden Path model, and (b) to test the predictions of the Construal theory, the Recency/Precedate Proximity model and the Anaphor Resolution model for RC attachment preferences. The test items used in the experiments involve RCs following complex DPs, in which the second noun either is in genitive case and depends on the first one or is headed by the lexical preposition me (≡ with), as shown in (1a) and (1b) respectively:

(1a) Kapjos kitakse ton ipireti
someone-NOM-M looked-3SG the-ACC-SG-M servant-ACC-SG-M
tis ithopiu
the-GEN-SG-F actress-GEN-SG-F
pu itan sto balkoni.
that was on-the-ACC-SG-N balcony-ACC-SG-N
‘Someone looked at the servant of the actress who was on the balcony.’

(1b) Kapjos kitakse ton ipireti
someone-NOM-M looked-3SG the-ACC-SG-M servant-ACC-SG-M
me tin ithopio
with the-ACC-SG-F actress-ACC-SG-F
pu itan sto balkoni.
that was on-the-ACC-SG-N balcony-ACC-SG-N
‘Someone looked at the servant with the actress who was on the balcony.’

The structures shown in (1a and b) have been selected, because in various studies and languages it has been found that the form of the
complex DP that precedes the RC affects RC attachment preferences (Baccino et al., 2000; De Vincenzi and Job, 1993, 1995; Gilboy et al., 1995). More precisely, when the second noun is introduced by a theta-assigning preposition, like *with*, then the RC is preferably attached to the second noun. However, languages seem to manifest divergent attachment preference patterns when the second noun is introduced by a non theta-assigning preposition or when it is in the genitive case. In order to be in a position to examine whether the form of the complex DP has an effect on RC attachment preferences in Greek, one condition of the experiments included complex DPs in which the second noun was headed by a lexical preposition, whereas the other condition incorporated complex DPs in which the second noun was in the genitive case.

The Garden Path model predicts that attachment decisions are initially guided by the Late Closure principle, which favours attachments to the most recent phrase. Sentences (1a) and (1b) are ambiguous, in that the RC is attached either to the first NP or to the second one. The two options for each sentence are represented in the following tree diagrams:

(1a)
```
  DP
   |
  NP
   |
  N
   |
  DP
   |
  CP
```

(1a')
```
  DP
   |
  NP
   |
  N
   |
  D
```

(1b)
```
  DP
   |
  NP
   |
  N
   |
  PP
```

(1b')
```
  DP
   |
  NP
   |
  P
```

\(\text{ton ipireti tis ithopiu pu...}\)  \(\text{ton ipireti me tin ithopio pu...}\)

\(\text{‘the servant of the actress who...’}\)  \(\text{‘the servant with the actress who...’}\)
In (1a') and (1b'), the RC is attached higher up in the tree, whereas in (1a") and (1b") the RC is attached lower. Hence, according to Late Closure, the derivations of (1a') and (1b') should be more costly than those of (1a") and (1b"), since they involve attachment not to the most recent phrase but to a phrase that is higher up in the tree. Therefore, according to the Garden Path model, native speakers of Greek should initially prefer to attach the RC to NP2 in both (1a) and (1b). Discourse factors are expected to play a role in later processing choices and only in accordance with thematic considerations. As far as (1b) is concerned, the Garden Path model does not predict any reanalysis effects, since the first noun is not an available host because of the intervention of the lexical preposition *me* (with) and a different thematic domain. On the other hand, the pragmatic principle Relativized Relevance might influence the final interpretation of the RC in sentences like (1a). Relativized Relevance requires the RC to be preferably attached to the noun that is the most salient discourse referent in terms of sentence comprehension. In sentences like (1a), the first noun, being the direct object of the main clause, carries important information for the sentential meaning and, therefore, the RC should be reanalysed as being attached to the first rather than to second NP.

The Construal theory relates the RC attachment preferences to the thematic domain hypothesis, in the sense that modifying constituents are associated with rather than attached into the current thematic processing domain. This means that a low-attachment preference for RCs should be obtained across different languages, if the two DPs that precede the RC belong to different thematic domains. In (1b) in which the second noun is introduced by the lexical preposition *me* (with), the last processing thematic domain, when the RC is encountered, is the one defined by the preposition. In this thematic domain, only the DP *to koritsi* (the girl) is available to head the RC, as shown in (2).

However, when both DPs belong to the same thematic domain, then both nouns are available hosts and the attachment of the RC to either noun depends on semantic, discourse and pragmatic considerations, because RCs are modifiers and, hence, non-primary phrases\(^1\). Thus, in sentences like (1a), the RC will be preferable attached to the first noun due to the Relativized Relevance.
According to Gibson and collaborators’ model, RC attachment preferences are determined by the competition between Recency and Predicate Proximity. Recency is assumed to hold universally and requires incoming elements to be attached to the most recent phrase, whereas Predicate Proximity is parameterized and requires new constituents to be attached as close as possible to the IP node. Cross-linguistic differences found in RC attachment preferences are accounted for by the relative weight of Predicate Proximity in different languages. The strength of Predicate Proximity is determined cross-linguistically by the distance allowed between the verb and its arguments in different language. Adjacency of the arguments to the verb is not necessary in Greek; in fact, it is possible for the object to be far from the verb by which it is governed, as shown below:

(3) She wrote the letter quickly and without any hesitations.
(4) Eghrapse tin epistoli ghrigora ke horis endhiasmus.
    wrote-3SG the-ACC-SG-F letter-ACC-F quickly and without hesitations-ACC-PL-M
    “She wrote the letter quickly and without any hesitations.”
(5) *She wrote quickly and without any hesitations the letter.
(6) Eghrapse ghrigora ke horis endhiasmus tin epistoli.
    wrote-3SG quickly and without hesitations-ACC-PL-M the-ACC-SG-F letter-ACC-SG-F
    “She wrote the letter quickly and without any hesitations.”
Therefore, Predicate Proximity is expected to be strong in Greek and induce high-attachment preferences. Furthermore, Gibson et al.’s model does not anticipate that the form of the complex DP that precedes the RC would affect attachment preferences. Therefore, there should be no differences between (1a) and (1b) with respect to the way the RC is attached and a high-attachment preference should be found across the board.

The Anaphor Resolution model, along with the Recency/Predicate Proximity model, relates the RC preferences to language-specific properties. Hemforth and her colleagues argue that RC attachment preferences are guided by the anaphoric binding module, which states that pronouns tend to be attached to the most salient referent. The way RCs are introduced across different languages will determine their attachment patterns. More specifically, languages in which RCs are introduced by relative pronouns will exhibit a high-attachment preference whereas the reverse will be manifested in languages in which complementizers can also introduce RCs. The description and the discussion of RCs in Greek in section 3.1 made it clear that Greek RCs can be introduced not only by relative pronouns but also by the complementizer pu (that). More importantly, the use of the relative complementizer pu is not only possible but also preferred by native speakers of Greek in everyday speech. Hence, according to Hemforth et al. (1998) and Konieczny et al., (1997), a low-attachment preference should be obtained in Greek for complex DPs with genitives.

To summarise, Table 4.1 presents the predictions of the parsing models discussed earlier with respect to RC attachment preferences in Greek:

<table>
<thead>
<tr>
<th>Parsing models</th>
<th>Genitives</th>
<th>Prepositions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garden path model</td>
<td>First parse</td>
<td>Final parse</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Construal theory</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Recency/Predicate Proximity model</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Anaphor resolution model</td>
<td>Low</td>
<td>–</td>
</tr>
</tbody>
</table>
4.1. EXPERIMENT 1: SENTENCE COMPLETION QUESTIONNAIRE

In this section, a paper-and-pencil task will be presented, which was conducted in order to obtain an initial overview on RC attachment preferences in Greek. This task is a sentence completion experiment, in which the subjects were given sentential beginnings and were asked to choose one of two possible continuations of the sentence. This questionnaire task is an off-line measure and, therefore, it reflects the subjects’ final interpretations rather than their performance during on-line processing.

4.1.1. Method

4.1.1.1. Materials

The critical materials were constructed around 24 core sentences containing a RC with two possible antecedents. The RCs were always subject-RCs introduced by the complementizer *pu* (that). The two DPs preceding the RC were always animate, had different gender (either feminine or masculine) and involved a functional/professional relationship.

Two conditions of each test sentence were constructed, differing only with respect to the form of the complex DP that preceded the RC. In one condition, the second DP was dependent on the first DP and was in genitive case, whereas in the second condition, the second DP was introduced by the lexical preposition *me* (with). In the former, both nouns belong to the same thematic domain, whereas in the latter, the second noun belongs to the thematic domain formed by the lexical preposition *me* (with). Examples of both conditions are given below:

- **Genitives**
  
  \[(7a) \text{Enas dhimosioghrafos kitakse } \text{ton } \text{fititi tis kathighitrias pu itan } \ldots\]
  
  ‘A journalist looked at the student-M the-GEN-F teacher-GEN-F that was \ldots’

- **PPs**
  
  \[(7b) \text{Enas dhimosioghrafos kitakse } \text{ton } \text{fititi me tin kathighitria pu itan } \ldots\]
  
  ‘A journalist looked at the student-M with the teacher-ACC-F that was \ldots’

The sentences were ambiguous up to the auxiliary verb *itan* (was). The subjects had to choose between an N1 and an N2-attachment continuation of the sentence fragment. In the sentence continuations, the
ambiguity was resolved by means of gender information on a past participle, which agreed either with the first or the second noun, resulting in N1 or N2-attachment of the RC respectively:

- N1-attachment
  
  (8a) … thimomenos apo ti sizitisi.
  ‘… angry-M because of the discussion.’

- N2-attachment
  
  (8b) … thimoneni apo ti sizitisi.
  ‘… angry-F because of the discussion.’

The two nouns within the complex DP were selected so that both of them could be equally plausible hosts for the RC on semantic and pragmatic grounds. Moreover, notice that the PPs in sentences like (7b) could not function as modifiers of the preceding verb and denote the instrument, because the complement of the preposition was always an animate referent. However, the English translation equivalents of the PP condition (see 7b), but not of the genitive condition (7a), allow for an additional attachment ambiguity in which the PP (with the teacher) might be attached to the verb, so that (7b) could be interpreted to mean that the journalist together with the teacher looked at the pupil. This possibility is also available in Greek but is less plausible when the complement of the preposition is animate. To verify these intuitions, we gave all 24 experimental sentences with the PPs but without the RCs (e.g. Ένας δημοσιογράφος κοιτάζει τον μαθητή με την καθηγήτρια ‘A journalist looked at the student with the teacher’) to 13 native speakers of Greek and asked them to rate which of two interpretations, one based on verb attachment of the PP (e.g. ‘A journalist together with the teacher looked at the student’) versus one based on NP attachment (e.g. ‘A journalist looked at the student who was with the teacher’), was more plausible. It turned out that the reading in which the PP is attached to the NP received an 81.83% plausibility score, whereas the verb attachment reading received a much lower plausibility score, 30.16%. One-sample t-tests showed that both scores were significantly different from 50% (NP-attachment: t1(12) = 7.110; p < 0.001; t2(23) = 24.994; p < 0.001; verb attachment: t1(12) = 3.367; p < 0.01; t2(23) = 12.040; p < 0.001), which confirmed that the additional verb-attachment ambiguity is not very plausible for the kinds of sentences we tested. In addition, most of
the subjects participating in this plausibility test reported that the NP-attachment reading was the most natural interpretation of the sentences and the one that first came to their mind when reading the sentences.

In addition to the experimental sentences there were 48 filler sentences involving a variety of constructions. Half of the fillers were ambiguous and half were unambiguous.

Two versions of the questionnaire were constructed so that each version contained the same fillers and the same number of experimental sentences. Moreover, all subjects were exposed to both conditions and never saw the same sentence more than once. The Greek critical sentences together with their literal English translations are given in Appendix I.

4.1.1.2. Procedure The sentences were presented on typed sheets. The subjects were given the beginnings of the sentences and immediately afterwards two possible continuations were provided. For the unambiguous filler sentences, only one continuation was possible and this choice was based on grammatical or plausibility reasons. The ambiguous sentences were given to the subjects up to the point where they were ambiguous. An example of the test items used in the sentence completion questionnaire is provided in (9):

(9) Enas dhimosioghrafos kitakse ton fititi tis kathightrias pu itan …
(9a) thimomenos apo ti sizitisi. (9b) thimomeni apo ti sizitisi.
‘A journalist looked at the student-M the-GEN-F teacher- GEN-F that was …
(a) angry-M because of the discussion. (b) angry-F because of the discussion.’

In half of the critical sentences the N1-attachment option was provided first, whereas in the other half it was provided second, to make sure that the subjects’ responses were not biased by the order that the two options appeared.

The subjects were instructed to read the sentences only once and to circle the option that seemed most appropriate to them as a completion of the sentence. The whole procedure did not last more than 15 minutes.

4.1.1.3 Subjects 20 native speakers of Greek (13 females and 7 males; mean age: 20,01) who were studying at the University of Athens participated in this task. All of them were naïve with respect to the purpose of the experiment.
4.1.2. Results

Figure 4.1 illustrates the mean percentages of N1 and N2-attachment responses for each condition across subjects. The results in Figure 4.1 show that the subjects responded differently in the two conditions. Namely, in the genitive condition, there were more high-attachment responses than low, while the reverse is true for the preposition condition. Statistical analyses were also conducted to see whether the two conditions differed significantly. The design of the experiment involved one factor, namely, the type of antecedent, complex DPs incorporating either genitives or PPs. The experiment had a repeated-measures design, since all subjects were tested on the same items and conditions. Thus, a one-way repeated measures ANOVA with two levels (genitives vs. prepositions) was performed on the data. The effect of ‘Antecedent’ was significant for both the subject and the item analysis ($F_1(1,19) = 54.405; p < 0.001; F_2(1,23) = 107.858; p < 0.001$). This means that the antecedent type of the RC influenced the subjects’ interpretations of the sentences. In addition, one-sample t-tests were conducted in order to test whether the NP1 and the NP2 advantages for
genitives and PPs respectively were statistically different from chance level, which was set at 50%. These tests confirmed that the high-attachment preference for genitives \((t1(19) = 4,945, p < 0,001; t2(23) = 4,258, p < 0,001)\) and the low-attachment preference for PPs \((t1(19) = 4,199, p < 0,001; t2(23) = 7,460, p < 0,001)\) were significantly different from chance level.

4.1.3. Discussion

The purpose of the off-line task was to explore whether the form of the complex DP that precedes the RC affects RC attachment preferences in Greek. The results show that the RC attachment preferences do depend on the type of the complex DP, indicating that the manipulation of the thematic relationships between the two antecedents of the RC is indeed an influencing factor.

These preliminary results are compatible with the thematic domain hypothesis of Construal. It was found that when the second DP belonged to a different thematic domain than the first DP, as in the case of the PP condition, the RC was preferably attached low, to the second DP, whereas a high-attachment preference was obtained when the second DP forms a single thematic domain together with the first DP, as in the genitive condition. Furthermore, the N1-attachment preference in the genitive condition can be accounted for by the Relativized Relevance principle, as in this condition the first noun is an available host for the RC and is also a prominent referent.

Notice that these findings are also compatible with the Garden Path model, since they have been obtained from an off-line measure and, therefore, an initial low-attachment preference might have been masked by final interpretative biases. To investigate on-line processing decisions an on-line has been conducted.

4.2. EXPERIMENT 2: SELF-PACED READING TASK

The purpose of the self-paced reading (SPR) task was to examine whether the results of the off-line task can be replicated when an on-line measure is used. The SPR technique is one of the most common techniques used in studies on syntactic ambiguity resolution along with
eye-tracking experiments. SPR tasks are on-line measures, which seek to explore performance during comprehension and in which the sentences are presented in a word-by-word or phrase-by-phrase fashion. The time the subjects take to request the next word or phrase is measured. SPR methodology makes it possible to ‘consider momentary processing throughout a sentence’ (Mitchell and Green, 1978: 610). The advantage of SPR tasks is that readers cannot look back to the phrases or the words they have previously read and, thus, they are encouraged to keep up-to-date with their processing (Mitchell and Green, 1978: 610). In addition, SPR tasks have yielded results that do not always match the off-line patterns (see for example, De Vincenzi and Job, 1993, 1995) and, therefore, are supposed to reflect initial parsing choices (cf. Fernández, 2003).

The experimental paradigm used in the present study was a phrase-by-phrase non-cumulative SPR task, in which the subjects read sentences divided into segments, while the time they took to read each segment was recorded. A phrase-by-phrase segmentation was chosen, because a word-by-word presentation might reflect an unnatural reading performance and more importantly the separation of the two antecedents of the RC might bias the subjects towards low-attachment. The format of the SPR task was similar to the one used by De Vincenzi and Job (1993, 1995).

4.2.1. Method

4.2.1.1. Materials

The materials consisted of sentences which included RCs with two antecedents. As in the off-line experiment, two types of complex NPs were included:

- sentences in which the second NP is in genitive case and therefore does not form a thematic domain of its own and
- sentences in which the second NP is assigned a theta-role by the lexical preposition me (with).

The design of the experiment involved four conditions, as shown in Table 4.2.

The manipulation of the Attachment type (high vs. low) makes it possible to directly compare the high and low conditions and see which one is read more quickly. Moreover, the use of different types of antecedents allows us to examine whether thematic information affects the attachment of RCs.
24 critical items were tested for these four conditions. The experimental sentences ranged in length from 14 to 16 words. Also notice that the sentences in all four conditions were minimal pairs, in the sense that they included the same words and they only differed in the form of antecedent (genitive vs. preposition) and the attachment type (high vs. low). Each sentence was divided into 5 segments, as illustrated in the following examples.

- **Genitives – High-attachment (gh)**

(10a) Enas theatis kituse a-NOM-SG-M spectator-NOM-M looked-IMP.3SG
    ton proponiti tis athlitrias the-ACC-SG-M trainer–ACC-M the-GEN-SG-F athlete-GEN-F
    pu fenotan poli stenohorimenos that seemed-3SG very upset-M
    apo tin apofasi tis epitropis from the-ACC-SG-F decision-ACC-F the-GEN-SG-F committee-GEN-F

‘A spectator was looking at the trainer (masc) of the athlete (fem) who seemed very upset (masc) because of the decision of the committee.’

- **Genitives – High-attachment (gl)**

(10b) Enas theatis kituse a-NOM-SG-M spectator-NOM-M looked-IMP.3SG
    ton proponiti tis athlitrias the-ACC-SG-M trainer–ACC-M the-GEN-SG-F athlete-GEN-F
    pu fenotan poli stenohorimeni that seemed-3SG very upset-F
A spectator was looking at the trainer (masc) of the athlete (fem) who seemed very upset (fem) because of the decision of the committee.

- PPs – High-attachment (ph)

(10c) Enas theatis kituse
a-NOM-SG-M spectator-NOM-M looked-IMP.3SG
ton proponiti me tin athlitria
the-ACC-SG-M trainer-ACC-M with the-ACC-SG-F athlete-ACC-F
pu fenotan poli stenohorimenos
that seemed-3SG very upset-M
apo tin apofasi tis epitropis.
from the-ACC-SG-F decision-ACC-F the-GEN-SG-F committee-GEN-F
‘A spectator was looking at the trainer (masc) with the athlete (fem) who seemed very upset (masc) because of the decision of the committee.’

- PPs – Low-attachment (pl)

(10d) Enas theatis kituse
a-NOM-SG-M spectator-NOM-M looked-IMP.3SG
ton proponiti me tin athlitria
the-ACC-SG-M trainer-ACC-M with the-ACC-SG-F athlete-ACC-F
pu fenotan poli stenohorimeni
that seemed-3SG very upset-F
apo tin apofasi tis epitropis.
from the-ACC-SG-F decision-ACC-F the-GEN-SG-F committee-GEN-F
‘A spectator was looking at the trainer (masc) with the athlete (fem) who seemed very upset (fem) because of the decision of the committee.’

The entire list of the experimental sentences can be found in Appendix I.
The first segment consisted of the subject and the verb of the main clause and the second segment consisted of the complex DP. The two nouns used had different gender, either feminine or masculine and they also indicated functional/professional relationships exactly like in the offline task. In half of the materials the first DP was masculine and the second feminine, whereas in the other half the first DP was feminine and the second masculine. This was done in order to exclude the possibility that the RC attachment preference is affected by the gender of the preceding DPs. For example, Carreiras and Clifton (1999) found that a high-attachment preference was obtained only for masculine nouns and not for feminine ones, though only when pragmatic disambiguation was used.

In this experiment, both nouns of the complex DP were presented in one chunk. The reason for this choice is that the separation of the two DPs might bias the subjects towards low-attachment. However, Gilboy and Sopena (1996) have argued that segmentation might affect RC attachment preferences in the sense that, when both nouns are presented together, prosodic cues are available and incline subjects to attach the RC to the first DP. On the other hand, according to Gilboy and Sopena, prosody does not come into play when the two nouns are presented in two different segments. Actually, Gilboy and Sopena confirmed their suggestion by a SPR task in which two types of segmentation were used and compared in terms of RC attachment preferences. Namely, a high-attachment preference was obtained when the two nouns were presented together and no preference was obtained when the two nouns were presented separately. Nonetheless, one problem with Gilboy and Sopena’s materials is that the disambiguation of the sentences was rendered semantically. Carreiras and Clifton (1999) did not manage to obtain a high-attachment preference for both masculine and feminine nouns when they used pragmatic instead of grammatical information. A supplementary problem that arises with Gilboy and Sopena’s study is that it is not clear why prosodic cues do not evolve when both nouns are presented in separate segments. In addition, when the experimental sentences were disambiguated via morphological information the high-attachment preference in Spanish was further confirmed in an eye-tracking experiment, which is supposed to be immune to prosodic effects (Carreiras and Clifton, 1999). De Vincenzi and Job (1993, 1995)
also found a low-attachment preference in Italian across different segmentation types. These latter findings undermine Gilboy and Sopena’s claim that segmentation might affect RC attachment preferences.

The third segment involves the beginning of the ambiguity and includes the relative complementizer and the verb of the subordinate clause. The verb of the RC was the verb *fenome* (to seem) and not the auxiliary verb *time* (to be) as in the off-line task, because the third singular form of the verb *to be* coincides with the third plural form, whereas the verb *to seem* has different forms for the third singular and the third plural form, as shown below:

(11) I Eleni *itan* sto balkoni.  
‘Helen was on the balcony.’

(12) Ta pedhja *itan* sto balkoni.  
‘The children were on the balcony.’

(13) I Eleni *fenotan* stenohorimeni.  
‘Helen seemed upset.’

(14) Ta pedhia *fenondan* stenohorimena.  
‘The children seemed upset.’

The use of the syncretic form *itan* (was/were) could be problematic for the conditions that involved a complex DP with a PP, since in this case the RC could refer to both DPs and the verb could be in plural, as shown in example (15):

(15) Mja kiria kituse ton kirio me to koritsi pu ghelusan.  
‘A woman was looking at the man with the girl who laughed-3pl.’

Notice that if the verb *to be* had been used instead of the verb *to seem*, then the subjects might have interpreted it as a plural form in the preposition condition and, then, they would have to reanalyse it once they would have encountered the fourth segment, which includes a singular past participle form. To avoid this confound, a verb form that is unambiguously a singular form was used, namely the form *fenotan* (seemed-3sg).

The fourth segment is the disambiguating segment and includes an adverbial and a past participle form. The resolution of the ambiguity is rendered on morphological grounds and more specifically by gender information, as shown in (10a–d). Grammatical instead of pragmatic
information was employed to disambiguate the sentences for the use of world-knowledge at the disambiguating point might trigger the instantiation of processes that are associated with plausibility factors and not necessarily with initial parsing decisions. Notice, for instance, that in an eye-tracking experiment, Carreiras and Clifton (1999) found a high-attachment preference for equivalent constructions in Spanish when they used morphological gender as means to resolve the ambiguity. When pragmatic information was instead applied a high-attachment preference was found only for the materials in which the first noun was masculine. An adverb modifying the past participle was also added to make sure that the subjects actually read this segment and did not skip it, particularly since all other segments consisted of more than one word. The adverbs used were always high frequency words, such as poli (very), arketa (enough), ligho (a bit). Notice that De Vincenzi and Job (1993, 1995) did not include an ambiguous segment but rather the same segment incorporated the beginning of the ambiguity with the relativiser and the main verb as well as the disambiguating element. In our experiments, the ambiguous and the disambiguating elements were presented separately to make sure that the critical segment is only associated with the processing of the disambiguating information and not with the processing of the ambiguous elements.

Finally, the fifth segment consisted of a PP. A fifth segment was included for the reading of the final segment is reported to involve processes that have to do with the semantic plausibility and the coherent meaning of the entire sentence. Thus, the fifth segment was added to make sure that these processes do not take place on the critical (fourth) segment.

Subjects read these sentences in a segment-by-segment fashion, with the presentation of each new segment being triggered by the pressing of a pacing button by the subjects. The times between button presses provide the crucial experimental measure. To make sure that subjects paid attention to what they were reading, they were also required to answer a question about the attachment of the RC after having read each sentence, such as, ‘Was the trainer upset because of the decision of the committee?’ The correct responses to the questions were either a simple ‘YES’ or a simple ‘NO’. ‘YES’ and ‘NO’ questions were evenly distributed across the four conditions.
Subjects’ reading times will be compared. The critical segment is the fourth segment, since it is here where the disambiguation occurs. A low-attachment preference would be evident from shorter reading times for the fourth segment of (10b) and (10d) relative to the ones in (10a) and (10c), because in the former sentences (10b) and (10d) the form of the gender marking on the adjective is compatible with the low-attachment, whereas in (10a) and (10c) it is not. If, on the other hand, subjects prefer to attach the relative clause to the first of the two NPs, reading times should be shorter for (10a) and (10c) than for (10b) and (10d) on the fourth segment.

Seventy two filler items were included to divert subjects’ attention from the structure of the materials. The filler sentences made use of different kinds of syntactic constructions. Like the experimental items they were divided into five segments and were followed by a content question. The answer to these questions was either a simple ‘YES’ or a simple ‘NO’; the ‘YES’ and ‘NO’ questions were evenly distributed across the fillers. Moreover, there also were 10 practice sentences at the beginning of each trial to familiarise the subjects with the procedure of the experiment.

Four experimental versions were constructed so that each subject was exposed to all conditions and never saw the same item more than once.

4.2.1.2. Procedure The experiment was designed using the New Experimental Set Up (NESU) software (Baumannnet et al., 1993). The stimuli were presented on a TFT computer monitor in white letters (Arial 24pt) on a dark background. The participants reacted by pressing a button on a dual box after reading each segment of the sentences.

The subjects were instructed to read the sentences as quickly and as carefully as they could. After having read a sentence in a segment-by-segment fashion, a yes-no question appeared on the screen which subjects answered by pressing one of the two buttons on a dual box. The green button on the right side was for ‘YES’ and the red button on the left side was for ‘NO’. After the subjects pressed a marked key on the keyboard, the next sentence was presented for (self-paced) reading. At this point they could take a break for as long as they wanted to, if they felt tired. The whole experiment lasted from three quarters to an hour depending on the subject’s reading pace.
4.2.1.3. **Subjects**  Twenty native speakers of Greek participated in the self-paced reading experiment, seven of which were male and thirteen were female and their mean age was 24.1 years. All of them were students at the University of Essex. The subjects were naïve with respect to the purpose of the experiment.

4.2.2. **Results**

The correct percentage of responses for the filler items was 92.22%, which ensures that the subjects paid attention to the task they were performing. All erroneous responses for the experimental items were excluded from any subsequent analyses, which resulted in the elimination of 8.54% of the data set. Reading times (RTs) that were 2SD above the mean for each condition were excluded from further analyses. This resulted in the elimination of 4.58% of the data set.

The RTs per each condition and segment as well the error rates per each condition are shown in Table 4.3.

The data from the first three segments do not reveal any interesting differences between the four conditions. On the other hand, the results from the fourth (see also Figure 4.2) and fifth segment as well as from the time the subjects took to answer the comprehension question and the errors they made, point towards the same direction as the results of the off-line task. Namely, the subjects exhibited different attachment preferences according to the type of the antecedent. More precisely, there was a strong tendency towards high-attachment in the genitive condition, whereas the preposition condition demonstrated a low-attachment preference.

<table>
<thead>
<tr>
<th>Segment</th>
<th>G-High</th>
<th>G-Low</th>
<th>P-High</th>
<th>P-Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>873.38</td>
<td>900.74</td>
<td>816.12</td>
<td>840.18</td>
</tr>
<tr>
<td>Second</td>
<td>1419.36</td>
<td>1516.41</td>
<td>1594.86</td>
<td>1618.11</td>
</tr>
<tr>
<td>Third</td>
<td>970.59</td>
<td>1011.88</td>
<td>1000.27</td>
<td>1086.73</td>
</tr>
<tr>
<td>Fourth</td>
<td>882.64</td>
<td>1222.12</td>
<td>938.38</td>
<td>864.32</td>
</tr>
<tr>
<td>Fifth</td>
<td>875.78</td>
<td>961.17</td>
<td>1022.01</td>
<td>872.11</td>
</tr>
<tr>
<td>Sixth (Question)</td>
<td>2645.62</td>
<td>2821.98</td>
<td>3043.62</td>
<td>2708.08</td>
</tr>
<tr>
<td>Error rate</td>
<td>10%</td>
<td>12.50%</td>
<td>7.50%</td>
<td>4.17%</td>
</tr>
</tbody>
</table>
These observations were further supported by statistical analyses, in which both the subjects and the items were treated as random effects. The design was a Repeated-Measures one, since all subjects were exposed to the same items and conditions. On the second and third segments, there was only one independent variable, namely the type of the ‘Antecedent’, which could incorporate either genitives or PPs. Hence, a one-way ANOVA was conducted with ‘Antecedent’ as the experimental factor, which has two levels, genitives vs. PPs. The statistical analyses showed that the effect of ‘Antecedent’ did not approach significance in either segment.

On the fourth, fifth and sixth (question) segments, the dependent variable was the RTs and the independent variables were the type of the preceding complex DP and the attachment. Since this design involved two factors, namely ‘Antecedent’ and ‘Attachment’, with two levels each, genitive vs. preposition and high vs. low respectively, 2 × 2 ANOVAs were performed on the data set. On the fourth segment, which is also the critical one, the main effects as well as the interaction were significant. A significant main effect of ‘Antecedent’ was obtained, significant in both the subject and the item analyses, which means that
overall the sentences containing genitives were read faster than those containing prepositions ($F_1(1,19) = 7,217, p < 0,05; F_2(1,23) = 5,384, p < 0,05$). In addition, a significant main effect of ‘Attachment’ was also found in both the subject and the item analysis, showing that the high and the low conditions differed significantly ($F_1(1,19) = 15,341, p < 0,01; F_2(1,23) = 9,678, p < 0,01$). More precisely, the high conditions were overall read faster than the low conditions. Most importantly, however, the interaction between ‘Antecedent’ and ‘Attachment’ was significant for both the subjects and the items ($F_1(1,19) = 20,798, p < 0,01; F_2(1,23) = 20,492, p < 0,01$). This finding suggests that the form of the complex DP affected the RC attachment preferences in opposite directions.

To further explore the direction of the interaction and determine whether there are any significant differences between individual pairs, pairwise comparisons were run on the data set with subjects and items as random effects. Since the design of the experiment is a Repeated-Measures one, paired samples t-tests were used. The pairwise comparisons showed a significant difference between the G-High (882 ms) and the G-Low (1222 ms) condition, demonstrating that the high-attachment sentences were read faster than the low-attachment ones in the genitive condition ($t_1(19) = 4,568, p < 0,01; t_2(23) = 4,558, p < 0,01$). On the other hand, the P-High (938 ms) and the P-Low (864 ms) conditions also differed significantly in the subject analysis, which shows that the sentences disambiguated towards high and attachment were read slower than the ones disambiguated towards low-attachment ($t_1(19) = 2,489, p < 0,03$).

On the fifth segment, the only significant result was the interaction between ‘Antecedent’ and ‘Attachment’ which just approached significance in the subject analysis ($F_1(1,19) = 3,738, p = 0,068$), whereas it reached significance in the item analysis ($F_2(1,23) = 4,964, p < 0,05$). This result is probably a spill-over effect from the fourth segment and provides further support for the fact that the two forms of the complex DPs yielded different attachment preferences. Pairwise comparisons showed that the difference between the P-High (1022 ms) and P-Low (872 ms) conditions was marginally significant in the subject analysis ($t_1(19) = 2,068, p = 0,053$), whereas it only approached significance
in the item analysis ($t_2(23) = 1,830, p = 0,080$). This also provides evidence that the low-attachment sentences were read faster than the high-attachment ones in the preposition condition.

Two-way ANOVAs on the data from the time the subjects took to answer the comprehension questions showed that the interaction between ‘Antecedent’ and ‘Attachment’ type was significant only in the item analysis ($F_{2}(1,23) = 5,165, p < 0,04$). This is another piece of evidence indicating that the type of the antecedent affected RC attachment preferences. Subsequent pairwise comparisons did not reveal any significant differences among either of the pairs.

Statistical analyses on the errors the subjects made when they answered the comprehension questions were also performed. A main ‘Antecedent’ effect was obtained, which means that the subjects made fewer errors when the sentence contained a DP with a PP than with a genitive ($F_{1}(1,19) = 7,120; p < 0,05; F_{2}(1,23) = 5,793; p < 0,05$). The main effect of ‘Attachment’ and the interaction between ‘Antecedent’ and ‘Attachment’ did not reach significance.

### 4.2.3. Discussion

The results of the SPR task replicated the results of the off-line task. In both tasks, the type of the antecedent determined RC attachment preferences in Greek. Furthermore, the low-attachment preference for the preposition condition that was obtained in the questionnaire study was supported by the on-line data. In addition, a clear high-attachment preference was obtained for the genitive condition in the SPR experiment, which corroborated the N1-attachment found for the genitive condition in the paper-and-pencil task. Hence, the Greek data are parallel to the results of similar studies that were conducted in a number of different languages showing that the RC attachment preferences vary cross-linguistically and depend on the form of the complex DP that precedes the RC (see for example Baccino et al., 2000; De Vincenzi and Job, 1993, 1995; Gilboy et al., 1995).

The Garden Path model can account for the low-attachment preference found in the PP condition by virtue of Late Closure. Nevertheless, the high-attachment preference found for the genitive condition in Greek further supports the claim first made by Cuetos and Mitchell
(1988: 91) that the Late Closure strategy postulated by the Garden Path model is not entirely general. Indeed, a universal parsing strategy stating that new incoming material is attached to the phrase currently being processed does not seem to adequately explain the data set obtained not only in Greek but also in other languages.

In addition, the combination of the Recency and the Predicate Proximity strategy suggested by Gibson et al. (1996a) cannot accommodate the Greek results mainly because of the different attachment preferences found for the two types of the complex DPs. Recall that the Recency/Predicate Proximity model predicted a high-attachment preference for Greek RCs across different types of antecedent. However, a high-attachment preference was obtained only for the genitival but not for the prepositional complex DPs. Therefore, Gibson et al.’s model, cannot account for the Greek findings.

Moreover, the Anaphor Resolution model (Hemforth et al., 1998; Konieczny et al., 1997) also fails to account for the findings from the genitival antecedents in Greek. Recall that, according to Anaphor Resolution, the Anaphoric Binding bias should result in low-attachment preference in the genitive condition, since the RCs used in this study were introduced by a complementizer. Instead, an N1-attachment preference was found for the genitive condition, which is incompatible with Anaphor Resolution.

Note that none of the three models considered thus far succeeds in providing an account for the entire data set obtained in Greek. The Garden Path model explains the attachment patterns in the preposition condition but not in the genitive condition. On the other hand, the Recency/Predicate-Proximity model fails to account for the divergent preferences for RC attachments in the same language. Finally, the parameterised parsing principle suggested by the Anaphoric Binding model to account for the variation in different languages is not supported by the Greek results.

One model that successfully accounts for the data is the Construal theory (Frazier and Clifton, 1996). First, the thematic domain hypothesis was verified by the Greek data because the manipulation of the availability of the two nouns in terms of thematic considerations did result in different attachment preferences. More precisely, when the second noun was introduced by a lexical preposition and, hence,
belonged to a different thematic domain from the one of the first noun, a low-attachment preference was obtained. In the genitive condition, however, both nouns were in the same thematic domain and, thus, both were available hosts for the RC. According to the Construal theory, in such cases initial parsing choices can be influenced by semantic and pragmatic factors, as the constructions involve RCs, which are non-primary phrases. Hence, along the lines of Relativized Relevance, the high-attachment preference found in the genitive condition of the SPR task could be due to the fact that the first noun, being the object of the main clause, contained important information for the comprehension of the sentence and, therefore, was a more adequate host for the RC than the second noun. Even though Construal provides an adequate account for the Greek data, it does not offer equally sufficient explanations for the low-attachment preference that has been found with genitival complex DPs in languages like English. More specifically, the Gricean maxim put forward to justify the N2-attachment preference in English does not seem to make the correct predictions for other languages like Dutch or Afrikaans (cf. section 2.1.2 and Mitchell et al., 2000). For this reason and despite the fact that the present findings cannot be used to argue against the predictions of Construal, in what follows I will build on the postulations of Construal and Recency/Predicate Proximity and present an alternative account of the Greek data.

The high-attachment preference obtained with genitives in Greek, as opposed to the low-attachment preference found for example in English, provides evidence in support of cross-linguistic variation in sentence processing. Following Gibson and his collaborators (Gibson et al., 1996a, 1999), I also think that the divergent processing patterns observed in different languages for such constructions originate from cross-linguistic differences. Gibson et al. suggest that the relevant grammatical property is the flexibility of word order. Going one step further, free word order has been associated with inflectionally ‘strong’ languages\(^4\) (cf. Comrie, 1981; Haider, 1988; Roberts, 1997; Weerman, 1997; and Catsimali, 1990; Horrocks, 1994 for Greek\(^5\)). In Greek and other highly inflected languages, the morphological features carry information about the syntactic functions and relations within a sentence. For example, S-V agreement is encoded on the inflectional suffix of the verb making the use of
an overt subject superfluous, the morphological case features carried by the
determiner and the noun make the syntactic functions within a
clause visible and agreement relations among determiners, adjectives
and nouns are also morphologically marked. When parsing a highly
inflected language morphological cues are important in order to arrive
at the interpretation of the sentence. Bearing this in mind, I will make
the assumption that, in morphologically rich languages, the parser
makes extensive use of morphological information for two reasons. On
one hand, the parser uses morphological information – probably together
with phrase-structure information – in order to access the
Syntax/Morphology interface (Embick and Noyer, to appear; Halle and
Marantz, 1993; Harley and Noyer, 1999) and relate the actual morpho-
logical features to the abstract syntactic ones and establish the syntactic
relations within the processing material. On other hand, the use of mor-
phological information by the parser results in the adoption of certain
processing mechanisms, which are rather interpretative in nature
instead of genuinely syntactic but, nevertheless, help the parser quickly
assign an interpretation to the sentence. One possible consequence of
such processes, relevant for the constructions investigated in the present
study, is the prominence of the direct object, which favours attachment
to this constituent. Another consequence of such an interaction might be
indeterministic parsing, when unambiguous morphological information
is not provided. Evidence in support of this claim comes from a Greek
SPR study on the processing of subject/object ambiguities
(Papadopoulou and Tsimpli, 2005a). For illustration purposes consider
the Greek sentence (16a) and its English translation (16b):

(16) a. Kathos etroghe ta biskota epesan sto patoma.
    while ate-IMP.3SG the-PL-N cookies-N fell.3PL on-the floor
    ‘While he was eating the cookies fell on the floor.’

Various English studies (cf. Frazier and Rayner, 1982; Mitchell, 1987;
Pickering and Traxler, 2003; Traxler, 2003) have reported that native
speakers prefer to analyse the DP the cookies as the direct object of
the embedded verb rather than as the subject of the coming main clause.
By contrast, the Greek native speakers participating in this study did not
experience any garden-path effects when encountering the disambiguating
information on the main verb, which indicates that Late Closure was not employed. One possible explanation for the differences between Greek and English might be the fact that in Greek the parser, in the light of the morphologically ambiguous material, generates more ‘flat’ structures delaying any definitive attachments and, thus, it makes any reanalysis less costly. No need to say that the actual effects of morphological information on on-line sentence processing require further investigation.

Turning now to the low-attachment preference found with PPs, along the lines of the thematic domain hypothesis (cf. Frazier and Clifton, 1996, 1997), this is due to lexical effects. As has already been stated, the lexical preposition constitutes a ‘barrier’, which makes the first DP a less available host for the RC. Such information is available to the parser through the Lexicon, which contains the lexical entries together with possible thematic information. To be more specific, when the PP me tin athlitria (with the athlete-f) is encountered, the equivalent lexical entries are accessed and the parser makes use of the fact that the lexical preposition can impose a thematic role on its complement. This results in the formation of a new thematic domain instantiated by the preposition, which deactivates the first DP as possible attachment site and favours the attachment of the RC to second noun. Such lexical biases are expected to hold universally and affect initial parsing decisions, which has been supported by a number of studies in various languages not only for ambiguous RCs but also for other constructions (Adams et al., 1998; Liversedge et al., 1998).

The claim that in highly inflected languages sentence processing is affected by morphological information does not deny the existence of a universal processing principle, which favours local attachments. In morphologically rich languages, such a principle, similar in nature with Right Association, Late Closure, Branch Right or Recency, might be a ‘last-resort’ strategy employed by the parser when lexical information has not yet been made available and, therefore, full morphological analysis triggering certain effects on parsing decisions has not yet taken place. The present findings cannot be used to evaluate such a hypothesis, because the complex DP has been fully analysed both morphologically and lexically before the ambiguous material has been encountered and, thus, I will leave this issue open for future research.
To summarise, it has been argued that the source of cross-linguistic variation in sentence processing observed in the present study is language specific properties and more specifically the ‘richness’ of inflectional morphology. In highly inflected languages, the parser’s decisions are affected by the following factors:

(a) lexical cues, which are used by the parser to define thematic domains (i.e. the thematic domain hypothesis) and to derive argument structure information;
(b) morphological cues, which are employed to establish syntactic relations within a clause but also for comprehension purposes, i.e. the favour to attach incoming material to argument positions (i.e. direct objects) or indeterministic parsing;
(c) a ‘last-resort’ universal parsing strategy, like Late Closure, employed when lexical information is not yet available.

Lexical cues, at least when they indicate the generation of a new thematic domain, are universal, can override Late Closure and are not easy to be overruled by other biases like pragmatic ones. On the other hand, the processing strategies employed due to the use of morphological information are language specific, can be overridden by lexical cues and are vulnerable to discourse-level information. Notice, however, that, when morphological information is used to determine syntactic relations, such choices are assumed to not be affected by other sources of information even lexical ones\(^1\). Finally, Late Closure is assumed to be universal and difficult to be overruled by pragmatic information when it is effective.

In the next chapter, I will present two additional experiments, in which it will be tested whether pragmatic biases can alter the preferences found with sentences presented in isolation. These experiments will also provide further evidence to evaluate the Construal theory as well as the account proposed here.

NOTES

\(^1\) In the Greek sentence (1a), the last thematic domain includes both nouns. Notice that according to Alexiadou and Stavrou (1999), the possessor is licensed by a PP headed by an empty preposition, as illustrated in (36) in section 3.2.1. This means that the
possessor belongs to the thematic domain defined by this PP and, thus, one could argue that the two nouns belong to different thematic domains. Nevertheless, Alexiadou and Stavrou (1999: 39, note 1) say that the DPs in genitive they are dealing with are assigned a theta-role ‘either from the head noun or the context’, which indicates that the PP cannot be viewed as a distinct thematic domain. Therefore, under Alexiadou and Stavrou’s analysis, both nouns also belong to the same thematic domain.

Notice that the predictions of this model are relevant only for complex DPs that incorporate non-thematic prepositions or genitives.

This claim goes back to the distinction between configurational and non-configurational languages originally proposed by Chomsky (1981) and Hale (1982), which seems to be incompatible with more current syntactic frameworks (Chomsky, 1995; Kayne, 1994; see also Müller, 2002). Notice, however, that the relation of inflectional morphology to word order flexibility is important for the human sentence processor, which has to use ‘surface’ cues to assign an interpretation to the input. Therefore, the distinction between configurational and non-configurational languages, even though it might not have an effect on the derivations produced by the computational system, might result in the adoption of different parsing mechanisms.

See Tzanidaki (1996) for some problems with such approaches in Greek.

Following Smith and Tsimpi (1995: 25–27, 169–171) and Tsimpi (1992), I also assume that the morphological component is separate from the conceptual/mental Lexicon and ‘constitutes an interface level between the grammar and the conceptual/mental lexicon’ (Smith and Tsimpi, 1995: 27).

Following current syntactic frameworks (cf. Chomsky, 1995), I assume that the Grammar consists of a set of rules that generate structures, which are then subjected to further operations in two interface systems, namely LF (the conceptual/intentional system) and PF (the articulatory/perceptual system. In addition, I also assume a Syntax/Morphology interface, which is responsible for the way words and their internal structure relate to the structures generated by the syntax (Embick and Noyer, to appear).

Schlesewsky and Bornkessel (2004), based on ERP evidence, also suggest that the ‘richness’ of inflectional morphology results in the adoption of different parsing routines.

Preliminary evidence in favour of this hypothesis has been obtained in the study on subject/object ambiguities (Papadopoulou and Tsimpi, 2005a). In one condition of this study disambiguation occurred immediately after the embedded verb via the case features of the determiner as shown below:

(i) a. Kathos etroghe tus …
    while ate-IMP.3SG the-ACC-PL-N

b. Kathos etroghei …
    while ate-IMP.3SG the-NOM-PL-N
In (ia) the determiner is unambiguously marked for accusative and, therefore, it has to be analysed as the head of a DP object, whereas in (ib) it is unambiguously marked for nominative and, hence, it has to be analysed as the head of a subject DP. RTs on the determiner were shorter for (ia) than for (ib), which indicates a preference to attach new material to the phrase currently being processed along the lines of Late Closure. Notice that this finding contrasts with that from sentence (16a), where evidence for such a preference was not obtained. One possible explanation for the divergent results with (i) and (16a) might be the fact that Late Closure effects are evident only when lexical cues are not yet available to produce further morphological and lexical analysis and affect the parser's choices.

In a Greek study on the effects of morphological case on S-V agreement (Papadopoulou and Plemenou, in preparation), it has been found that such a syntactic operation is not affected by surface morphological cues.
In this chapter the RC attachment ambiguity will be further studied by investigating whether the use of an appropriately biased context towards high or low-attachment affects attachment preferences.

Different models of ambiguity resolution give different answers to the question of how parsing is influenced by contextual effects. For example, serial-autonomous models, such as the Garden Path model, maintain that parsing decisions are based on syntactic considerations alone by a syntactic processor. This means that the process of ambiguity resolution is context-independent. However, whenever the selected reading is not consistent with the continuation of the sentence, a reanalysis can be made based on semantic and pragmatic grounds. Therefore, serial-autonomous models hypothesise that the initial analysis is only based on syntactic information, whereas the reanalysis processes can be influenced by contextual effects.

On the contrary, parallel-interactive models, such as Constraint-satisfaction (MacDonald, 1993, 1994, 1997; MacDonald et al., 1994a, 1994b; Spivey-Knowlton and Tanenhaus, 1994; Spivey-Knowlton et al., 1993; Taraban and McClelland, 1990; Thornton et al., 1998, 1999; Trueswell and Tanenhaus, 1994; Trueswell et al., 1994) models, suppose that all sources of information are used in parallel in order for the ambiguity to be resolved. This means that no priority is given to syntax; rather, syntactic, semantic and pragmatic information interacts for the initial choice to be made. Moreover, according to these models, all alternative choices are processed in parallel and are kept in mind until a signal input that resolves the ambiguity towards one or another choice is encountered.
Finally, discourse-based models (Altmann and Steedman 1988; Altmann et al., 1992; Crain and Steedman, 1985; Murray, 1994; Steedman and Altmann, 1989), claim that a single reading is adopted with respect to syntactic and discourse-based features. This means that the selection of the appropriate structure is guided by information from the discourse context and that initial parsing decisions can be influenced by the discourse-context.

5.1. STUDIES ON CONTEXT EFFECTS IN RC ATTACHMENT PREFERENCES

Two studies have investigated whether discourse-level information can affect RC attachment preferences. Zagar et al. (1997) used an eye-tracking experiment to investigate whether the attachment of the relative clause to the first DP in French is attributed to structural or to discourse-based factors. They assumed that, if the DP1-interpretation is linked to discourse-based processes, then it should be possible to turn it into a DP2-preference by manipulating the context (context biased towards high-attachment interpretation vs. context biased towards low-attachment interpretation).

The type of context used by Zagar et al. is extra-sentential and is based on the referential context hypothesis (Altmann et al., 1992; Britt, 1994; et al., 1992; Crain and Steedman, 1985; Mitchell et al., 1992; Sedivy and Spivey-Knowlton, 1994; Spivey-Knowlton and Tanenhaus, 1994; van Berkum et al., 1999; van Berkum et al., 2000). The referential context hypothesis was tested on sentences such as (1), in which the sequence *that he was having trouble with* could be interpreted either as a complement clause or as a relative clause:

(1) The psychologist told the woman that he was having trouble with …

The initial syntactic preference is to interpret the sequence as a complement clause instead of a relative clause. However, the proponents of the referential theory argued that in isolated sentences the complement reading is favoured over the RC one, because the RC reading would require the existence of more than one potential referent for the noun
the woman. To put it differently, when sentence (1) is incorporated in a text that has more than one potential referent for the noun the woman, then the initial complement-clause reading can be overridden. Therefore, ‘referential context’ means a context that creates the appropriate circumstances, namely to introduce more than one potential referent, for a noun to be used as a potential host for a RC. In the case of the RC attachment ambiguity it is assumed that the RC is more likely to be attached to the host that has several referents in a preceding discourse context. Hence, in order to bias subjects towards high or low-attachment several referents should be introduced for the first or the second noun respectively. This is what Zagar and his collaborators did as shown in (2) and (3):

- **Context biasing towards high-attachment interpretation:**

  (2) The hearing was about to begin and everyone was waiting for the judge. The audience was chatting noisily and talking about the case. *The singer* (fem) *and her barristers* (masc) were standing in a corner of the courtroom².

  **Target sentence:**

  (2'/H11032) A journalist approached the barrister (masc) of the singer (fem) who seemed more confident (masculine or feminine gender for N1- and N2-attachment respectively).

- **Context biasing towards low-attachment interpretation:**

  (3) The hearing was about to begin and everyone was waiting for the judge. The audience was chatting noisily and talking about the case. *The singers* (fem) *and their barristers* (masc) were standing in a corner of the courtroom.

  **Target sentence:**

  (3'/H11032) A journalist approached the barrister (masc) of the singer (fem) who seemed more confident (masculine or feminine gender for N1- and N2-attachment respectively).

Zagar et al. assumed that the attachment of the relative clause to the first or the second noun should be discarded once it has been established that
there is only one possible referent for the first or the second noun respectively. Moreover, they compared two reading conditions, one in which subjects were instructed to pay attention to the sentences they read (question condition), and one in which they were encouraged to adopt a more relaxed reading style (reading condition).

Their results can be summarised as follows:

- An overall high-attachment preference was obtained regardless of context.
- Significant differences were obtained between the two reading conditions; namely, in the reading condition, no significant differences were obtained between the two kinds of disambiguation (high vs. low-attachment), whereas in the question condition, a high-attachment preference was obtained regardless of context.
- A context effect was obtained in the accuracy of responses; specifically, accuracy was greater when the contextual bias was consistent with the type of sentence (low-attachment biasing context and low-attachment disambiguated sentence or high-attachment biasing context and high-attachment disambiguated sentence) than when it was not (low-attachment biasing context and high-attachment disambiguated sentences or high-attachment biasing context and low-attachment disambiguated sentences).

Zagar et al. interpreted their results as evidence in support of the view that relative clause attachment preferences are influenced by structural factors rather than by contextual effects and they argued for the existence of a structural bias that favours DP1 instead of DP2 preference. Their results also suggest that initial RC attachment preferences cannot be altered by biased contexts, which is opposed to the claims of discourse-based models. However, one problem with Zagar et al.'s study is that the context provided was not sufficiently biasing to override the initial preferences. This is because Zagar et al. did not treat the high- and low-attachment biasing contexts equally. More specifically, although the high-attachment contexts contained several potential referents for the first noun and only one for the second, the low-attachment contexts contained several potential referents for both nouns, as shown in examples (2) and (3) respectively. This asymmetry might have affected the results. Besides, Zagar et al. conducted a pre-test completion experiment...
in order to test the effect of biasing referential contexts on the interpretation of those sentences and they found a significant but slight context effect (Zagar et al., 1997: 427). Thus, the context effect they found is weak and might have not been strong enough to bias subjects’ initial interpretations. Thus, the results of Zagar et al.’s study do not provide a straightforward or definite answer to the question of whether contextual effects influence initial RC attachment preferences and this issue requires further investigation.

In a study conducted in Dutch, Desmet et al. (2002) investigated the influence of referential context on RC attachment preferences in a sentence completion study and an eye-tracking experiment. They studied Dutch sentences such as (4):

(4) De agenten verhoren de adviseur van de politici die spreekt met een zachte stem
   ‘The police interrogate the advisor of the politicians who speaks with a soft voice.’

Previous studies examining this kind of construction in isolation found a NP1 preference for Dutch (Brysbaert and Mitchell, 1996; Mitchell and Brysbaert, 1998; Mitchell et al., 2000). Like Zagar et al. (1997), Desmet et al. presented these sentences in different referential context conditions, with a preceding neutral context, a preceding high-attachment biasing context, and a preceding low-attachment biasing context. Desmet et al. found that while in the off-line study the participants’ preferences were strongly influenced and indeed reversed by the preceding referential context, in the eye-tracking experiment they were only slightly modulated by context information. Most importantly, the reading times revealed a significant high-attachment preference independent of the preceding context. Desmet et al. conclude from these findings that referential context does not influence initial attachment decisions, but plays a role in later phases of sentence processing. Desmet et al. (2002)’s results are consistent with those of Zagar et al. (1997). However, both studies have only examined RCs headed by complex DPs containing non-thematic (of-type) prepositions and were not designed to examine how discourse level information interacts with lexical-semantic cues in RC attachment ambiguity resolution. Recall that the
experiments reported in chapter 4 (but also studies carried out in other languages) revealed that the thematic relationships between the two DPs that precede the relative clause influence the interpretation of the ambiguity. Therefore, it is worthwhile testing how referential contexts interact with lexical-semantic biases and affect structural ambiguity resolution on-line.

Consider now the predictions of the parsing models introduced in chapter 4 with respect to contextual effects on RC ambiguity resolution. Firstly, the Garden Path model, as already noted, claims that initial parsing decisions are guided solely by structural considerations, whereas pragmatic biases influence only final interpretations. Accordingly, the Garden Path model expects initial RC attachment preferences not to be altered by the presence of a biased context; namely, the high and low-attachment preference found for complex DPs with genitives and thematic prepositions respectively should not be modified by discourse biases in on-line tasks. On the other hand, contextual factors might evolve in off-line tasks and influence processing choices.

On the other hand, the Construal theory deems that contextual effects emerge at an early stage of sentence processing, if the relevant structures are modifying constituents and only when the Thematic Domain hypothesis does not differentiate between two alternative interpretations. Recall that RCs are modifiers and, hence, according to the Construal theory, they are susceptible to non-structural sources of information. In addition, when the two possible antecedents for the RC belong to the same thematic domain, the Thematic Domain hypothesis does not bias towards either reading and, thus, contextual factors can guide the attachment preferences. Therefore, the Construal theory predicts that pragmatic factors will exert a role in RC attachment preferences when the second DP of the complex DP is in genitive case, whereas RC attachment preferences with prepositional complex DPs will not be affected by contextual cues.

Furthermore, Constraint-satisfaction models expect RC attachment preferences to be affected by discourse factors. More specifically, they claim that the felicity of DP modification determines RC attachment preferences cross-linguistically (Thornton et al., 1998, 1999). By felicity of DP modification they mean that a DP is more likely to be further
modified if it has not received much modification. The context used in these experiments is a referential one and it manipulates the felicity of DP modification. Therefore, Constraint-satisfaction approaches expect RC attachment to be dependent on referential context cues.

In addition, the Tuning theory does not make any specific predictions for the way discourse factors affect attachment decisions. Tuning suggests that RC attachment preferences are determined by the way this ambiguity has most frequently been resolved in the past. However, Tuning does not specify whether these choices might alter when the sentences are incorporated in contexts biased towards an option that is not favoured by the frequency data.

Finally, the Recency/Predicate Proximity and the Anaphor Resolution models do not make any specific claims in relation to context effects in RC attachment preferences. Thus, these two models will not be considered in this chapter.

An off-line and an on-line task have been conducted to examine whether the use of referential context may alter RC attachment preferences, (see also Papadopoulou and Clahsen, 2006). The design of both experiments was such that the subjects’ attachment preferences when the target sentences were preceded by referential contexts biasing towards NP1 or NP2 were compared to the data obtained when the target sentences were presented in isolation (Experiment 1). In other words, Experiments 1 and 2 functioned as baseline conditions for the experiments to be reported in this chapter.

5.2. EXPERIMENT 3: SENTENCE COMPLETION QUESTIONNAIRE

The purpose of this sentence completion task is to make sure that the contexts used are biased enough to affect RC attachment preferences. Recall that the results of experiments 1 and 2 described earlier revealed a low-attachment preference in the preposition condition while the reverse result was obtained in the genitive condition. If adequately biased contexts can override attachment preferences, then a high and a low-attachment preference should be expected in high and low-attachment biasing contexts respectively and regardless of the form of the antecedent.
5.2.1 Method

5.2.1.1 Materials Twenty four (24) experimental and forty eight (48) filler texts constituted the questionnaire study. The texts consisted of five to six sentences and were followed by a target sentence. For the experimental items, the target sentences were similar to the ones used in Experiment 1. Referential context was used in order to bias the subjects towards high or low-attachment. More specifically, in the text preceding the target sentence, two potential referents were introduced either for the first or the second antecedent of the RC. Hence, the contexts in the present study were symmetrical in that low and high-attachment biasing contexts incorporated two referents for the second and the first noun respectively. In addition, the form of the complex DP that preceded the RC was also manipulated, as in the previous experiments, namely the second DP was either in genitive case or was headed by the lexical preposition *me* (with). Since the data from this task were compared to the ones from the first off-line experiment in a between-subjects design, the manipulation of the context and the form of the complex DP resulted in four experimental conditions illustrated in Table 5.1.

In the high-attachment-biasing-context condition, two referents were introduced for the first noun of the complex DP, whereas in the condition where the context was biased towards low-attachment, two referents were introduced for the second noun of the complex DP that preceded the RC, as illustrated in examples (5a) and (5b) respectively:

(5a) Context biased towards the high-attachment (two N1s, one N2)
The schoolyard was crowded. Children, parents and teachers were waiting for the celebration to start. It was 10.30 and the

In the high-attachment-biasing-context condition, two referents were introduced for the first noun of the complex DP, whereas in the condition where the context was biased towards low-attachment, two referents were introduced for the second noun of the complex DP that preceded the RC, as illustrated in examples (5a) and (5b) respectively:

(5a) Context biased towards the high-attachment (two N1s, one N2)
The schoolyard was crowded. Children, parents and teachers were waiting for the celebration to start. It was 10.30 and the

<table>
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<th>TABLE 5.1. The experimental conditions of Experiment 3</th>
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<td>Form of complex DPs</td>
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celebration was supposed to have started at 10. One pupil was
talking with two of her teachers. The pupil and one of the teach-
ers were really upset. The other teacher was listening to the con-
versation sceptically.

(5b) Context biased towards the low-attachment (one N1, two N2s)
The schoolyard was crowded. Children, parents and teachers
were waiting for the celebration to start. It was 10.30 and the cel-
ebration was supposed to have started at 10. One teacher was
talking with two of his pupils. The teacher and one of the pupils
were really upset. The other pupil was listening to the conversa-
tion sceptically.

According to the referential context hypothesis, restrictive RCs are used
to distinguish between possible referents. Hence, the RC is more likely
to be attached to the noun, which has two potential referents in the pre-
vious text than to the noun, which only has one referent in the prece-
ding context.

The texts were followed by a target sentence of the form DP1-DP2-
RC, in which the second DP either was in genitive case or was intro-
duced by a preposition, as shown below:

(6a) O dhiefthintis kitakse ton
    the-NOM-SG-M director-NOM-M looked-3SG the-ACC-SG-M
dhaskalo tis mathitrias pu itan …
    teacher-ACC-M of-the-GEN-SG-F pupil-GEN-F that was …
      ‘The director looked at the teacher of the pupil who was …’

(6b) O dhiefthintis kitakse ton
    the-NOM-SG-M director-NOM-M looked-3SG the-ACC-SG-M
dhaskalo me ti mathitria pu itan …
    teacher-ACC-M with the-ACC-SG-F pupil-ACC-F that was …
      ‘The director looked at the teacher with the pupil who was …’

As in Experiment 1, up to the word itan (was) the sentences were
ambiguous, since pu (that) is not marked for gender, case or number.
The target sentences were followed by two options (6a’) and (6b’), each
of them consisting of a past participle that resolved the ambiguity
towards high or low-attachment according to the gender of the nouns:

(6a’) *High-attachment*
nevriasmenos eksetias tis kathisterisis
angry-NOM-SG-M because of the-GEN-SG-F delay-GEN-F

(6b’) *Low-attachment*
nevriasmeni eksetias tis kathisterisis
angry-NOM-SG-F because of the-GEN-SG-F delay-GEN-F

The order of high- or low-attachment disambiguating continuations was counterbalanced across the materials, so that a subject’s potential preference towards the first or the second option would be controlled. Four versions of the questionnaire were constructed; each version contained all the conditions tested, so that each subject was exposed to all conditions and did not see the same target sentence more than once.

To examine whether both NPs introduced in the two context conditions preceding the experimental sentence are equally plausible hosts for an RC, all experimental contexts used in the main experiments were given to 10 adult native speakers of Greek (none of whom participated in any of the main experiments) who were asked to rate the plausibility of the continuations on a 5-point scale. Continuations were sentences that contained one of the two referents introduced in the context paragraphs followed by an RC, e.g. *A journalist looked at the pupil that was angry*. An inflectous condition has been added, in which the continuation sentence contained an NP modified by an RC that was not introduced in the context paragraph. Infelicitous continuations yielded low plausibility ratings across the two referential context conditions (M = 1,29, s.d. = 0,44), whereas continuations with one of the two NPs introduced in the contexts received high plausibility ratings. In the contexts biasing towards NP1, the plausibility ratings were M = 4,0, s.d. = 0,57 for NP1, M = 3,68, s.d. = 0,51 for NP2 and M = 1,26, s.d. = 0,47 for infelicitous continuations. The infelicitous continuations were statistically less preferred than both NP1 ($t_1(9) = 11,520, p < 0,001; t_2(23) = 13,286, p < 0,001$) and NP2 continuations ($t_1(9) = 12,688, p < 0,001; t_2(23) = 9,765, p < 0,001$). In the contexts biasing towards the second NP, the scores were M = 4,19, s.d. = 0,47 for NP1, M = 3,67, s.d. = 0,53 for NP2 and M = 1,31, s.d. = 0,43 for
infelicitous continuations. In this context condition, NP1-continuations \((t1(9) = 13,466, p < 0.001; t2(23) = 12,459, p < 0.001)\) and NP2-continuations \((t1(9) = 11,488, p < 0.001; t2(23) = 11,347, p < 0.001)\) were also significantly more preferred than infelicitous ones. As can be seen, the mean plausibility ratings were parallel for continuations that contained the NP1 and for those that contained the NP2 indicating that both NPs presented in the contexts are plausible hosts for the RCs employed.

In addition, 48 filler items were added. The filler items were constructed exactly as the test items, in the sense that they consisted of a text followed by a target sentence that the subjects had to complete by choosing one of two given options. The filler items included different types of texts and constructions. For half of the filler texts, only one completion of the target sentence was correct and this choice was based on semantic and pragmatic information given in the text. For the other half, the context biased the subjects towards one of the two completions.

5.2.1.2. Procedure The subjects were instructed to read the texts and the target sentences carefully and to circle the option that seemed more appropriate to them as a completion of the sentence. It did not take them more than forty minutes to complete the whole task.

5.2.1.3. Subjects Twenty students (females: 12, males: 8; mean age: 20.05) of the University of Athens participated voluntarily in the experiment. All of them were native speakers of Greek and they were naïve with respect to the purpose of the experiment.

5.2.2. Results Some subjects did not provide an answer on a small number of trials and others chose both options. These ambiguous or unanswered responses were left out so that the means add up to 100%. The mean number of responses over subjects was calculated per each condition shown in Figure 5.1.

The data reported in Figure 5.1 reveal that the NP1 attachment preference found for genitives when the sentences are presented in isolation is stronger in the high-attachment biasing context condition and much reduced in the low-attachment biasing context condition. On the other
hand, the NP2 attachment preference obtained for PPs in the baseline condition is eliminated in the high-attachment biasing contexts and is still present in the low-attachment biasing context condition.

In order to examine these descriptive observations statistically, repeated measures ANOVAs were run on the subjects’ NP1 responses. In the items analysis, within-items ANOVAs were performed, because the same items were used in all context conditions. The two within-items factors were Context, which had three levels (no- vs. high-biasing vs. low-biasing contexts), and Antecedent, which had two levels (genitives vs. PPs). In the subjects analysis, I used a between-subjects design, because one group of people saw the no-context condition and another group saw the biasing-context conditions. Each biasing-context condition has been compared with the no-context condition and Context (no- vs. either high or low-biasing contexts) has been treated as a between-subjects factor and Antecedent as a within-subjects factor.

The statistical analyses confirmed the modulating role of a biasing referential context on RC attachment. In the items analysis, there were significant main effects of Context \( (F_{2,46} = 26,761; p < 0.001) \) and
Antecedent \((F2(1,23) = 187,272; p < 0.001)\), as well as a significant interaction between Context and Antecedent \((F2(2,46) = 5,895; p < 0.01)\). Separate comparisons of the no-context condition with each biasing context condition also revealed main effects of Context (high-biasing vs. no-context conditions: \(F1(1,38) = 3,314; p = 0.077; F2(1,23) = 7,352; p < 0.02\); low-biasing vs. no-context conditions: \(F1(1,38) = 1,863; p = 0.180; F2(1,23) = 5,470; p < 0.03\)) and Antecedent (high-biasing vs. no-context conditions: \(F1(1,38) = 65,737; p < 0.01; F2(1,23) = 129,222; p < 0.001\); low-biasing vs. no-context conditions: \(F1(1,38) = 78,697; p < 0.001; F2(1,23) = 105,010; p < 0.001\)), and a significant Context × Antecedent interaction (high-biasing vs. no-context conditions: \(F1(1,38) = 4,256; p < 0.05; F2(1,23) = 8,395; p < 0.01\); low-biasing vs. no-context conditions: \(F1(1,38) = 1,676; p = 0.203; F2(1,23) = 4,243; p = 0.051\)). One-sample t-tests were also performed to test whether the NP1 or NP2 advantages were statistically different from chance level (50%). Recall that in the no-context condition, the high-attachment preference for genitives and the low-attachment preference for PPs were significantly different from chance level. In the high-attachment biasing context, there was an NP1 advantage in the genitive condition \((t1(19) = 4,381; p < 0.001; t2(23) = 7,433; p < 0.001)\) and no NP2 advantage in the PP condition \((t1(19) = 0,395; p = 0.697; t2(23) = 0,150; p = 0.882)\). On the other hand, in the low-attachment biasing context there was an NP2 advantage in the PP condition \((t1(19) = 5,804; p < 0.001; t2(23) = 7,924; p < 0.001)\) and no NP1 advantage in the genitive condition \((t1(19) = 0,630; p = 0,536; t2(23) = 1,311; p = 0.203)\).

### 5.2.3. Discussion

The context effect found in this experiment suggests that an appropriately biasing context plays a role in the way the RC attachment ambiguity is resolved. Namely, more N1 responses were obtained in contexts biasing towards high-attachment than in the baseline condition, whereas in low-attachment contexts there were more NP2 responses as compared to the no-context condition. Notice that this result is compatible with both the Garden Path model and the Construal theory. The former allows for contextual factors to evolve in off-line tasks, which are supposed to reflect final processing preferences,
whereas the latter claims that discourse factors influence the attachment of modifiers.

In addition, the antecedent effect replicates the finding of the experiments described in chapter 4, i.e. that thematic factors influence the resolution of the RC attachment ambiguity. The interaction between context and antecedent type reveals that the contexts used were sufficiently biased to affect the subjects’ attachment preferences. This means that the NP2 advantage for PPs found in the baseline condition was wiped out in the high-attachment contexts, whereas the NP1 advantage for genitives in the no-context condition was significantly reduced in the contexts biasing towards low-attachment. To further explore the referential context effects and their interaction with thematic considerations in on-line sentence processing, I conducted a SPR task, which is reported in detail in the following section.

5.3. EXPERIMENT 4: SELF-PACED READING TASK

The purpose of the SPR task was to investigate whether discourse and pragmatic factors influence initial parsing preferences. Notice that a context effect was found in Experiment 3, which means that the type of context used was sufficiently biased to affect RC attachment preferences and, thus, this type of context can also be used in the on-line experiment.

If subjects rely on context to attach the RC either to the first or the second antecedent, sentences disambiguated towards high-attachment should be expected to be read faster than sentences disambiguated towards low-attachment, if they are preceded by high-attachment biasing context. On the other hand, sentences disambiguated towards high-attachment should be expected to be read slower than sentences disambiguated towards low-attachment, if they are preceded by a low-attachment biasing context.

5.3.1. Method

5.3.1.1 Materials The materials consisted of 24 test items. The test items contained a text followed by a target sentence. The context used in this self-paced reading experiment was the same as the one used in the
off-line task since the results of the questionnaire study showed that the context was biased enough to affect RC attachment preferences. Each target sentence contained two DPs, which the relative clause could be attached to, like in the off-line task. The target sentences were divided into five segments exactly as in Experiment 2. The first segment contained the subject and the verb of the main clause and the second segment contained the two possible antecedents of the RC. The third segment included the complementizer pu (that) together with the verb of the subordinate clause. The fourth segment was the critical one, since this is where the disambiguation occurred and the fifth segment is the final one and contained a PP.

The text that preceded the target sentence, the antecedent and the attachment type were manipulated in order to explore which of these three factors would affect RC attachment preferences. Hence, the text was biased either towards high or low-attachment according to the referential context hypothesis, in the way described in section 7.1. The second DP was dependent either on the first DP and was in genitive case or was headed by a preposition, as in the previous experiments. The disambiguation occurred inside the RC, by manipulating the gender of a past participle in accordance with the gender of either the first or the second DP. If the past participle agreed with the first DP, the sentence was disambiguated towards high-attachment, whereas if the past participle agreed with the gender of the second DP, the sentence was disambiguated towards low-attachment. The manipulation of these factors resulted in eight conditions, as shown in the following Table.

The texts used were parallel to the ones presented in (4) and the target sentences were similar to the ones illustrated in (10a) – (10d) in chapter 4.

<table>
<thead>
<tr>
<th>TABLE 5.2. The conditions used in Experiment 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>High (H)</td>
</tr>
<tr>
<td>Low (L)</td>
</tr>
</tbody>
</table>
The whole list of the texts and the experimental sentences can be found in Appendix I. In addition, 24 filler items were added. The filler items consisted of a text followed by a target sentence, exactly as for the experimental items. The fillers included different types of texts and constructions.

5.3.1.2 Procedure. This experiment as the previous one was designed using the NESU software. The texts and the target sentences were presented on a TFT computer monitor in white letters (Arial 24pt) on a dark background. First, the entire text appeared on the screen and the subjects could take as much time as they wanted to read it. The text was presented all at once, and not in a sentence-by-sentence fashion, as in Zagar et al. (1997)’s study, and remained on the screen until the subjects read it, so that the subjects read it in their own pace and fully understand it. The subjects were instructed to press a button as soon as they had read the text. Immediately after they pressed the button, the target sentences appeared on the screen divided into five segments, as specified in examples (10a)–(10d) of chapter 4. Again, the subjects were instructed to press the button as soon as they had read each segment.

After they read a set of texts and sentences, a message appeared on the screen instructing them to answer questions referring either to the text or to the target sentences. This was done in order to be sure that subjects paid attention to the texts and the sentences they read. The questions always referred to the filler items. This happened eight times during the experiment and each time after they had read different numbers of texts, so that the subjects did not form expectations as to where a question would follow. The questions were typed on paper and the subjects had to circle the correct answer, which was either a simple ‘YES’ or a simple ‘NO’. Each sheet of paper contained the questions of one section and there was an equal number of ‘YES’ and ‘NO’ questions. The sentences were counterbalanced so that each subject read an equal number of high and low-attachment sentences and genitive and preposition constructions in a high-, or low-attachment biased context. All subjects were exposed to all conditions and no subject ever read the same item in more than one condition.

Each subject was given written instructions that explained the purpose and the procedure of the experiment. Since it was important to
make sure that the subjects paid attention to the texts and the sentences they read, the subjects were told that the purpose of the experiment was to test their memory capacity in different conditions and they were asked to read each item as quickly and as accurately as they could. Before the beginning of each trial, each subject was exposed to seven practice texts in order to become familiar with the procedure of the experiment. The experiment did not last longer than an hour and a half.

5.3.1.3. Subjects 38 Greek students (females: 21, males: 17; mean age: 23.22) from the University of Essex participated in the experiment. All of them were native speakers of Greek and they were naive with respect to the hypotheses tested.

5.3.2. Results

The percentage of correct responses to questions for the filler items was 92.2% in the experimental version in which sentences were presented in isolation, and 80.7% in the versions with preceding context, indicating that the participants paid attention to the task. All erroneous responses for the experimental items were excluded from the analysis reported in the next section, which resulted in the elimination of 8.54% of the data set. Reading times (RTs) that were two standard deviations above the mean for each condition were excluded from the present analysis. This resulted in the elimination of 4.58% of the data set in the version with isolated sentences and 5% in the versions with context; see the section ‘additional analyses’ below for an analysis of the RTs based on the whole data set.

The mean RTs per condition and across subjects are provided for each segment in Table 5.3.

The data from the first three segments do not seem to reveal any interesting differences.

On the other hand, the RTs from the fourth and the fifth segments show that the N2-attachment preference for complex DPs with thematic prepositions found in Experiment 2 is found both biasing contexts, whereas the N1-attachment preference attested with genitives is only obtained in the high-attachment biasing context condition.

These descriptive observations were further supported by statistical analyses. Separate analyses for ‘subjects’ and ‘items’ were performed for
the on-line task as for the off-line task. As the same sentences were used in all context conditions, I ran repeated-measures ANOVAs for items with Antecedent (PP vs. Gen), Attachment (high vs. low), and Context (High, Low, No) as within-items factors. In the subjects analysis, I treated Context as a between-subjects factor, because one group of people saw the sentences in isolation and a different one saw the sentences preceded by the biasing contexts. Thus, in the subjects analysis the between-subjects factor Context refers to the comparison of the no-context condition to either the high- or the low-attachment biasing context conditions. Antecedent and Attachment were treated as within-subjects factors. Items analyses are also reported when the no-context condition is compared to the high and the low-attachment biasing contexts. In that case, a series of repeated $2 \times 2 \times 2$ ANOVAs was performed with Context (no vs. either high or low-attachment biasing context), Antecedent (genitives vs. PPs) and Attachment (NP1 vs. NP2 sentences) as within-items factors.

On the first segment, no statistically reliable differences were found. A significant main effect of Context was found on the second segment (no-context vs. high-attachment biasing context condition: $F(1,56) = 28,268; p < 0,001$; no-context vs. low-attachment biasing context condition: $F(1,56) = 19,631; p < 0,001$; $F(2,46) = 112,082$, 

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### TABLE 5.3. Experiment 4: Mean RTs per segment for each experimental condition

<table>
<thead>
<tr>
<th>Segment</th>
<th>Attachment</th>
<th>High-attachment biasing context</th>
<th>Low-attachment biasing context</th>
<th>No context</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Genitive PP</td>
<td>Genitive PP</td>
<td>Genitive PP</td>
</tr>
<tr>
<td>First</td>
<td>NP1</td>
<td>843.04 815.96</td>
<td>760.73 804.91</td>
<td>873.38 816.12</td>
</tr>
<tr>
<td></td>
<td>NP2</td>
<td>791.68 840.25</td>
<td>809.85 848.88</td>
<td>900.74 840.18</td>
</tr>
<tr>
<td>Second</td>
<td>NP1</td>
<td>918.46 1054.51</td>
<td>1183.03 935.06</td>
<td>1419.36 1594.88</td>
</tr>
<tr>
<td></td>
<td>NP2</td>
<td>986.19 989.50</td>
<td>1012.60 1010.62</td>
<td>1516.41 1618.11</td>
</tr>
<tr>
<td>Third</td>
<td>NP1</td>
<td>738.72 709.06</td>
<td>682.83 704.86</td>
<td>970.58 1000.27</td>
</tr>
<tr>
<td></td>
<td>NP2</td>
<td>756.48 733.55</td>
<td>765.66 772.48</td>
<td>1011.8 1086.73</td>
</tr>
<tr>
<td>Fourth</td>
<td>NP1</td>
<td>856.48 807.49</td>
<td>911.87 851.90</td>
<td>882.64 938.38</td>
</tr>
<tr>
<td></td>
<td>NP2</td>
<td>1023.11 739.62</td>
<td>955.82 721.08</td>
<td>1222.12 864.32</td>
</tr>
<tr>
<td>Fifth</td>
<td>NP1</td>
<td>726.44 735.94</td>
<td>676.57 756.91</td>
<td>875.77 1022.00</td>
</tr>
<tr>
<td></td>
<td>NP2</td>
<td>835.61 675.99</td>
<td>738.42 689.18</td>
<td>961.17 872.11</td>
</tr>
</tbody>
</table>
The third segment (no-context vs. high-attachment biasing context condition: \( F_1(1, 56) = 40.622; p < 0.001 \); no-context vs. low-attachment biasing context condition: \( F_1(1, 56) = 32.040; p < 0.001 \); \( F_2(2, 46) = 42.008, p < 0.001 \)), and the fifth segment (no-context vs. high-attachment biasing context condition: \( F_1(1, 56) = 12.025; p < 0.01 \); no-context vs. low-attachment biasing context condition: \( F_1(1, 56) = 15.613; p < 0.001 \); \( F_2(2, 46) = 66.269; p < 0.001 \)). Table 5. 2 shows that this effect is due to slower RTs in the no-context condition than in the two conditions with preceding contexts. In segment 2, the comparison of the no-context condition to the high-attachment biasing context condition revealed a significant main effect of Antecedent in the subjects analysis (\( F_1(1, 56) = 5,195, p < 0.03 \)), which reflects the fact that genitives were read faster than PPs.

On the critical fourth segment, i.e. the point of disambiguation, the items analysis revealed main effects of Context (\( F_2(2, 46) = 7.876; p < 0.01 \)) and Antecedent (\( F_2(1, 23) = 15.673; p < 0.01 \)), as well as significant interactions between Antecedent and Attachment (\( F_2(1, 23) = 19.697; p < 0.001 \)) and between Context and Attachment (\( F_2(2, 46) = 6.969; p < 0.01 \)), whereas the three-way Antecedent × Attachment × Context interaction did not reach statistical significance (\( F_2(2, 46) = 2.333; p = 0.120 \)). In the comparison of the no-context and the high-attachment biasing context conditions, I obtained an effect of Antecedent (\( F_1(1, 56) = 14.569; p < 0.001 \); \( F_2(1, 23) = 8.813; p < 0.01 \)), Attachment (\( F_1(1, 56) = 6.522; p < 0.02 \); \( F_2(1, 23) = 4.730; p < 0.04 \)), Context, which was significant only in the items analysis (\( F_1(1, 56) = 2.365; p = 0.130 \); \( F_2(1, 23) = 7.899; p < 0.01 \)), and a significant Antecedent × Attachment interaction (\( F_1(1, 56) = 17.188; p < 0.001 \); \( F_2(1, 23) = 15.113; p < 0.01 \)). The interactions between Context and Antecedent (\( F_1(1, 56) = 0.033; p = 0.855 \); \( F_2(1, 23) = 0.605; p = 0.445 \)), Context and Attachment (\( F_1(1, 56) = 1.366; p = 0.247 \); \( F_2(1, 23) = 3.682; p = 0.068 \)) as well as the three-way interaction did not reach significance (\( F_1(1, 56) = 1.312; p = 0.257 \); \( F_2(1, 23) = 2.399; p = 0.135 \)). The comparison of the no-context and the low-attachment biasing context revealed significant effects of Antecedent (\( F_1(1, 56) = 10.634; p < 0.01 \); \( F_2(1, 23) = 10.406; p < 0.01 \)), Context – significant only in the items analysis (\( F_1(1, 56) = 2.911; p < 0.001 \).
\( p = 0.094; F2(1,23) = 15.263; p < 0.01 \) – and significant interactions between Antecedent and Attachment \((F1(1,56) = 10.783; p < 0.01; F2(1,23) = 18.810; p < 0.001)\) and between Attachment and Context \((F1(1,56) = 4.116; p < 0.05; F2(1,23) = 12.757; p < 0.01)\), whereas Attachment \((F1(1,56) = 1.057; p = 0.308; F2(1,23) = 1.602; p = 0.218)\), the Context \(\times\) Antecedent interaction \((F1(1,56) = 0.002; p = 0.968; F2(1,23) = 0.605; p = 0.445)\), and the three-way interaction were not significant \((F1(1,56) = 1.776; p = 0.188; F2(1,23) = 3.475; p = 0.075)\).

To further explore the significant interactions between Antecedent and Attachment as well as between Context and Attachment, planned comparisons were performed in which I ran separate ANOVAs for the genitive and the PP conditions. The items analysis, in which we treated Context (no vs. high vs. low-attachment biasing contexts) and Attachment (NP1 vs. NP2 sentences) were within-items factors revealed significant main effects of Attachment (genitives: \(F2(1,23) = 11.481; p < 0.01\); PPs: \(F2(1,23) = 6.653; p < 0.02\)) and Context (genitives: \(F2(2,46) = 3.682; p < 0.05\); PPs: \(F2(2,46) = 6.594; p < 0.01\)) for both the genitives and PPs, whereas the interaction between Context and Attachment was significant for genitives \((F2(2,46) = 5.307; p < 0.02)\), but not for PPs \((F2(2,46) = 0.511; p = 0.607)\). Moreover, for genitives, when the no-context condition was compared to the high-context condition, there was found a significant effect of Attachment \((F1(1,56) = 20.244; p < 0.001; F2(1,23) = 13.977; p < 0.001)\) and an interaction of Context and Attachment, which was marginally significant in the items analysis \((F1(1,56) = 2.361; p = 0.130; F2(1,23) = 4.029; p = 0.057)\), whereas there was no main effect of Context \((F1(1,56) = 1.163; p = 0.285; F2(1,23) = 3.240; p = 0.085)\). In the same condition (= genitives), the comparison between the no- and the low-context conditions showed significant effects of Attachment \((F1(1,56) = 5.807; p < 0.02; F2(1,23) = 10.039; p < 0.01)\) and Context – the latter only in the items analysis \((F1(1,56) = 1.684; p = 0.200; F2(1,23) = 7.608; p < 0.02)\) – and a significant Context \(\times\) Attachment interaction \((F1(1,56) = 3.450; p = 0.069; F2(1,23) = 8.956; p < 0.01)\).

For the PPs, the comparison of the no- to the high-attachment biasing context condition showed a significant Attachment effect in the items analysis \((F1(1,56) = 2.070; p = 0.156; F2(1,23) = 7.606; p < 0.02)\),
whereas there was no main effect of Context \((F1(1,56) = 3,427; p = 0,070; F2(1,23) = 0,021; p = 0,886)\), and the interaction between Context and Attachment \((F1(1,56) = 0,004; p = 0,950; F2(1,23) = 0,359; p = 0,555)\) was not significant. The comparison of the no- to the low-context condition revealed an Attachment effect \((F1(1,56) = 7,227; p < 0,01; F2(1,23) = 6,651; p < 0,02)\) and an effect of Context – but only in the items analysis \((F1(1,56) = 2,538; p = 0,117; F2(1,23) = 6,614; p < 0,02)\) – whereas the Context \(\times\) Attachment interaction was not significant \((F1(1,56) = 0,555; p = 0,460; F2(1,23) = 1,067; p = 0,312)\).

These results show that in the sentences with genitives, the NP1 sentences were read faster than the NP2 ones, whereas in the PP conditions the NP1 sentences were read slower than the NP2 ones. Moreover, the statistical analyses suggest that the biasing context conditions affected sentences with genitives differently from sentences with PP antecedents. Consider genitive antecedents. In the no-context condition, there is a significant advantage for NP1 attachment of almost 340 ms \((1222,12 - 882,64: t1(19) = 4,568; p < 0,001; t2(23) = 4,558, p < 0,01)\), which is significantly reduced to a mere 44 ms \((955,82 - 911,87)\) advantage in the low-attachment biasing context \((t1(56) = 1,857; p = 0,069; t2(23) = 2,993, p < 0,01)\). This is different for sentences with PP antecedents. In the no-context condition, there is a significant 74 ms advantage for NP2 attachment \((938,38 - 864,32: t1(19) = 2,315; p < 0,05; t2(23) = 1,55, p = 0,135)\) in sentences with PPs, and in the high-attachment biasing context, there is still an NP2 advantage of 68 ms \((807,49 - 739,62)\); the 6 ms difference between these two is not significant. What these results show is that even though biasing contexts are unable to wipe out or reverse the different attachment preferences for genitives and PPs, an appropriate context may significantly reduce the NP1 advantage for genitives but not the NP2 advantage for PPs.

Finally, the within-items analysis on the fifth segment also revealed a significant Antecedent \(\times\) Attachment interaction \((F2(1,23) = 12,100; p < 0,01)\). The between-subjects analysis also showed a significant interaction between Antecedent and Attachment in both comparisons of the no-context condition to the high-attachment \((F1(1,56) = 7,839; p < 0,01)\) and the no-context to the low-attachment biasing context.
condition \(F1(1, 56) = 9,311; p < 0,01\). The significant Antecedent × Attachment interaction (like the one on the critical segment) reflects a high-attachment preference for genitives and a low-attachment preference for PPs across the different context conditions. In the items analysis, planned comparisons across the three context conditions confirmed that high-attachment sentences were read significantly faster than low-attachment ones in the genitive conditions \(F2(1, 23) = 4,591; p < 0,05\), and vice versa in the PP conditions \(F2(1, 23) = 6,647, p < 0,02\). The subjects analysis demonstrated the same results for the PPs when the no-context condition was compared to the high- \(F1(1, 56) = 6,358; p < 0,02\) and to the low-attachment biasing context \(F1(1, 56) = 7,489; p < 0,01\), whereas the difference between high and low sentences for the genitives was significant when the no-context condition was compared to the high-attachment biasing context condition \(F1(1, 56) = 4,079; p < 0,05\) and it only approached significance in the comparison of the no-context and the low-attachment biasing condition \(F2(1, 56) = 2,943; p = 0,092\).

5.3.2.1. Additional analyses For the above-reported analyses, incorrect responses and outliers (i.e. reading times that were two standard deviations above the mean for each condition) were excluded, which resulted in the elimination of approximately 20% of the experimental data. To determine whether this led to any distortions after data elimination, I performed an additional analysis of the reading times on the critical segment which was based on the whole data set, including data points that yielded incorrect responses. Moreover, instead of excluding outliers using standard deviations, this new analysis was based on the medians of the RTs on the critical segment. The results were parallel to those reported earlier. Comparison of the no-context with the high-attachment biasing context conditions revealed effects of Antecedent \(F1(1, 56) = 5,843; p < 0,02\), Attachment \(F1(1, 56) = 3,609; p < 0,063\), a significant Antecedent × Attachment interaction \(F1(1, 56) = 7,631; p < 0,01\), as well as an interaction of Attachment × Context \(F1(1, 56) = 4,133; p < 0,05\). These effects and interactions (except for the latter) were also seen in the earlier analysis. Likewise, the comparison of the no-context and the low-attachment biasing context revealed the same effect of Antecedent \(F1(1, 56) = 6,831; p < 0,02\), and interactions
of Attachment × Context ($F(1,56) = 5,535; p < 0,03$), and Antecedent × Attachment ($F(1,56) = 3,852; p = 0,05$) that were seen in the earlier analysis. Therefore, data elimination in the earlier analysis has not led to any artifacts or distortions.

A further additional analysis was performed to more directly compare our results to those of the two previous studies (Zagar et al., 1997; Desmet et al., 2002) that have examined context effects on RC attachment preferences. Recall that these studies have only tested RC attachment in sentences with genitive (of-type) antecedents and did not find main effects or interactions with Context in their on-line experiments. Desmet et al. (2002), for example, only obtained an effect of Attachment (reflecting an NP1 advantage), even in the low-attachment biasing context. For comparison, I performed the same ANOVA reported earlier for mean RTs on the critical segment, but this time only for a subset of our data, namely those items in which the RC was headed by a complex NP + NP$_{\text{GEN}}$. This analysis revealed main effects of Context ($F(2,22) = 3,682; p < 0,05$) and Attachment ($F(1,23) = 11,481; p < 0,01$), and a significant Context × Attachment interaction ($F(1,23) = 5,307; p < 0,05$). These results are different from those of both Zagar et al. (1997) and Desmet et al. (2002) and show that attachment preferences do in fact alter across the three context conditions. Specifically, the NP1 preference present in the no-context and the high-attachment-biasing conditions is eliminated in the low-context-biasing condition suggesting that an overall (no context) high-attachment bias can be overridden by a suitable low-attachment favouring context.

5.3.3. Discussion

Summarizing the results of the reading experiment, it was found that a supporting context did significantly magnify attachment preferences of the no-context condition and an appropriately (i.e. low-attachment) biasing context elicited a significant reduction of the high-attachment preference for genitive antecedents. On the other hand, a high-attachment biasing context did not modulate the overall low-attachment bias for RCs headed by complex DPs containing thematic prepositions. These results suggest that discourse-level information does indeed influence early parsing decisions.
It should be noted, however, that these findings contrast with the results from the two previous studies (Desmet et al., 2002; Zagar et al., 1997) that have examined context effects on RC attachment preferences and failed to find main effects or interactions with Context in their on-line measures (see section 5.1). Given the present results, one might wonder why two previous studies (Desmet et al., 2002; Zagar et al., 1997) examining the role of referential context for RC attachment preferences did not obtain any context effects in their on-line measures, even though the kinds of materials used were similar to the ones used in this study.

It is always hard to decide why an experiment did not produce a particular kind of effect, and one can only speculate about possible reasons. One possibility might be that the discrepancies are due to the different methodologies used. Recall that both Zagar et al. (1997) and Desmet et al. (2002) used eye-tracking, a technique that tends to result in faster reading than is the case for self-paced reading. Hence, it might be the case that the slower self-paced reading times relative to reading under eye-tracking allowed for discourse factors to come into play and affect parsing decisions. Note, however, that if this was correct, context effects should have been found in all conditions, as was indeed the case in the off-line task, and not just for sentences with genitives, as was the case in the SPR experiment. An additional factor could be differences in the local biases that any context effect has to overcome. Suppose the N1 bias for genitives is relatively weak in Greek, then it could be the case that context effects act rapidly enough to overcome a relatively weak bias under the (slower) conditions of self-paced reading, but not at the higher rates of reading examined in eye-tracking studies, and hence the discrepancy between our results and those of Zagar et al. (1997) and Desmet et al. (2002). Note, however, that there is a strong bias for genitives in Greek, as can be seen from the 339 ms advantage for DP1 attachment in the no-context condition (cf. Table 5.3). The bias for genitives is substantially stronger than the one for PPs, for which there was only a 74 ms advantage for the preferred attachment in the no-context condition. Thus, if ‘strength of attachment bias’ was a crucial factor for the presence of context effects in the self-paced reading task, then we should have found stronger context effects for PPs than for genitives, and this is just the opposite of what the data showed. Therefore, this
possibility can be ruled out and it can be maintained that the context effect obtained in the self-paced reading task is not due to methodological artefacts.

Let us now turn to the predictions made by the parsing models introduced in the beginning of this chapter and see how they can accommodate these findings. From the perspective of purely modular approaches (see e.g. Frazier, 1987), we would not have expected to see any context effects on ambiguity resolution in the on-line self-paced reading experiment. This is because discourse information is said to influence only the final interpretation of a sentence, but not early parsing decisions. This prediction was not confirmed. It has been found that contextual cues affected RC attachment preferences, which argues against a parser which is purely syntax-driven.

On the other hand, multiple-constraint models of sentence processing (e.g. Thornton et al., 1999) and the referential context hypothesis (e.g. Altmann and Steedman, 1988) claim that all sources of information are accessed in parallel and are available at all levels of parsing. This would mean that strong context effects should have been found for complex DPs with genitives and lexical prepositions in both context conditions. Our results show that this was not the case. Instead, a low-attachment favouring context significantly reduced the N1 advantage in sentences with genitives, whereas the N2 preference for RCs headed by complex DPs linked by thematic prepositions could not be overridden by a high-attachment favouring context. These differences between different RC antecedents do not receive a straightforward explanation from the idea that discourse-level information is accessed in parallel at all levels of parsing. Therefore, neither syntax-first nor multiple-constraints accounts of parsing provide a full account of our findings.

Construction Theory (Frazier and Clifton, 1996, 1997) claims that adjuncts and modifiers (instead of being syntactically attached) are associated within the closest thematic domain using both syntactic and non-syntactic information. According to this account, discourse-level information may influence early parsing decisions, but only for adjuncts and modifiers that occur within a given thematic domain. From this, we would expect that referential context information is more likely to affect RC attachment preferences in sentences with genitives
than in those with PP antecedents, because in the PP construction, the thematic preposition *me* (with) creates a local thematic domain with the second DP, which makes N1 unavailable for RC attachment. By contrast, in the genitive construction, both nouns belong to the same thematic domain and are thus potential hosts for the RC, and in such cases, discourse-level information may also affect early parsing decisions. The results presented in this chapter confirm these predictions. An N2-attachment preference was found for the PP construction in the self-paced reading task across the three context conditions, which was not significantly affected by contextual manipulations. This is consistent with the idea that modification (e.g. by RCs) of constituents outside the current thematic domain is computationally costly, and hence dispreferred (cf. Frazier and Clifton, 1996). Lexical prepositions such as *me* (with) create a local thematic domain of their own, and, therefore, the ambiguous RC is preferably associated with the second (lower) DP. In the genitive construction, however, no such thematic cue is present, and both DPs are potential hosts for the RC. In this case the parser is affected by discourse-level information, hence the context effects obtained for the genitive construction in the self-paced reading task.

Alternatively, the present findings can also be accounted for by the model put forward in section 4.2.3. It was maintained that the cross-linguistic variation observed in RC attachment preferences are due to the ‘richness’ of the inflectional paradigms in languages like Greek. The high-attachment preference obtained with genitives in sentences presented in isolation was accounted for by the activation of interpretative procedures associated with morphological analysis of the input. Hence, the contextual effects found with genitives are expected, as such procedures, not being purely syntactic, allow for discourse-level influences. By contrast, context effects are not expected for PP-antecedents for the same reasons as the ones exemplified in relation to Construal.

5.4. CONCLUDING REMARKS

Taken together the results from Experiments 3 and 4, argue in favor of a multiple-stage human sentence processor. This is because context effects were found for both types of complex DPs in the off-line task,
whereas in the SPR task RC attachment preferences were affected by referential contexts only in complex DPs with genitives. Such a finding cannot be accounted for by multiple-constraint models of sentence processing (e.g. Thornton et al., 1999) and the referential context hypothesis (e.g. Altmann and Steedman, 1988), which claim that all sources of information are accessed in parallel and are available at all levels of parsing. On the other hand, these differences between off-line and on-line measures can be captured by parsing theories, which maintain that sentence processing is constrained and that not all information cues are accessed in parallel. Notice, however, that the findings reported in this chapter go against purely modular models\(^8\), e.g. the Garden Path model, because they cannot explain the context effects obtained in the genitive condition. As already discussed in the previous section, Construal can explain these findings, because the pragmatic effects were found to be restricted by thematic information, in the sense that they did influence parsing decisions only when there were not any lexical constraints.

More generally, the results of the present study indicate that the parser has immediate access to lexical-thematic properties, whereas discourse-level information is a secondary resource that is employed in cases in which either syntactic and lexical information is insufficient for ambiguity resolution or the sentential analysis is also determined by interpretative rather than purely syntactic cues and, hence, they are not resistant to general world knowledge biases. The view that lexical cues have an immediate effect on parsing is compatible with some modular theories of sentence processing. For example, Frazier (1990) (but see also Ferreira and Henderson, 1991a, 1991b; Rayner et al., 1983) proposed a theta-predication module that operates in parallel with the module responsible for creating constituent analysis. Moreover, Crocker (1996) also argued that lexical items are the input to the syntactic processor, and the output is a representation of an utterance’s thematic interpretation. The results presented in this chapter are consistent with the idea that lexical-thematic information is processed in parallel with other grammatical (syntactic and morphological) information and that discourse-level information affects processes which are not purely syntactically- or lexically-driven, as shown by the differential effects of context for the genitives and the PP conditions.
NOTES

1 See also note 32 in chapter 2.
2 As already mentioned, the experiment was performed in French. For ease of presentation, I present English equivalents of the test materials.
3 The Greek texts and the target sentences together with their English translations are reported in Appendix I.
4 See section 4.2.1 for more details on the segmentation used and the materials.
5 Given the design of this study, the no-context condition functioned as a baseline to compare the effects of the referential context, and in the statistical analyses, referential context was found not to affect the attachment preferences for PPs. However, a more direct comparison of the two context conditions might perhaps reveal significant effects, even for the PP conditions. To address this possibility, an additional ANOVA with Attachment (NP1/NP2) and Context (high-attachment biasing/low-attachment biasing) was performed on the mean reading times in region 4 for PPs. This analysis revealed an effect of Attachment ($F_1(1,37) = 3.773, p = 0.06$; $F_2(1,23) = 7.606, p < 0.02$), but no Context $\times$ Attachment interaction ($F_1(1,37) = 0.8626, p = 0.369; F_2(1,23) = 0.359, p = 0.555$), confirming that the two context conditions did not affect the attachment bias for PPs.
6 I would like to thank Don C. Mitchell who brought to my attention this issue.
7 Another difference between the present study and the Zagar et al. and Desmet et al. studies is that in the latter complex DPs with prepositions ([DP1 + prep[P DP2]]) were used as RC antecedents, e.g. de adviseur van de politici (the advisor of the politicians) and l’avocat de la chanteuse (the barrister of the singer), whereas in the former the corresponding condition had two case-marked DPs without a preposition, e.g. ton proponiti tis athlitrias (the-ACC trainer-ACC the-GEN athlete-GEN). Thus, it could be that an attachment bias for a construction with a free-standing lexical element (i.e. a preposition) is harder to overcome by contextual information than for a corresponding construction with bound morphemes. Evidence that this is indeed a relevant factor for RC attachment comes from Lovric’s (2003) study of Serbo-Croatian who found that RC attachment is lower when the two DPs are linked with the functional preposition od (of) than when the second DP is marked for genitive case. That contextual information does not affect RC attachment preferences in cases in which the two DPs are linked by a preposition is also evident from my findings for the Dp + PP condition, for which no effects of context were obtained, similarly to Zagar et al. (1997) and Desmet et al. (2002). Perhaps the presence of the preposition (irrespective of its thematic properties) in the constructions tested by Zagar et al. (1997) and Desmet et al. (2002) leads to more deterministic parsing decisions that are harder to overcome by discourse-level information than the corresponding constructions with purely case-marked RC antecedents that I tested.
8 It is worthwhile noting that purely modular theories (Frazier, 1978, 1987; Frazier and Fodor, 1978) cannot explain the thematic or lexical effects obtained in RC attachment preferences for a number of various languages, even when sentences are presented in isolation.
CHAPTER 6

AMBIGUITY RESOLUTION STRATEGIES IN
A SECOND LANGUAGE

In this chapter I will present data on the way second language learners of Greek process ambiguous RCs. The aim of this chapter is (a) to compare the parsing strategies used by L2 learners with those employed by native speakers and (b) to explore whether the parsing theories discussed in chapter 4 can also capture L2 data.

In the second language acquisition field, a lot of work has been done on linguistic knowledge in language learners (see e.g. Hawkins, 2001; White, 1991 and the contributions in Ritchie and Bhatia, 1999). By contrast, the mechanisms used by L2 learners to process L2 input in real-time are not yet fully understood (see Fodor, 1998; Klein, 1999). However, some researchers have recently begun to use on-line experimental techniques, such as cross-modal priming, eye tracking or self-paced reading/listening tasks, to investigate L2 parsing (Dussias, 2001; 2003; Felser et al., 2003; Fernández, 1999; 2003; French-Mestre and Pynte, 1997; French-Mestre, 2002; Juffs, 1998a; 1998b; Juffs and Harrington, 1995; 1996; Kilborn, 1989; 1992, among others). The results obtained thus far point to interesting directions with respect to L2 processing but are far from being conclusive (cf. Juffs, 2001; Marinis, 2003; Papadopoulou, 2005). The details of how L2 learners parse sentences are still largely unknown and more studies are required to address questions such as:

- Are L2 learners able to acquire the parsing mechanisms employed by native speakers of the language?
- How do parsing mechanisms emerge in L2 learners?
- Do L2 learners transfer parsing mechanisms from their first language to the foreign language?
Answers to these questions might also turn out to be relevant for understanding why it is so much harder to achieve native-like performance in an L2 than in one’s native language.

Though, as already mentioned, the way L2 learners parse the input in the target language has not widely been investigated, there are researchers who have pointed out that research on the processing strategies employed by second language learners could shed light on controversial areas of second language acquisition. As early as in the 80s, there were authors who had emphasised the important role of parsing strategies in the course of second language acquisition, claiming that L2 learners rely on processing strategies to analyse the L2 input rather than on grammatical constraints imposed by the Universal Grammar (Bley-Vroman, 1991; Clahsen, 1984; 1988; Clahsen and Muysken, 1986; 1989; 1996; Meisel, 1991). Besides, Chaudron (1985) has posed the question whether the incomplete acquisition broadly observed in SLA is due to non-optimal parsing mechanisms employed by the L2 learners. More recently, this question has been tackled by many researchers (Eubank, 1993; Fernández, 1999; Hoover and Dwivedi, 1998; Juffs and Harrington, 1995; 1996; Klein, 1999; Schachter and Yip, 1990; White and Juffs, 1998; White and Genesee, 1996), who have started exploiting the possibility that the difficulties L2 learners face in the target language may have to do with the way the L2 learners parse the L2 input.

In the area of psycholinguistics, and more specifically of sentence processing, most of the research has been done on the way native speakers parse their first languages; thus, the various parsing models do not make explicit predictions concerning the parsing mechanisms in a second language. There are, however, psycholinguists who have been involved in the L2 processing and they have conducted experiments with second language learners (Dussias, 2001; 2003; Felser et al., 2003; Fernández, 1999; 2003; Frenck-Mestre and Pynte, 1997; Frenck-Mestre, 2002; MacWhinney, 1997 among others).

The structure of this chapter will be as follows. In section 6.1, studies that have specifically dealt with the strategies L2 learners employ to parse ambiguous L2 input will be presented and analysed. In section 6.2, I will discuss the predictions of sentence processing models with respect to the routines used in L2 parsing. Finally, in section 6.3 the experiments
with L2 learners of Greek will be presented in detail and the findings will be analysed accordingly.

6.1. L2 AMBIGUITY RESOLUTION STUDIES

As already mentioned, there are not many studies on L2 sentence processing\(^1\), even though recently there is an growing interest in the way L2 learners parse input in a second language. In a relatively early study, Birdsong (1992) performed an off-line interpretation task with native speakers of French and L2 learners of French with English as their first language. In this task, subjects were presented with ambiguous sentences and they were asked to indicate the most likely interpretation of this sentence. For example, sentence (1) can be interpreted either as, *They found the dark cave* or as *They found the cave to be dark:*

(1) On a trouvé la cave sombre.
‘They have found the cave dark.’

Both the native speakers and the L2 learners of French preferred the second interpretation, showing uniformity in the way they interpreted such sentences. Notice, however, that the task was an off-line one, and, therefore, no claims regarding the on-line processing of ambiguous sentences can be made. There is, however, an increasing number of studies that have used on-line techniques to examine L2 sentence processing. In this section I will focus on studies that have investigated the parsing routines used by L2 learners to process structurally ambiguous sentences\(^2\). The studies conducted on L2 ambiguity resolution thus far have investigated three constructions: (a) subject vs. object ambiguity, (b) main verb vs. reduced relative clause ambiguity and (c) relative clause attachment ambiguities. In what follows, I will present the studies that examined the aforementioned ambiguities in each sub-section.

6.1.1. The subject vs. object ambiguity

Juffs and Harrington (1996) conducted an on-line grammaticality judgement task on sentences like (1)–(4) below with very advanced
Chinese learners and native speakers of English:

(2) *Garden Path sentences – optionally transitive verbs*
    After Bill drank the water proved to be poisoned.

(3) *Non Garden Path sentences – purely intransitive verbs*
    After Sam arrived the guests began to eat and drink.

(4) *Garden Path sentences – Verbs subcategorising for two arguments*
    Sam warned the student cheated on the exam.

(5) *Non Garden Path sentences – Verbs subcategorising for one argument*
    Jane knew her mother hated Tom.

The sentences were presented word-by-word via the moving window technique, whereas at the end of the sentence subjects had to judge the grammaticality of the sentences they read, thus providing an additional off-line performance measure. Juffs and Harrington found that garden-path sentences like (2) and (4) were more likely to be rejected than the non garden-path ones not only by the L2 learners but also by the native speakers. In addition, both groups were garden-pathed when they encountered the verbs *proved* and *cheated* in (2) and (4) respectively, which means that they had initially analysed the DPs, *the water* and *the student*, as the objects of the verbs *drank* and *warned* respectively instead of as subjects of the incoming verb. This finding might be accounted for by the use of Late Closure (see also section 2.1.1), which requires new material to be attached to the phrase currently being processed and shows that the L2 learners and the native speakers do not differ in the parsing strategies they employ. However, differences between the two groups were obtained in sentences such as (3) and (5). More specifically, the L2 learners were less accurate on these sentences and they also slowed down longer than the native speakers when encountering the DPs *the guests* and *her mother* and the verbs *began* and *hated*. In a later study Juffs (1998b) did a similar on-line grammaticality judgement task for sentences like (2) and (3) with advanced Chinese, Japanese, Korean and Romance learners of English. The Chinese, Japanese and Korean learners of this study were also found to take longer to read the DPs following intransitive verbs in sentences like (3) than the native speakers, even though their grammaticality
judgements did not differ from those of the native speakers and the Romance learners. This result suggests that there might be a dissociation in the development of grammatical knowledge and parsing mechanisms (Juffs, 1998b: 421).

Frenck-Mestre and Pynte (1997) also investigated the subject/object ambiguity with English learners of French and French learners of English in eye-tracking experiments. The aim of the study was to investigate whether the L2 learners transfer lexical properties from their first language when processing L2 input. In order to do that, they used verbs that had different argument structures in the two languages, such as the following:

\[(6a)\] Every time the dog obeyed the pretty little girl showed her approval.  
\[(6a')\] Chaque fois que le chien obéissait la jolie petite fille montrait sa joie.  
\[(6b)\] Every time the dog barked the pretty little girl showed her approval.  
\[(6b')\] Chaque fois que le chien aboyait la jolie petite fille montrait sa joie.

In sentence (6a), the verb, *obey*, is optionally transitive and thus the DP, *the pretty little girl*, could be analysed either as the direct object of the verb or as the subject of the subsequent main clause; the ambiguity is resolved towards the subject-interpretation by the presence of the main verb, *showed*. In sentence (6b), the verb, *bark*, is intransitive, making the direct object-interpretation of the DP, *the pretty little girl*, impossible and thus the sentence is unambiguous. On the other hand, the equivalent French verbs of *obey* and *bark* are *obéir* and *aboyer* respectively and both of them are intransitive verbs in French; this means that in French the direct object interpretation of the DP, *la jolie petite fille* (the pretty little girl) with the verb *obéir* (obey) in sentence (6a') is impossible. Thus, native speakers of English should exhibit processing difficulties with sentence (6a) but not with sentence (6b), whereas for native speakers of French sentences (6a') and (6b') should be processed in the same way. As far as the L2 learners are concerned, if they transfer subcategorisation information of the verb from their first language to the
second, then French learners of English should find no processing difficulties with sentence (6a) as compared to sentence (6b), since both verbs are intransitive in French. On the other hand, English learners of French, should find sentence (6a’) harder than (6b’), since in English the verb obey is optionally transitive. Their subjects were tested in both their first and second languages. Frenck-Mestre and Pynte found the following results:

- English sentences:

  (i) Both native speakers and French learners of English exhibited difficulties with sentences such as (6a) at the point of disambiguation, which means that both groups initially processed the DP, *the pretty little girl*, as the direct object of the verb obey.

  (ii) French learners of English took longer time to read the subordinate verb in sentences such as (6a) than in sentences such as (6b), which means that lexical information from the native language momentarily influenced L2 processing.

- French sentences:

  (i) English learners of French took longer time to read the subordinate verb in sentences such as (6a’) than in sentences such as (6b’), which replicates the result from the English sentences with L2 learners.

In other words, Frenck-Mestre and Pynte found evidence for transfer only at the region of the verb that carried different argument structures in the two languages, whereas at the remaining regions native speakers and L2 learners exhibited the same pattern of results. Frenck-Mestre and Pynte interpret their findings as suggesting that (a) L2 processing does not qualitatively differ from L1 processing and (b) that argument structure information of the native language is transferred onto the second one but affects L2 processing only momentarily. Notice, however, that the subjects were tested for their native and second language in the same trial, which means that both languages were active during the experiment and this could promote transfer effects. In addition, the French verbs used were not purely intransitive and could also be subcategorised by an indirect object (Frenck-Mestre and Pynte, 1997: 142–143). Thus, the difficulty the English learners of French experienced when reading
sentences such as (6a’) might not be due to transfer effects but rather to the fact that some of the verbs that were supposed to be unequivocally intransitive are also used with an indirect object.

In a more recent study, Papadopoulou and Tsimpi (2005b) tested the subject/object ambiguity with native speakers and advanced L2 learners of Greek in an on-line grammaticality judgement task. They tested optionally transitive and purely intransitive verbs, whereas the ambiguities were resolved via morphological cues: (a) in one condition the ambiguities were resolved by number features of the main verb, and (b) in the other condition the ambiguities were resolved by the case features of the DPs following the embedded verbs:

(7a) **Optionally transitive verbs – disambiguation on the main verb via number**
Kathos majireve ta makaronja epesan sto patoma.
while cooked-IMP.3S the-PL spaghetti-PL fell-3PL on-the floor
‘While (s)he was cooking, the spaghetti fell on the floor.’

(7b) **Purely intransitive verbs – disambiguation on the main verb via number**
Kathos etrehe ta makaronja epesan sto patoma.
while ran-IMP.3S the-PL spaghetti-PL fell-3PL on-the floor
‘While (s)he was running, the spaghetti fell on the floor.’

(8a) **Optionally transitive verbs – disambiguation on the DP via case**
Kathos majireve i astaki epesan sto patoma.
while cooked-IMP.3S the-NOM-PL lobsters-NOM fell-3PL on-the floor
‘While (s)he was cooking, the lobsters fell on the floor.’

(8b) **Purely intransitive verbs – disambiguation on the DP via case**
Kathos etrehe i astaki epesan sto patoma.
while ran-IMP.3S the-NOM-PL lobsters-NOM fell-3PL on-the floor
‘While (s)he was running, the lobsters fell on the floor.’

The L2 learners did not differ from the native speakers in their grammaticality judgements. On the other hand, they were found to be garden-pathed both on the main verb in (7a) and on the noun following the embedded verb in (8a), whereas garden-path effects with the native
speakers were obtained only for sentences like (8a). Papadopoulou and Tsimpli argue that the L2 learners use Late Closure to parse ambiguous sentences like (7a) and (8a), probably due to memory constraints and limitations, whereas the native speakers opt for a less deterministic way of parsing and make final parsing decisions only when unambiguous morphological information is provided (see also section 4.2.3 and footnote 9 in chapter 4).

Finally, Felser and Roberts (2004) also examined the subject/object ambiguity with native speakers and advanced Greek learners of English in a SPR task, in which they manipulated the plausibility of the DPs following the embedded verb in sentences like (2) above. They found that the L2 learners were more influenced by plausibility cues than the native speakers and they experienced difficulties to recover from initial misanalyses of such sentences.

6.1.2. The main clause vs. reduced relative clause ambiguity

Juffs (1998a) investigated the main clause vs. reduced RC ambiguity with advanced learners of English and addressed the following questions:

(i) Are L2 learners of English able to process sentences such as (1)?
(ii) Do they show sensitivity to morphological and syntactic cues as well as to the argument structure of the verbs?
(iii) Is there an impact of the first language on the way L2 learners parse temporarily ambiguous sentences such as (1)?

In order to address the second research question, Juffs (1998a) manipulated three variables:

- the morphology of passive participles (verb forms that are unambiguously marked as participles, like seen in (9) and (10) vs. ambiguous verb forms like criticised and watched in (11), (12) and (13), (14), respectively),
- the plausibility of analyzing the word following the first verb form as an object of a main verb (by adding adverbials providing misleading or ‘bad’ cues such as almost every day in (10), (12) and (14) vs. adverbials providing ‘good’ cues such as during the morning in (9), (11) and (13)), and
• the argument structure of the first verb form (transitive verbs like criticize in (11) and (12) vs. optionally transitive verbs such as watch in (13) and (14)).

The manipulation of these variables resulted in six conditions exemplified below:

(9) **Unambiguous participle – good cue**
The bad boys seen during the morning were playing in the park.

(10) **Unambiguous participle – bad cue**
The bad boys seen almost every day were playing in the park.

(11) **Ambiguous participle – transitive verb – good cue**
The bad boys criticized during the morning were playing in the park.

(12) **Ambiguous participle – transitive verb – bad cue**
The bad boys criticized almost every day were playing in the park.

(13) **Ambiguous participle – optionally transitive verb – good cue**
The bad boys watched during the morning were playing in the park.

(14) **Ambiguous participle – optionally transitive verb – bad cue**
The bad boys watched almost every day were playing in the park.

In order to investigate a possible L1 influence on L2 parsing strategies, Juffs examined speakers of Romance languages in which RCs follow the head noun, as is also the case in English, and speakers of Chinese, Japanese and Korean, in which the RC precedes the head noun. Moreover, the parsing of RCs in Chinese and Japanese/Korean might involve the reanalysis from a main to a relative clause analysis, whereas in Romance languages, though reduced RCs are possible, morphological markers – at least in the written speech – usually disambiguate the verb form.

Juffs conducted an on-line grammaticality judgment task (similar to the one described in 6.1.1) for sentences like (9)–(14). The accuracy data from the grammaticality judgment task showed that the Romance speakers were better overall than the Chinese and the Japanese/Korean speakers, and did not significantly differ from the natives, which suggests that L1 grammatical properties can affect performance in a second
language. Moreover, the L2 learners, and especially the Japanese/Korean group, were more likely to be misled in their judgments by the presence of ‘bad cue’ adverbials that followed an ambiguous verb form than were the native speakers.

The reading time data revealed that overall the L2 learners were slower than the native speakers. However, the Chinese learners of English were slower than the other L2 groups, especially when reading the disambiguating region, namely the main verb. In addition, the L2 learners’ reading pattern differed from that of the native speakers on the region that contained the passive participle and the following constituent. More specifically, the L2 learners took longer to read sentences that contained a ‘bad’ adverbial cue – even with unambiguous participles – than sentences in which the adverbial supported the reduced relative clause analysis. This effect was more pronounced in the Chinese speakers, which might be due to the fact that participles are not morphologically marked in Chinese. The RTs on the disambiguating region showed that sentences such as (12) and (14) were read more slowly than sentences like (9) and (11), which shows that both the native speakers and the L2 learners were sensitive to the argument structure of the verbs and the type of constituent following the past participle.

With respect to the question of L2 learners’ ability to employ native-like parsing routines, the findings from this study provide a partially positive answer. This is because even though both L2 and L1 processing were found to be affected by morphological and syntactic cues as well as verb argument structure, the L2 learners differed from the native speakers in that a confusing post-ambiguity cue affected both the L2 learners’ RTs and judgements. This finding is interpreted by Juffs as an indication of the fact that L2 learners, when processing L2 input online, do not feel as confident as native speakers do so that their parsing ability is ‘less robust’ than that of native speakers (Juffs, 1998a: 133). Notice, however, that the issue of whether L2 learners transfer processing mechanisms from their native to the second language cannot be addressed here as nothing is known about how this kind of ambiguity is resolved in the subjects’ native languages. Furthermore, Juffs’ study offers a data set from both native speakers and L2 learners that argues against the predominance of Minimal Attachment. The fact that
interaction between verb argument structure and constituent type affected all groups’ ambiguity resolution pattern could be taken as evidence against sentence processing models which assume that lexical information does not influence initial parsing decisions. Finally, Juffs’ findings suggest that grammatical similarities between the first and the second language in the way (reduced) RCs are construed may influence the processing of these constructions in the L2.

6.1.3. The PP-attachment ambiguity

In their eye-tracking study, Frenck-Mestre and Pynte (1997) also tested the PP-attachment ambiguity with advanced English learners of French. In this experiment, Frenck-Menstre and Pynte addressed the question whether L2 learners’ parsing strategies differ from the ones native speakers use even when the structures under investigation are identical in the native and the second language. Their materials consisted of temporarily ambiguous sentences involving the attachment of a PP either to a VP or to an DP, such as (15):

(15) Brutus hit the gladiator with the shield with his bare hands.

The sentence above is ambiguous up to the PP *with the shield*, since this PP could be attached either to the verb, *hit*, or to the DP, *the gladiator*. It is the PP, *with his bare hands*, that disambiguates the sentence towards DP-attachment. According to strictly phrase-structure-driven parsers, like the Garden-Path model, VP-attachment of the PP will always be preferred over NP-attachment, because of the Minimal Attachment strategy, which leads to the simplest tree representation. On the other hand, if one assumes that lexical information of the verb can guide initial parsing decisions, then PP-attachment depends on whether subcategorisation information encoded on the verb allows a second argument or not. Frenck-Mestre and Pynte made use of the subcategorisation information carried by the verb to investigate whether L2 learners are sensitive to non-syntactic cues when processing L2 input. They employed materials with ditransitive and montransitive verbs, such as (16a)–(16d):

(16a) They accused the ambassador of espionage but nothing came of it.
(16b) They accused the ambassador of Indonesia but nothing came of it.
(16c) He rejected the manuscript *on purpose* because he hated its author.

(16d) He rejected the manuscript *on horses* because he hated its author.

In sentences (16a) and (16b), the verb is ditransitive allowing two arguments, whereas in sentences (16c) and (16d), the verb is monotransitive and is subcategorised by one argument only. For sentences (16a) and (16b), notice that, whether parsing models assume lexical information to guide initial parsing decisions or not, the predictions are the same; namely sentence (16a) will be easier than sentence (16b), either because of Minimal Attachment or because of the lexical information carried by the verb, *accuse*. However, parsing models make different predictions for sentences (16c) and (16d); phrase-structure-driven models predict (16c) to be easier than (16d) because of the Minimal Attachment strategy, whereas lexically-driven or constraint-based models predict exactly the opposite result because of the subcategorisation information of the verb, *reject*.

Frenck-Mestre and Pynte found that for both groups of subjects the PP-attachment depended on the type of the verb that was used. This means that with monotransitive verbs subjects preferred to attach the PP to the DP rather than to the VP, whereas with ditransitive verbs the subjects preferred the VP- over the DP-attachment. This result supports a lexically-driven parser, since subcategorisation information carried by the verb was found to affect initial parsing decisions. Though overall the L2 learners were found to use similar processing strategies to those employed by native speakers, there was some evidence suggesting that the two groups of participants differed in the processing of the sentences. More specifically, first fixations from the native speakers on the noun of the PP showed that there were no significant differences among the four conditions exemplified in (16a)–(16d). On the other hand, first fixations from the non-natives indicated that the L2 learners took longer to read VP- than NP-attachment disambiguated sentences (16c vs. 16d respectively) when followed by monotransitive verbs. In addition, first-pass regressions also showed that L2 learners, tended to regress more often when the sentences were disambiguated towards VP- than towards
NP-attachment irrespective of whether the verb was monotransitive or ditransitive, contrary to the natives who did not exhibit such an effect. Frenck-Mestre and Pynte interpreted these two results as evidence that L2 learners prefer to attach incoming material locally. To put it simply, in DP-attachment disambiguated sentences, the PP is attached to the most recent phrase; this results in local attachment, which might be favoured by L2 learners. Nonetheless, Frenck-Mestre and Pynte note that this local attachment strategy is influenced by the subcategorisation information of the verb, since in first-fixations the difference between VP- and DP-attachment was significantly different only for monotransitive verbs.

6.1.4. The RC attachment ambiguity

Fernández (1999; 2003) has conducted several experiments on the RC attachment ambiguity with monolingual speakers and learners of English and Spanish in order to address the question of whether learners of a second language employ the same processing strategies as native speakers of this language. In this section, I will focus on her studies with L2 learners (see also note 1). In an off-line study, she examined ambiguous sentences containing RCs preceded by complex DPs involving a non theta- and a theta-assigning preposition as illustrated below (Fernández, 1999: 225):

- DP-of-DP

(17) Roxanne read the review of the play that was written by Diane’s friend.

- DP-with-DP

(18) The crowd cheered for the singer with the guitarist that was awarded a medal.

The subjects’ task was to answer a question following each sentence, asking which of the two NPs is the head of the RC:

(17’) What was written by Diane’s friend? the review the play
(18’) Who was awarded a medal? the singer the guitarist

The questionnaire also included unambiguous filler items, which were used to determine the subjects’ proficiency.
Table 6.1 (reported from Fernández, 1999: 227) presents the low-attachment preference percentage for each group.

Notice that the native speakers of English exhibit the highest low-attachment percentage, obeying the late closure strategy; this result is consistent with other studies on RC attachment preferences in English. Moreover, the two groups differ significantly in terms of attachment preferences across the two conditions, in that the native speakers of English provided higher percentages of low-attachment preference than the learners. Fernández interprets this result as indicative of the fact that L2 processing differs from L1 processing. In addition, the fact that Spanish learners of English manifested a tendency towards high-attachment, namely the preference found in their first language, suggests that processing strategies are transferred from the first language to the second. Besides, Fernández found that the proficiency in English correlated significantly with attachment preferences, namely the higher the proficiency of an individual the more likely this individual was to attach the RCs low. In other words, the more fluent a learner was in English the more native-like processing strategies s/he used. Fernández concluded that L2 processing depends on the language history of the subject in the second language. Fernández (1999; 2003), based on the evidence from L2 processing, makes the interesting hypothesis that the so-called incomplete learning in L2 could be due to the fact that L2 learners transfer processing strategies from their first language, which might not suit the L2 input and thus, the use of incorrect parsing strategies could result in representations of the grammar that are different from those of native speakers.

Frenck-Mestre (1997; 2002; 2005) also presents data from L2 learners on RC attachment preferences, which indicate that the parsing routines

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Native speakers of English</th>
<th>Spanish learners of English</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP-of-DP</td>
<td>67.8</td>
<td>30</td>
</tr>
<tr>
<td>DP-with-DP</td>
<td>77.2</td>
<td>43.3</td>
</tr>
</tbody>
</table>

Table 6.1. Low-attachment preference percentages in Fernández (1999)
in the first language are directly transferred into the target language. She conducted an eye-tracking experiment with native speakers of French, beginning English and Spanish learners of French as well as advanced English learners of French. In the critical materials, the sentences were disambiguated by the means of number information on the embedded verb:

(19) Aline telephone aux filles de la gardienne qui reviennent de Paris.

Aline calls to-the-PL daughters of the-SG-FEM nanny who returns from Paris.

‘Aline calls the daughters of the nanny who are/is returning from Paris.’

The control group of French monolinguals exhibited an overall high-attachment preference. The results from the Spanish learners were similar to the ones from the native speakers of French, in that a high-attachment preference was also obtained. On the other hand, the beginning English learners showed a low-attachment preference, whereas the advanced English learners patterned with the native speakers of French and also exhibited a high-attachment preference. Based on the findings from the beginning learners of French, Frenck-Mestre argues in favour of transfer effects in L2 processing. Moreover, she claims that linguistic experience in the target language plays a predominant role in the adoption of native-like parsing routines.

Dussias (2001; 2003) also presents data from L2 learners that support the impact of the participants’ daily exposure to the target language on L2 parsing. More specifically, she conducted a Spanish self-paced reading task with advanced Spanish learners of English, English learners of Spanish and a monolingual Spanish control group with sentences like (20):

(20) El perro mordió a, cuñada del maestro / que vivió en Chile/con su esposo.

‘The dog bit the sister-in-law of the teacher-masc / who lived in Chile / with her husband.’
(21) El perro mordió al cuñado de la maestra / que vivió en Chile / con su esposo.
   ‘The dog bit the brother-in-law of the teacher-fem / who lived in Chile / with her husband.’

The monolingual Spanish group exhibited a high-attachment preference, whereas the Spanish learners of English preferred to attach the RCs low. On the other hand, the English learners of Spanish manifested only a trend for an N2-attachment preference, which was not statistically significant. Dussias interprets these findings in terms of exposure-based processing models and argues that the accumulated exposure to the target language results not only in the use of the parsing strategies of the target language but also in attrition, as the L1 processing mechanisms are abandoned in favour of the L2 ones (cf. the results from the Spanish learners).

Finally, Felser et al. (2003) conducted an off-line grammaticality judgment, an attachment judgment questionnaire and a SPR task with advanced German and Greek learners of English and a control group of native English speakers. In the attachment judgment questionnaire, they examined the RC attachment preferences of all groups for sentences like (22) and (23) below:

(22) The dean liked the secretary of the professor who was reading a letter.
(23) The dean liked the professor with the secretary who was reading a letter.

In sentences such as (23), which involve thematic prepositions, all groups of subjects exhibited a low-attachment preference. On the other hand, in sentences like (22), which contain non-thematic prepositions, the native speakers differed from the L2 learners in that they showed no preference for either attachment site, whereas the native speakers of English preferred to attach the RC to the second noun. The same finding has been replicated in the SPR task, in which the ambiguities were resolved by number information on the embedded verb:

(24) The dean liked / the secretary of the professors / who / was (were) / reading a letter.
(25) The dean liked / the professors with the secretary / who / were (was) / reading a letter.
Furthermore, in the grammaticality judgment experiment it was tested whether the L2 participants did accept sentences like (22) and (23) above as grammatical and whether they were able to detect subject-verb agreement violations. In this task, the L2 learners’ grammaticality judgment scores did not differ from those of the native speakers. Felser et al. account for their findings in terms of the Thematic Domain hypothesis and they argue that L2 learners parsing decisions are mainly guided by thematic/lexical cues (see also section 6.3.4).

6.1.4.1. Summary  The results of the studies reviewed on L2 ambiguity resolution are informative about the processing mechanisms used in a second language but still far from definite. Hence, the studies conducted on the area of L2 sentence processing have not yet provided any clear answers to the questions raised at the outset:

- Are L2 learners able to acquire the parsing mechanisms employed by native speakers?
- How do parsing mechanisms emerge in L2 learners?
- Do L2 learners transfer parsing mechanisms from their first language to the foreign language?

Regarding the first question, the findings obtained thus far indicate that L2 learners employ different parsing strategies from native speakers. Furthermore, developmental aspects of L2 processing have not yet been investigated in depth. With respect to the third question the evidence available is rather inconclusive. Namely, some studies showed that the L1 parsing strategies are transferred into the target language, whereas the results of other studies provided no evidence of such transfer effects. Also notice that not all studies used independent methods to test whether the difficulties subjects experience when processing L2 input stem from the incomplete acquisition of the relevant grammatical constructions.

In what follows I will describe in detail the experiments on RC attachment preferences with L2 learners of Greek.

6.2. RC ATTACHMENT PREFERENCES IN GREEK AS L2

In the present study, I investigated the way L2 learners of Greek resolve RC-attachment ambiguities. The purpose of this study is
twofold. First, the experiments with L2 learners seek to explore more general questions involved in L2 processing, such as the following:

(i) whether L2 learners use the same parsing strategies as the ones employed by the native speakers;
(ii) whether there is a dissociation between parsing mechanisms and grammatical knowledge.

An additional aim of this study is to test the predictions of the parsing models presented in chapter 2 and examine whether they can also handle L2 processing.

In order to pursue the aforementioned purposes, a grammaticality judgement, an acceptability judgement and a self-paced reading task with Spanish, German and Russian L2 learners of Greek were conducted. Subjects with Spanish, German and Russian as first languages have been chosen for two reasons. First, the RC attachment ambiguity has been investigated with native speakers of these three languages. There are findings for the way Spanish, German and Russian native speakers parse RC-attachment ambiguities in their native languages and these findings can be compared with the results from Spanish, German and Russian learners of a second language. Furthermore, the common feature among these three languages is that they all exhibit a high-attachment preference for RCs, when the complex DP involves non theta-assigning prepositions. In addition, the findings on the RC-attachment ambiguity from the native speakers of Greek (see chapter 4) are parallel to the results reported in studies on Spanish, German and Russian, in that native speakers of Greek also displayed a high-attachment preference. The fact that the target language and the learners’ L1s are similar in this respect ensures that potential differences between the native speakers and the L2 learners cannot be attributed to transfer effects.

An additional aim of the L2 study is to further evaluate the processing models put forward to account for RC attachment preferences. Recall from the experiments with the native speakers (chapter 4) that the form of the complex DP – involving either a genitive or a theta-assigning preposition – affected the RC attachment preferences. When the complex DP incorporated a genitive a high-attachment preference was obtained, whereas when the complex DP contained a PP the RC was preferably attached to the second noun. In the experiments with L2
learners, the form of the complex DP was also manipulated in order to
test whether L2 learners’ attachment preferences are also affected by
semantic/thematic information.

The different attachment preferences depending on the type of the
antecedent found in the experiments with native speakers of Greek were
interpreted as providing evidence in support of the thematic domain
hypothesis formulated in the Construal framework. The manipulation of
the form of the complex DP in the experiments with L2 learners of
Greek can further test this hypothesis. Recall that the thematic domain
hypothesis is supposed to be a universal component of the human
parser. If this is true, then L2 processing should be found to be affected
by thematic information. Thus, the thematic domain hypothesis predicts
that in the PP condition the RC should be attached low. Notice that the
thematic domain hypothesis makes no predictions for the condition
with genitives. Construal, however, predicts that, when both nouns
belong to the same thematic domain, the Relativised Relevance princi-
ple comes into play and favours attachment to the most salient host. In
the materials of the experiments, the most salient host is the first noun,
since it is the object of the main verb and, thus, according to Construal,
a high-attachment preference should be found.

The fact that the target language (= Greek) and the learners’ L1s
exhibit similar attachment preferences makes it possible to test the pre-
dictions of experience-based models for sentence processing, such as the
Tuning theory. The Tuning theory claims that parsing decisions stem
from records that the parser keeps based on exposure grounds. If this is
true, then one would expect L2 learners’ records to be formed by the way
ambiguities are resolved in both languages. Tuning theory has not been
engaged in specifying exactly how records from more than one language
will be kept, namely whether records from different languages will be
kept separately or together. Nevertheless, and maybe irrespective of the
way statistical records from different languages are kept, one prediction
of Tuning is that second language learners’ parsing decisions will be
determined by their accumulated experience in their first as well as their
second language. The L2 learners that participated in the present study
were all exposed to languages exhibiting a low-attachment preference
with prepositional complex DPs and a high-attachment preference with
genitival complex DPs. Thus, Tuning predicts that the L2 learners of Greek will also show a low and high-attachment preference with PP and genitive complex DPs respectively when processing Greek L2 input, as their experience in both languages is based on records favouring this particular type of attachment.

The findings from the native speakers showed that the Anaphoric Binding principle cannot be a viable determinant for RC attachment preferences in Greek. However, one might argue that this strategy operates in the subjects’ first languages and is then transferred to the target language when processing L2 input. If this happens, then L2 learners of Greek should preferably attach the RC low, since the target sentences contain the relative complementizer *pu* (that).

Furthermore, the predictions the Recency/Predicate Proximity model makes with respect to L2 processing will also be considered. Recall from section 2.2.3 that according to this model Recency is a universal parsing principle and, hence, should be available when L2 learners parse sentences in the second language. On the other hand, Predicate Proximity, though also operative universally, has different strength across different languages. As pointed out in section 4.2.3, Predicate Proximity is strong in Greek, since Greek is a relatively free word-order language, which allows a great distance between the verb and its object. The subjects that participated in the experiments were highly proficient in Greek and it is unlikely that they were not aware of the fact that in Greek objects can be separated from verbs. Assuming, thus, that the learners’ grammatical knowledge is equal to the one of native speakers, one would expect L2 learners to employ Predicate Proximity and attach the RC high across the board.

Finally, the L2 learners’ grammatical knowledge of the constructions involved was independently tested by using a grammaticality judgement task, which was administered separately from the off- and on-line attachment judgement experiments. In this way, it can be examined to what extent the L2 learners’ attachment preferences depend on their knowledge of grammar or rather are dissociated from grammatical knowledge.

In what follows, I will first give details on the subjects’ background knowledge in Greek. Then, I will present the design of the grammaticality
judgement, acceptability judgement and self-paced reading tasks. Finally, the results will be reported and analysed.

6.2.1. Background information and Proficiency of the L2 learners in Greek

The subjects who took part in the study were eighteen Spanish (twelve women and six men), nineteen German (seventeen women and two men) and ten Russian (eight women and two men) L2 learners of Greek. All the subjects have a high educational level and all of them have a University degree. The mean age for the Spanish, the German and the Russian group was 38.78, 42.89, 27.3 years respectively at the time they did the experiments. In addition, all of them had formal instruction in Greek. All of them were currently living and working or studying in Athens when the experiments took place. Moreover, most of the subjects were first exposed to Greek in their adulthood. The age at which each particular individual came into contact with Greek is given in Table 6.2.

As is obvious, all the subjects (except Nick and Rebecca) were first exposed to Greek in their adulthood. Even Nick and Rebecca who reported that their first contact with Greek was in their childhood, did not grow up with Greek or have a monolingual Greek parent. Rather they occasionally heard Greek from their parents, grandparents and relatives.

Moreover, the subjects were asked to give information on the time they had spent in Greece as well as on the formal instruction they had received. Table 6.3 reports the two pieces of information per individual. The first figure represents the time they spent in Greece and the second one the amount of formal instruction they got in Greek.

As Table 6.3 indicates most of the subjects spent a considerable amount of time in Greece. As far as formal instruction received in Greek is concerned, some clarifications need to be made. All the subjects who reported to have learnt Greek for one year did so in Greece attending intensive courses. Moreover, the Spanish subjects Rosa and Ana learnt Greek in Spain for five years and subsequently came to Greece and continued their studies. In addition, Brigitte studied Greek
for two years in Germany and for one year in Athens, whereas Christine studied for one year in Germany and for another one in Greece. Eva studied Greek for one year in Germany and half a year in Athens and Thorsten did his Greek studies in Germany. The Russian subjects Eleni and Leila studied Greek in Russia for six years and only for one year in Athens. The rest of the subjects learnt Greek only in Greece.

It is well reported in the second language acquisition literature that the amount the subjects spent learning a second language and the time spent in the country where the second language is spoken does not necessarily entail that they will be competent in this language. In order to test the subjects’ performance in Greek using a more objective method, all the L2 learners completed a proficiency test\(^8\). The

<table>
<thead>
<tr>
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<th>Russians</th>
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</table>
Proficiency test examined the subjects’ knowledge of various grammatical phenomena as well as reading comprehension and writing skills. The individual scores (out of 80) per subject and language group are reported in Table 6.4.

The results of the proficiency scores show (a) that the subjects know Greek very well and (b) that they form a rather homogeneous group with respect to their level of proficiency in Greek. Finally, all the subjects reported that they had interaction with Greek people every day and that they used Greek for their every day activities. The high scores in the proficiency test as well as the other sources of background information indicate that the subjects have a good command of Greek.

<table>
<thead>
<tr>
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<th>TI/INS</th>
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<td>22/1</td>
<td>Gennadios</td>
<td>9/0,75</td>
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<td>Carlos</td>
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<td>Christine</td>
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<td>Ilona</td>
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</tr>
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<td>Esperanza</td>
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<td>Eva</td>
<td>0,33/1,5</td>
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<td>Francisco</td>
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<td>23/1</td>
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<td>Julia</td>
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<td>Helena</td>
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</tr>
<tr>
<td>Maria-José</td>
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<td>Hiltrud</td>
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<td>Sergei</td>
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<tr>
<td>Merce</td>
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<td>Karin</td>
<td>38/2</td>
<td>Mean</td>
<td>4,3/2,35</td>
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<tr>
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<td>Mokka</td>
<td>1/1</td>
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</tr>
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<td>Pedro</td>
<td>19/1</td>
<td>Nick</td>
<td>1/1</td>
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<td>Thorsten</td>
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<td>15/1</td>
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<tr>
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<td>Ulla</td>
<td>14/1</td>
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<tr>
<td>Mean</td>
<td>11,21/2,06</td>
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<td>19</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>14,14/1,42</td>
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</table>
In addition, the subjects were asked to report their knowledge of English. The reason for asking this was to test the possibility that the L2 learners’ processing strategies are influenced by another non-native language. I will come back to this point when the results are discussed. Table 6.5 illustrates the subjects’ level of proficiency in English according to their self-assessments.

Table 6.5 shows that the subjects are not homogeneous regarding their knowledge of English, in that they have different proficiency levels. Moreover, the German subjects as a group are the ones with the highest proficiency level.

<table>
<thead>
<tr>
<th>Spanish</th>
<th>Scores</th>
<th>Germans</th>
<th>Scores</th>
<th>Russians</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfonso</td>
<td>78</td>
<td>Anna</td>
<td>71</td>
<td>Angela</td>
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<td>Ana</td>
<td>77</td>
<td>Annette</td>
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<tr>
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<td>Brigitte</td>
<td>70</td>
<td>Eleni</td>
<td>78</td>
</tr>
<tr>
<td>Aurelio</td>
<td>78</td>
<td>Christelle</td>
<td>71</td>
<td>Gennadios</td>
<td>65</td>
</tr>
<tr>
<td>Carlos</td>
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<td>Francisco</td>
<td>67</td>
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<tr>
<td>Julia</td>
<td>78</td>
<td>Helena</td>
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<td>Leila</td>
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<td>Marga</td>
<td>75</td>
<td>Helga</td>
<td>78</td>
<td>Ludmilla</td>
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<td>Maria-José</td>
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<td>Matilde</td>
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<td>N</td>
<td>10</td>
</tr>
<tr>
<td>Merce</td>
<td>77</td>
<td>Karin</td>
<td>75</td>
<td>Mean</td>
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</tr>
<tr>
<td>Paci</td>
<td>76</td>
<td>Mokka</td>
<td>72</td>
<td>SD</td>
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<td>Pedro</td>
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<td>Penelope</td>
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<td>Rebecca</td>
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</tr>
<tr>
<td>Rosa</td>
<td>78</td>
<td>Stefanie</td>
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<td></td>
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<tr>
<td>Rosario</td>
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<td>Thorsten</td>
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<tr>
<td>Trinidad</td>
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<td>Ute</td>
<td>78</td>
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</tr>
<tr>
<td>N</td>
<td>18</td>
<td>Ulla</td>
<td>79</td>
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<td></td>
</tr>
<tr>
<td>Mean</td>
<td>75.3</td>
<td>N</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>3.27</td>
<td>Mean</td>
<td>73</td>
<td></td>
<td>5.8</td>
</tr>
</tbody>
</table>
6.2.2. Experiment 5: Grammaticality judgement task

The purpose of the grammaticality judgement task was to ensure that the subjects have acquired the relevant grammatical properties associated with the construction under investigation, i.e. relative clauses with complex antecedents as well as relative clauses with various kinds of dependencies.

6.2.2.1. Method materials

The format of the grammaticality judgement task (GJT) was adopted from Hawkins and Chan (1997) and consisted of 50 sentences. An equal number of grammatical and ungrammatical sentences, twenty-five each, was included in order not to bias the subjects towards a particular answer. All fifty sentences of the GJT contained RCs that were only introduced by the relative complementizer \( pu \) (that), because in all the experiments to be reported below the relative complementizer was used instead of the relative pronoun\(^{10} \).

The grammatical sentences constituted RCs involving subject, direct object, indirect object and genitive dependencies\(^{11} \) as well as RCs with

---

### TABLE 6.5. Knowledge of English in L2 learners

<table>
<thead>
<tr>
<th>Spanish</th>
<th>PR. LEV.(^{9} )</th>
<th>Germans</th>
<th>PR. LEV.</th>
<th>Russians</th>
<th>PR. LEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfonso</td>
<td>Intermediate</td>
<td>Anna</td>
<td>Advanced</td>
<td>Angela</td>
<td>None</td>
</tr>
<tr>
<td>Ana</td>
<td>Intermediate</td>
<td>Annette</td>
<td>Advanced</td>
<td>Anna</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Antonio</td>
<td>Intermediate</td>
<td>Brigitte</td>
<td>Intermediate</td>
<td>Eleni</td>
<td>Advanced</td>
</tr>
<tr>
<td>Aurelio</td>
<td>Elementary</td>
<td>Christelle</td>
<td>Intermediate</td>
<td>Gennadios</td>
<td>Intermediate</td>
</tr>
<tr>
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<td>Intermediate</td>
<td>Ilona</td>
<td>Elementary</td>
</tr>
<tr>
<td>Esperanza</td>
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<td>Eva</td>
<td>Intermediate</td>
<td>Ioulia</td>
<td>Advanced</td>
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<tr>
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</tr>
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<td>Julia</td>
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<td>Helena</td>
<td>Intermediate</td>
<td>Leila</td>
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<tr>
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<td>Helga</td>
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<td>Ludmilla</td>
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</tr>
<tr>
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<td>Hiltrud</td>
<td>Advanced</td>
<td>Sergei</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Matilde</td>
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<td>Irina</td>
<td>Intermediate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Merce</td>
<td>Intermediate</td>
<td>Karin</td>
<td>Intermediate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paci</td>
<td>None</td>
<td>Mokka</td>
<td>Advanced</td>
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<tr>
<td>Pedro</td>
<td>Elementary</td>
<td>Nick</td>
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<tr>
<td>Rosa</td>
<td>Intermediate</td>
<td>Stefanie</td>
<td>Intermediate</td>
<td></td>
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<tr>
<td>Rosario</td>
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<td>Thorsten</td>
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<td>Trinidad</td>
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<td>Ute</td>
<td>Intermediate</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ulla</td>
<td>Intermediate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
two antecedents, five per each category. When the head of the RC served the function of the subject or the direct object, \textit{pu} replaced the relativised element, as shown in examples (1) and (2) for Subject (S-RC) and Direct Object RCs (O-RC) respectively:

\begin{enumerate}
  \item (26) \textit{Htes sinandsa tin tragudhistría pu} meni konda sto spiti mu.  
    \textit{‘Yesterday I met the singer who lives close to my house.’}
  \item (27) \textit{To roloi pu} ehasita ena panakrivo Rolex.  
    \textit{‘The watch that he lost was an extremely expensive Rolex.’}
\end{enumerate}

In Indirect RCs, a resumptive clitic was used along with \textit{pu} as shown below:

\begin{enumerate}
  \item (28) \textit{O fititis pu tu} edhsota to vivlio dhen erhete pja sta mathimata.  
    \textit{‘The student who I gave the book to does not come to the classes any more.’}
\end{enumerate}

The Indirect Object RCs (IO-RC) of the GJT always included a resumptive clitic, because the lack of the clitic results in sentences, which might be considered as unacceptable by some speakers. When the head of the RC was in genitive case (Ge-RC), a resumptive possessive clitic was again employed, since the use of the relative complementizer without the retention of the possessive pronoun results in ungrammatical sentences:

\begin{enumerate}
  \item (29) \textit{I ithopios pu i morfi tis ehi simadhepsi mja olokiri epohi timithike telika me Oscar.}  
    \textit{‘The actress whose figure has influenced a whole period was finally awarded by Oscar.’}
\end{enumerate}

The RCs with two antecedents (2DPs) were ambiguous, in the sense that the attachment of the RC was not forced by either grammatical or pragmatic means, as illustrated in example (5):

\begin{enumerate}
  \item (30) \textit{Kituse epimona to egonaki tu kiriu pu kathotan ston kanape.}  
    \textit{‘(S)he was constantly looking at the great child of the man who was sitting on the sofa.’}
\end{enumerate}

The reason for including these sentences in the GJT was to determine whether the L2 learners of Greek are aware of this particular ambiguity and whether they accept these sentences as grammatical.
The ungrammatical sentences incorporated relativisation processes that are not possible in Greek. For example, five of the ungrammatical sentences involved RCs with doubly filled Comp (D-CP), which means that both the relative complementizer and the relative pronoun were used to introduce the RC, as shown in example (6):

(31) *O sigatikos ton opio pu miso ine fovera eghoistis.  
    ‘The flatmate that I hate is extremely selfish.’ (intended meaning)

In addition, five sentences included RCs, which lacked a relativiser element (No-CP):

(32) *Bike sto nosokomio i jaja kratusa sindrofja ta vradhja.  
    ‘The old lady I was keeping company to went to the hospital.’  
    (intended meaning)

Five sentences contained structures with preposition stranding (Pr-Str), which is impossible in Greek:

(33) *To thema pu ine afosiomeni i Eleni me ehi idhjetero endhjaferon.  
    ‘The topic Helen is so devoted to is particularly interesting.’  
    (intended meaning)

Likewise, five sentences included RCs introduced by the relative complementizer (NoRP), whereas they require either a relative pronoun or the relative complementizer together with a resumptive clitic:

(34) *O anthropos pu toso tifla eksartase ine anefthinos.  
    ‘The man you blindly depend on is irresponsible.’ (intended meaning)

Finally, five ungrammatical RCs with two antecedents (2DPs) were also included. The ungrammaticality lay on the order of the words:

(35) *Me to koritsi ton kirio pu kathoton sto pagaki oli kitusan.  
    ‘Everybody was looking at the man with the girl who was sitting on the bench.’ (intended meaning)

Procedure The sentences were written on printed sheets. Each sentence was followed by two options, either grammatical or ungrammatical. The subjects were asked to circle the option that seemed appropriate to them for each sentence. All the subjects were given written instructions to read
carefully all the sentences and judge them on grammatical and not pragmatic grounds. The whole procedure did not last more than twenty minutes.

**Subjects** The eighteen Spanish, nineteen German and ten Russian learners of Greek whose language profiles were given in section 6.2.1 participated in this task.

6.2.2.2 Results The individual scores for each particular individual are reported in Appendix I. The results for each structure tested in the Grammaticality Judgement task are summarised in Table 6.6 for all language groups.

The mean correct percentages from Table 6.6 indicate that the L2 learners performed well on constructions involving RCs. As far as the grammatical sentences containing RCs with two antecedents are concerned (see the highlighted scores in grammatical constructions), the subjects correctly accepted them as grammatical in high percentages. The L2 learners were also sensitive to errors in these sentences (see the highlighted scores in ungrammatical constructions). Moreover, the mean correct scores for both grammatical and ungrammatical RCs with two antecedents (93.35%, 88.4% and 85% for the Spanish, German and Russian groups respectively) further suggest that the L2 learners are

<table>
<thead>
<tr>
<th>Construction type</th>
<th>Spanish %</th>
<th>German %</th>
<th>Russian %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grammatical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-RC</td>
<td>98.9</td>
<td>96.8</td>
<td>94</td>
</tr>
<tr>
<td>O-RC</td>
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<td>Ge-RC</td>
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<td>64</td>
</tr>
<tr>
<td>2DPs</td>
<td>86.7</td>
<td>80</td>
<td>74</td>
</tr>
<tr>
<td><strong>Ungrammatical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-CP</td>
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<tr>
<td><strong>Mean</strong></td>
<td>80.67</td>
<td>87.14</td>
<td>85.6</td>
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</tbody>
</table>
competent in this construction. In addition, the scores on the sentences containing RCs with two antecedents in Table 6.6 do not significantly differ among the three language groups, which shows that the three groups of L2 learners performed similarly ($F(2,44) = 1,415; p = 0,254$ for grammatical sentences; $F(2,44) = 1,227; p = 0,303$ for ungrammatical sentences).

A final remark needs to be made with respect to the performance of the Spanish subjects on the grammatical IO- and Ge-RCs. Table 6.6 shows that the performance of the Spanish group was considerably lower than that of Germans and Russians (28.9% and 32.3% for IO- and Gen-RCs respectively). This also contrasts with the otherwise high numbers of correct percentages obtained in all other construction types. Therefore, the low percentages on IO- and Ge-RCs obtained by the Spanish participants cannot be attributed to a difference in the proficiency level between the Spanish subjects on one hand and the German and Russian subjects on the other. Rather, an explanation for this finding can be put forward in terms of the grammatical properties associated with these specific structures, i.e. IO- and Gen-RCs, and their availability in Greek and the participants’ first languages. Recall that these RCs in Greek involve the use of a resumptive clitic, which is a grammatical option in Greek, whereas a relative pronoun is required in Spanish, German or Russian, as shown below:

\[
\begin{align*}
(36) & \quad \text{a. O fititis } pu\, tu\, edhosa\, to \\
& \quad \quad \text{the-NOM-SG-M student-NOM-M that his-gave-1SG the-ACC-SG-N} \\
& \quad \quad \text{vivlio ehi eksafanisti.} \\
& \quad \quad \text{book-ACC-N has disappeared} \\
& \quad \quad \text{b. El estudiante } a\, quien \, di \, el \, libro \, ha \\
& \quad \quad \quad \text{the-SG-M student-M to who gave-1SG the-SG-M book-M has} \\
& \quad \quad \quad \text{desaparecido.} \\
& \quad \quad \quad \text{disappeared} \\
& \quad \quad \text{c. Der Student, } den \, ich \, dem \\
& \quad \quad \quad \quad \text{the-NOM-SG-M student-M who-DAT I the-ACC-SG-N} \\
& \quad \quad \quad \quad \text{Buch gegeben habe, ist verschwunden.} \\
& \quad \quad \quad \quad \text{book-N given have-1SG is disappeared} \\
& \quad \quad \quad \text{d. Студент, } которому я дал книгу, \\
& \quad \quad \quad \quad \text{student-NOM-SG-M who-DAT I gave-SG-M book-ACC-SG-F} \\
& \quad \quad \quad \quad \text{ich ez.} \\
& \quad \quad \quad \text{disappeared-SG-M} \\
& \quad \quad \quad \text{‘The student who I gave the book to has disappeared.’}
\end{align*}
\]
Notice, however, that if the unavailability of resumptive clitic with RCs was the factor that triggered the Spaniards’ low correct percentages on these constructions, one would expect similar findings for the Germans and the Russians, which was not the case. By contrast, I would like to suggest that the Spaniards’ low performance is due to the fact that Spanish allows for resumptive clitic in certain constructions but is more restrictive than Greek in their distribution. More specifically, Spanish patterns with Greek in that, apart from strong pronouns, it also uses pronominal clitics. For example, both languages express topicalisation by using clitic left dislocation (CLLD) structures (see also Anagnostopoulou, 1994; Parodi, 2001):

(38) a. Estos zapatos, los compré en Madrid.
    these shoes, them-bought in Madrid
    ‘These shoes, I bought in Madrid.’

However, Spanish is different from Greek in that it disallows resumptive clitics in interrogative and restrictive relative clauses:

(39) a. Que libro crees que María (*lo) compró?
    ‘Which book do you think Maria bought?’

b. Pjo vivlio nomizis oti (to) aghorase i Maria;
    ‘Which book do you think Maria bought?’
Furthermore, German and Russian are different from both Greek and Spanish in that they only have strong pronouns and not pronominal clitics. Based on these facts, one could argue that it is more difficult to ‘let go’ of the L1 syntactic properties associated with clitics (cf. Spanish learners) than to acquire those properties based on the L2 input (cf. Parodi, 2001; Valenzuela, 2005).

6.2.3. Experiment 6: Acceptability judgement task

The first experiment on RC attachment preferences in L2 learners was an off-line paper-and-pencil task, in which subjects were presented with sentences disambiguated towards either high or low-attachment. In addition, the form of the complex DP that preceded the RC was manipulated such that it either contained a PP or a DP in genitive case. The task used was an Acceptability Judgement task, the format of which was adopted from Birdsong (1992). The subjects were asked to determine the acceptability of the sentences they were presented with on a scale. The Acceptability Judgement task used by Birdsong (1992) was slightly modified with respect to the scale used. More particularly, Birdsong used the following scale: A = not all acceptable, I would not say it; B = acceptable in rare contexts; C = acceptable in about half contexts; D = acceptable in most contexts; E = completely acceptable, I would say it. Instead of Birdsong’s scale, the following scale was used: 1 = totally unacceptable, 2 = 25% acceptable, 3 = 50% acceptable, 4 = 75% acceptable, 5 = totally acceptable. Birdsong’s scale was not used, because it might be difficult for subjects to imagine contexts in which the sentences would appropriately be incorporated. Moreover, to ask subjects to imagine felicitous contexts encourages them to use pragmatic and meta-linguistic sources of information. Of course I am aware of the fact that all judgement tasks are more or less susceptible to the intervention of non-linguistic influences. Nevertheless, the use of a scale, which is based on the imagination of possible contexts, makes
this susceptibility even stronger. In addition, the wording ‘I would not say it’ and ‘I would say it’ was not used, because what one might say or not depends on a variety of psychological, social and discourse factors. Birdsong (1992: 718) notes that he used these two phrases in order to exclude the use of prescriptive grammatical rules by the subjects. In the present task, the use of prescriptive rules was avoided by giving written instructions to all subjects and asking them to base their judgements on their own intuitions and not on prescriptive rules.

It is hypothesised that attachment preferences may be reflected in the subjects’ acceptability judgements, such that preferred interpretations receive higher acceptability scores than dispreferred ones (Birdsong, 1992). The same hypothesis underlies the present task, in the sense that if for example high-attachment is preferred for genitives, there should be higher acceptability scores for sentences disambiguated towards high than low-attachment. Scaled judgements of acceptability were chosen instead of nominal ones, grammatical vs. ungrammatical or acceptable vs. unacceptable or good vs. bad, because of the nature of the sentences under investigation and the type of data I was seeking. The sentences tested cannot be categorically considered as grammatical or ungrammatical. Rather, their acceptability might depend on various factors, one of which is the form of the complex DP that precedes the RC. Therefore, I was interested in obtaining gradedness effects and in investigating how these vary as a function of the way the sentences were disambiguated and the form of the preceding complex DP. As Birdsong (1992: 714) notes, scaled judgements are ‘susceptible to gradedness effects in experimental performance’.

6.2.3.1. Method materials The experimental materials consisted of forty sentences, twenty grammatical and twenty ungrammatical. The critical grammatical items were equally distributed across four conditions

<table>
<thead>
<tr>
<th>Attachment preference</th>
<th>Type of complex DP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(g = genitive, p = PP)</td>
</tr>
<tr>
<td>l = low</td>
<td>gl</td>
</tr>
<tr>
<td>h = high</td>
<td>gh</td>
</tr>
</tbody>
</table>
and they varied according to the type of antecedent (preposition or genitive) and the type of attachment (high or low), as represented in Table 6.7.

Examples for each condition are given below:

- **Condition gh**

  (41) Enas kirios fonakse ton fititi tis kathigitrias pu itan apogoitevmenos apo to neo ekpedeftiko sistima.
  
  ‘A man called the student(masc) of the teacher (fem) who was disappointed(masc) by the new educational system.’

- **Condition gl**

  (42) Enas kirios fonakse ton fititi tis kathigitrias pu itan apogoitevmeni apo to neo ekpedeftiko sistima.
  
  ‘A man called the student(masc) of the teacher (fem) who was disappointed(femin) by the new educational system.’

- **Condition ph**

  (43) Enas kirios fonakse ton fititi me tin kathigitria pu itan apogoitevmenos apo to neo ekpedeftiko sistima.
  
  ‘A man called the student(masc) with the teacher (fem) who was disappointed(masc) by the new educational system.’

- **Condition pl**

  (44) Enas kirios fonakse ton fititi me tin kathigitria pu itan apogoitevmeni apo to neo ekpedeftiko sistima.
  
  ‘A man called the student(masc) with the teacher (fem) who was disappointed(femin) by the new educational system.’

These sentences are disambiguated by the form of the passive participle/adjective, through gender/number agreement. It is important to note that the recognition of attachment preferences in these sentences crucially depends on gender/number agreement between the two antecedents and the passive participle/adjective. In order to test whether the subjects included in our study were sensitive to the gender and number agreement between the DPs and the passive participle in the relative clause,
twenty ungrammatical sentences were added, in which there was a gender/number mismatch between the antecedent DP and the participle, as illustrated in (45):

(45) O ipiretis hamogelase ston vioghrafo tis ithopiu pu itan hamena stis skepsis tus.
‘The servant smiled at the biographer-masc-sg of the actress-fem-sg who was lost-neut-pl in their thoughts.’

Also note that the conditions illustrated in (11)–(14) were minimal pairs and only differed in the relevant variables, in contrast to Fernández’s study (1999) for example, in which different nouns have been used in various conditions. In addition to these forty sentences, there were twenty filler sentences involving different kinds of constructions, like reflexives, control verbs, raising verbs, gerunds and wh-extractions, ten of which were ungrammatical.

**Procedure**  The subjects had to read the sentences and then render scalar acceptability judgements from 1 (not at all acceptable) to 5 (completely acceptable). They were instructed to read the sentences as carefully and as quickly as they could and to rely on their personal judgements and not on prescriptive grammatical rules to rate the sentences. In addition, they were told that if they thought one sentence was bad on strictly grammatical grounds they should give it the lowest score, namely 1.

**Subjects** Eighteen Spanish, eighteen German and ten Russian learners of Greek participated in this experiment. In addition, sixteen native speakers of Greek also took part in the acceptability judgement task for control purposes.

**6.2.3.2. Results** First, the results from the ungrammatical experimental sentences will be reported. The following Table illustrates the percentages of correct responses from the ungrammatical experimental sentences per language group:

The percentages reported in Table 6.8 make it clear that the L2 learners of Greek that participated in the study were able to detect agreement
errors between the noun and the past participle. The equivalent percentage from the native speakers of Greek who also performed this task is 99.38%.

Consider now the results from the grammatical experimental sentences and recall that 1 stands for unacceptable and 5 for totally acceptable.

The mean acceptability scores for each condition are reported in the following table for the native speakers as well as the L2 learners.

The acceptability judgement scores illustrated in Table 6.9 show that the native as well as the L2 speakers of Greek behaved in parallel ways. In the preposition condition, all language groups gave lower scores to the sentences disambiguated towards high-attachment than to the sentences disambiguated towards low-attachment. In the genitive condition, the reverse pattern is observed. Namely, the sentences disambiguated towards high-attachment yielded higher acceptability scores than the ones disambiguated towards low-attachment. This difference seems to be bigger for the native group than the groups of L2 learners. To test
these observations statistically, ANOVAs were performed on the acceptability judgement scores with both subjects and items treated as random effects.

In order to determine whether there are reliable differences between the three groups of L2 learners, a three-way ANOVA was performed on the acceptability judgement scores with ‘Antecedent’ (PPs vs. Genitives) and ‘Attachment’ (high vs. low) as within-subjects factors and ‘L2 Group’ as between-subjects factor. The within-subjects factors had two levels each (Antecedent: genitives vs. prepositions; Attachment: high vs. low), whereas the between-subjects factor had three levels (Language: Spanish vs. German vs. Russian learners of Greek). ‘Language’ did not produce a significant interaction with either ‘Antecedent’ or ‘Attachment’ type, which shows that there were no differences between the three L2 groups. The main effect of ‘Attachment’ type approached significance only in the item analysis, showing that overall the low-attachment sentences were judged as more acceptable than the high-attachment ones ($F_2(1,57) = 4,845, \ p < 0,05$). The statistical comparisons confirm that the three L2 groups behaved similarly with respect to RC attachment irrespective of their native language. For further statistical analyses, I therefore collapsed them into one L2 group.

To compare the L2 learners to the native speakers control group, an ANOVA with ‘Antecedent’ and ‘Attachment’ as within-subjects factors and ‘Group’ (native speakers, L2 learners) as a between-subjects factor was performed. A main effect of ‘Antecedent’ was obtained, showing that overall the Gen conditions yielded higher acceptability judgment scores than the PP conditions ($F_1 \ (1,60) = 77,238, \ p < 0,001$; $F_2 \ (1,78) = 82,052$,

<table>
<thead>
<tr>
<th>Subjects</th>
<th>G-High Mean</th>
<th>SD</th>
<th>G-Low Mean</th>
<th>SD</th>
<th>P-High Mean</th>
<th>SD</th>
<th>P-Low Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greek</td>
<td>4.24</td>
<td>1.10</td>
<td>3.05</td>
<td>1.53</td>
<td>1.62</td>
<td>1.10</td>
<td>2.97</td>
<td>1.67</td>
</tr>
<tr>
<td>Spanish</td>
<td>3.26</td>
<td>1.72</td>
<td>3.17</td>
<td>1.71</td>
<td>2.06</td>
<td>1.44</td>
<td>3.02</td>
<td>1.76</td>
</tr>
<tr>
<td>German</td>
<td>3.82</td>
<td>1.24</td>
<td>3.54</td>
<td>1.38</td>
<td>2.50</td>
<td>1.40</td>
<td>3.17</td>
<td>1.36</td>
</tr>
<tr>
<td>Russian</td>
<td>3.50</td>
<td>1.50</td>
<td>2.70</td>
<td>1.53</td>
<td>2.42</td>
<td>1.39</td>
<td>3.04</td>
<td>1.51</td>
</tr>
</tbody>
</table>
$p < 0,001$). On the other hand, there was no significant main ‘Attachment’ effect, which shows that overall there was no bias towards low or high-attachment. A significant interaction between ‘Antecedent’ and ‘Attachment’ was also found, which indicates that genitives were treated differently from PPs with respect to RC attachment ($F1(1,60) = 80,203, p < 0,001$; $F2(1,78) = 84,214, p < 0,001$). Moreover, there was a significant interaction between ‘Group’ and ‘Antecedent’, which means that the native and the L2 speakers differed in the way they judged the sentences with genitives and PPs (Natives vs. L2 learners: $F1(1,60) = 8,398, p < 0,01$; $F2(1,78) = 8,930, p < 0,01$).

Finally, there was a significant interaction of ‘Antecedent’, ‘Attachment’, and ‘Group’ $F1(1,60) = 13,096, p < 0,01$; $F2(1,78) = 14,234, p < 0,001$), showing that the differences between the two antecedents are not the same for the two attachment types, and that the differences between them are not the same for native speakers and L2 learners.

Further examination of these interactions using matched $t$-tests revealed significant differences between the two genitive conditions (Gen-high vs. Gen-low) for the native speakers ($t1N(15) = 4,442, p < 0,001; t2N(19) = 5,923, p < 0,01$), but not for the L2 learners ($t1L2(45) = 1,714, p = 0,093; t2L2(59) = 1,877, p = 0,066$). This means that the natives judged the high-attachment sentences as more acceptable than the low-attachment ones in the genitive conditions, whereas the L2 learners showed no such preference. In the PP conditions (PP-high vs. PP-low), on the other hand, there was a significant low-attachment preference for both participant groups ($t1N(15) = 4,635, p < 0,01; t2N(19) = 4,486, p < 0,01; t1L2(45) = 5,451, p < 0,001; t2L2(59) = 5,474, p < 0,001$).

To summarise, the results from the Acceptability Judgement task showed that all L2 groups exhibited similar performance, as the comparisons among the L2 learners indicated. Moreover, the native speakers and the L2 learners behaved in parallel, in that both groups showed sensitivity to the type of antecedent and manifested a clear preference for low-attachment when the complex DP preceding the RC included a PP. However, in the genitive condition, though the native speakers showed a high-attachment preference, the L2 learners showed no preference for either attachment type.
In the sentence-completion and the SPR task reported in chapter 4, native speakers of Greek exhibited high-attachment preference with DPs incorporating genitives and a low-attachment preference with DPs involving PPs. Both results have been replicated by the native speakers’ findings in the Acceptability Judgement task. Thus, the different RC attachment preferences depending on the type of the antecedent seems to be a robust finding since it has been yielded from three different types of tasks, sentence-completion, acceptability judgement and self-paced reading experiments.

As far as the data from L2 learners are concerned, it was also found that the form of the complex DP affected the attachment preferences, which suggests that L2 learners are sensitive to thematic information when processing L2 input. However, the L2 learners of Greek did not exhibit a high-attachment preference with genitives as native speakers did. This is an interesting finding, because the first languages of the L2 learners, namely Spanish, German and Russian, have been found to display high-attachment preference when the complex DP that precedes the RC contains a non theta-assigning preposition (for Spanish) or a genitive (for German and Russian). Thus, the fact that L2 learners displayed no preference in the genitive condition cannot be attributed to transfer effects from their first languages. Moreover, the native speakers of Greek manifested a high-attachment preference in the same task and in the same condition, which means that the lack of preference for either high or low-attachment obtained from the L2 learners cannot be attributed to an artefact of the task used. Furthermore, this result is incompatible with experience-based models of sentence processing, such as the Tuning theory, because, though both the first and the second languages of the L2 learners tested in the present study should predispose them towards high-attachment preference, the subjects’ parsing strategies did not seem to be influenced by such biases.

However, one has to take in mind the fact that this result comes from an off-line task, which is not immune to meta-linguistic and pragmatic influences as well as to various psychological associations and, thus, cannot be taken as evidence reflecting on-line parsing choices. To further test the validity of this result and examine potential differences
between L2 learners and native speakers in processing these constructions, an on-line task was also conducted.

6.2.4. Experiment 7: Self-paced reading task (SPRT)

The experimental paradigm used for the on-line study is a self-paced reading task, which is identical to the one conducted to test RC attachment preferences in isolated sentences with native speakers of Greek and is described in section 4.2.1. An identical task was used in order to be able to directly compare the results from the native and the L2 speakers of Greek. Since the task is the same, the method will not be repeated in this section and I will proceed with the presentation of the results. Sixteen, eleven and nine L2 learners of Greek among the eighteen Spanish, eighteen German and ten Russian subjects who respectively participated in the previous tasks completed the SPR task.

6.2.4.1. Results

All sentences of the SPR task were followed by a YES/NO comprehension question. The percentages of the erroneous responses to the filler items were 11.7%, 7.07% and 7.35% for the Spanish, the German and the Russian subjects respectively, whereas the native speakers’ error percentage was 7.78%. These percentages indicate that the subjects paid attention to the task they were performing.

All erroneous responses to the experimental items were excluded from any subsequent analyses resulting in the elimination of 8.44% of the data set for the Greek group, 14.48% for the Spanish group, 18.18% for the German group and 22.69% for the Russian group. Recall from section 4.2.2 that for the native speakers RTs that were above and below 2SD from the appropriate condition mean were eliminated from the statistical analyses, which resulted in the removal of 4.48% of the data set. For the L2 learners, a cut-off point of 2.4SD above and below the appropriate condition mean was used instead and those RTs that were beyond this threshold were considered as outliers and were eliminated. This resulted in the elimination of 2.08%, 3.21% and 2.31% from the Spanish, German and Russian data set respectively. A 2.4SD cut-off point was used instead of the 2SD one applied for the native speakers because the data from L2 learners are more susceptible to variation than those from native speakers.
The RTs per each segment from each language group are reported in Table 6.10.

Recall from section 4.2.1 that the first segment contains the subject and the main verb, the second the complex DP, the third the beginning of the ambiguous region, the fourth is the critical segment, because it is where the disambiguation occurs via gender information and the fifth is the final one. The sixth segment contains the comprehension question, which appeared at once on the screen. An example of the test sentence

<table>
<thead>
<tr>
<th>Segment</th>
<th>Subjects(^{14})</th>
<th>Conditions</th>
<th>G-High</th>
<th>G-Low</th>
<th>P-High</th>
<th>P-Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Greeks</td>
<td></td>
<td>873,38</td>
<td>900,74</td>
<td>816,12</td>
<td>840,18</td>
</tr>
<tr>
<td></td>
<td>Spaniards</td>
<td></td>
<td>1876,03</td>
<td>1987,28</td>
<td>1784,97</td>
<td>1851,88</td>
</tr>
<tr>
<td></td>
<td>Germans</td>
<td></td>
<td>3000,52</td>
<td>2753,70</td>
<td>3174,88</td>
<td>2919,64</td>
</tr>
<tr>
<td></td>
<td>Russians</td>
<td></td>
<td>2085,63</td>
<td>2196,24</td>
<td>2137,43</td>
<td>2156,65</td>
</tr>
<tr>
<td>Second</td>
<td>Greeks</td>
<td></td>
<td>1419,36</td>
<td>1516,41</td>
<td>1594,86</td>
<td>1618,11</td>
</tr>
<tr>
<td></td>
<td>Spaniards</td>
<td></td>
<td>3018,37</td>
<td>3322,55</td>
<td>3230,45</td>
<td>3432,95</td>
</tr>
<tr>
<td></td>
<td>Germans</td>
<td></td>
<td>5515,01</td>
<td>5209,07</td>
<td>5241,24</td>
<td>4848,40</td>
</tr>
<tr>
<td></td>
<td>Russians</td>
<td></td>
<td>4459,79</td>
<td>4603,49</td>
<td>4868,03</td>
<td>4861,16</td>
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<tr>
<td>Third</td>
<td>Greeks</td>
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<td>970,5867</td>
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<td>1000,27</td>
<td>1086,73</td>
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<tr>
<td></td>
<td>Spaniards</td>
<td></td>
<td>1558,59</td>
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<td>1718,54</td>
<td>1621,09</td>
</tr>
<tr>
<td></td>
<td>Germans</td>
<td></td>
<td>1977,86</td>
<td>2288,31</td>
<td>2111,94</td>
<td>2053,23</td>
</tr>
<tr>
<td></td>
<td>Russians</td>
<td></td>
<td>1956,03</td>
<td>2013,10</td>
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<td>1745,48</td>
</tr>
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<td>Fourth</td>
<td>Greeks</td>
<td></td>
<td>882,64</td>
<td>1222,12</td>
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<td>864,32</td>
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<td></td>
<td>Spaniards</td>
<td></td>
<td>1915,85</td>
<td>1821,26</td>
<td>2035,71</td>
<td>1818,23</td>
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<td></td>
<td>Germans</td>
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<td>2648,49</td>
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<tr>
<td></td>
<td>Russians</td>
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<td>2285,79</td>
<td>2484,87</td>
<td>2649,23</td>
<td>2223,62</td>
</tr>
<tr>
<td>Fifth</td>
<td>Greeks</td>
<td></td>
<td>875,78</td>
<td>961,17</td>
<td>1022,01</td>
<td>872,11</td>
</tr>
<tr>
<td></td>
<td>Spaniards</td>
<td></td>
<td>1844,01</td>
<td>1758,26</td>
<td>1766,47</td>
<td>1582,99</td>
</tr>
<tr>
<td></td>
<td>Germans</td>
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<td>2209,39</td>
<td>2476,83</td>
<td>2252,47</td>
<td>2086,57</td>
</tr>
<tr>
<td></td>
<td>Russians</td>
<td></td>
<td>1653,10</td>
<td>1844,54</td>
<td>1868,19</td>
<td>1513,20</td>
</tr>
<tr>
<td>Sixth</td>
<td>Greeks</td>
<td></td>
<td>2645,62</td>
<td>2821,98</td>
<td>3043,62</td>
<td>2708,08</td>
</tr>
<tr>
<td>(Question)</td>
<td>Spaniards</td>
<td></td>
<td>4075,27</td>
<td>4013,82</td>
<td>4012,02</td>
<td>3888,85</td>
</tr>
<tr>
<td></td>
<td>Germans</td>
<td></td>
<td>5225,79</td>
<td>4624,76</td>
<td>5531,66</td>
<td>4811,26</td>
</tr>
<tr>
<td></td>
<td>Russians</td>
<td></td>
<td>4601,09</td>
<td>4128,93</td>
<td>4382,88</td>
<td>4898,45</td>
</tr>
</tbody>
</table>
is repeated below:

(46) Enas theatis kituse
    a-NOM-SG-M spectator-NOM-M looked-IMP.3SG
ton proponiti tis athlitrias
    the-ACC-SG-M trainer–ACC-M the-GEN-SG-F athlete-GEN-F
pu fenotan poli stenohorimenos
    that seemed-3SG very upset-M
apo tin apofasi tis epitropis.
    from the-ACC-SG-F decision-ACC-F the-GEN-SG-F committee-GEN-F

‘A spectator was looking at the trainer (masc) of the athlete (fem) who seemed very upset (masc) because of the decision of the committee.’

(46’) Itan stenohorimenos o proponitis;
    ‘Was the trainer upset?’

Longer RTs are supposed to reflect difficulties the subjects experienced when processing this particular phrase.

The RTs obtained on the first three segments do not seem to manifest any interesting differences. The RTs from the fourth segment indicate that the sentences disambiguated towards high-attachment in the preposition condition must have incurred processing load for all language groups, because the RTs for the P-HIGH condition are longer than the ones for the P-LOW condition (P-HIGHGR: 938,38 ms vs. P-LOWGR: 864,32 ms; P-HIGHSP: 2035,71 ms vs. P-LOWSP: 1818,23 ms; P-HIGHGE: 3225,71 ms vs. P-LOWGE: 2654,04 ms; P-HIGHRU: 2649,23 ms vs. P-LOWRU: 2223,62 ms). In the genitive condition, the native speakers as well as the German and Russian learners produced longer RTs for the sentences disambiguated towards low-attachment in the genitive condition (G-HIGHGR: 882,64 ms vs. G-LOWGR: 1222,12 ms; G-HIGHGE: 2648,49 ms vs. G-LOWGE: 2894,40 ms; G-HIGHRU: 2285,79 ms vs. G-LOWRU: 2484,87 ms). On the other hand, the Spanish subjects produced longer RTs for the sentences disambiguated towards high rather than low-attachment sentences (G-HIGHSP: 1915,85 ms vs. G-LOWSP: 1821,26 ms).
The RTs on the fifth segment demonstrate similar patterns as the ones described for the fourth segment. Finally, the RTs on the sixth segment, which reflect the time the subjects took to answer the comprehension question, show different patterns for the native speakers and the L2 learners. More precisely, the native speakers exhibit the same pattern of attachment preferences as they did on the fourth and fifth segments, namely a high and low-attachment preference for genitive and PP conditions respectively (G-HIGHGR: 2645.62 ms vs. G-LOWGR: 2821.98 ms; P-HIGHGR: 3043.62 ms vs. P-LOWGR: 2708.08 ms). On the contrary, all groups of L2 learners seem to show a low-attachment preference across the board (G-HIGHSP: 4075.27 ms vs. G-LOWSP: 4013.82 ms; G-HIGHGE: 5225.79 ms vs. G-LOWGE: 4624.76 ms; G-HIGHRU: 4601.09 ms vs. G-LOWRU: 4128.93 ms; P-HIGHSP: 4012.02 ms vs. P-LOWSP: 3888.85 ms; P-HIGHGE: 5531.66 ms vs. P-LOWGE4811.26 ms), with the exception of Russians who took more time the answer the question on the P-LOW condition than the ones on the P-HIGH (P-HIGHRU: 4382.88 ms vs. P-LOWRU: 4898.45 ms).

These descriptive facts were supported by statistical analyses. The statistical analyses on the data of the first three segments did not show any reliable main effects or interaction for either language group, whereas they revealed reliable effects on the fourth, fifth and sixth segments. Thus, I will focus on the last three segments. First, the analyses on the critical (4th) segment will be reported.

To examine whether the different language backgrounds of the L2 learners had an effect on their attachment preferences, three-way comparisons were also performed on the RTs from the L2 learners. ‘Language’ (Spaniards vs. Germans vs. Russians) was treated as a between-subjects factor, whereas ‘Antecedent’ (genitives vs. prepositions) and ‘Attachment’ (high vs. low) were treated as within-subjects factors. ‘Language’ did not interact with either ‘Antecedent’ or ‘Attachment’, which proves that the first language did not have an effect on the way the L2 learners processed the sentences. The interaction between ‘Antecedent’ and ‘Attachment’ was significant, indicating once again that the L2 learners were sensitive to the form of the antecedent \(F(1,33) = 10.672, p < 0.01; F(1,69) = 13.829, p < 0.01\). The main effect of ‘Attachment’ was also significant, showing that overall the
low-attachment sentences were read faster than the high-attachment ones ($F1(1,33) = 6.310, p < 0.05; F2(1,69) = 6.061, p < 0.05$). The main effect of ‘Language’ was also significant, probably because the Germans were slower than the Russians, who were also slower than the Spaniards. For further statistical analyses, the L2 groups were collapsed into one.

To compare the L2 learners to the native speakers control group, an ANOVA with ‘Antecedent’ and ‘Attachment’ as within-subjects factors and ‘Group’ (native speakers, L2 learners) as a between-subjects factor was performed. A main effect of ‘Group’ was found ($F1(1,54) = 60.98, p < 0.001, F2 (1,94) = 111.83, p < 0.001$), reflecting the fact that the native speakers’ reading times were overall much shorter than those of the L2 learners. On the other hand, there were no significant main effects of either ‘Antecedent’ or ‘Attachment’, indicating that overall there was no bias for a particular attachment or antecedent type. There was, however, a significant interaction between ‘Antecedent’ and ‘Attachment’ ($F1(1,54) = 15.061, p < 0.001; F2(1,94) = 13.621, p < 0.001$), showing that reading times of high and low-attachment sentences were different for the two antecedent types. Furthermore, a significant interaction between ‘Antecedent’ and ‘Group’ was obtained ($F1(1,54) = 6.214, p < 0.02; F2(1,94) = 4.389, p < 0.04$), showing that the L2 learners’ reading times were different from those of the native speakers for the two antecedent types. The interaction between ‘Attachment’ and ‘Group’ was also significant ($F1(1,54) = 13.156, p < 0.01; F2(1,94) = 5.492, p < 0.03$), indicating that the native speakers’ reading times were different from those of the L2 learners with respect to the two attachment types.

Further examination of these interactions using matched $t$-tests revealed significant differences between the two GEN conditions (Gen-high vs. Gen-low) for the native speakers ($t1N(19) = 4.47, p < 0.01; t2N(23) = 4.46, p < 0.01$), but not for the L2 learners ($t1L2(35) = 0.872, p = 0.389; t2L2(71) = 0.768, p = 0.445$), reflecting the fact that in the GEN conditions the natives read the (fourth segment of) high-attachment sentences much faster than the one in low-attachment sentences (see Table 6.10.), whereas the L2 learners showed no such preference. In the PP conditions (PP-high vs. PP-low), on the other hand, there was a significant low-attachment preference for both participant
groups \((t_{1N}(19) = 2.49, \ p < 0.04; t_{2N}(23) = 1.407, \ p = 0.173; t_{1L2}(35) = 3.859, \ p < 0.001; t_{2L2}(71) = 3.760, \ p < 0.001)\).

The three-way comparisons performed on the RTs from the L2 learners on the fifth and sixth segment with ‘Language’ (Spaniards vs. Germans vs. Russians) treated as a between-subjects factor and ‘Antecedent’ (genitives vs. prepositions) and ‘Attachment’ (high vs. low) as within-subjects factors showed that there were no significant differences between the three groups and, therefore, they were collapsed into one. A three-way ANOVA (with ‘Antecedent’ and ‘Attachment’ as within-subjects factors and ‘Group’ as a between-subjects factor) was performed on the RTs of the fifth segment in order to compare the L2 learners with the native speakers.

The significant main effects and interactions for the fifth segment are a subset of those obtained for the fourth segment. In particular, there are no effects that were not already present at the fourth segment. Instead, some effects from the fourth segment such as (Attachment \(\times\) Group and Antecedent \(\times\) Group) are either absent or weaker on the fifth segment. These observations suggest that the effects on the fifth segment are due to a spill-over from the ones originating at the critical (i.e. the fourth) segment. On the sixth segment, there were no statistically significant main effects or interactions left.

Table (6.11.) shows the performance\(^{15}\) of each group on the comprehension questions.

The comparison between the three L2 groups showed that they exhibited a parallel behaviour in terms of their error performance. The comparison between the native speakers and the L2 learners did not reveal any significant results apart from a significant interaction between

```
<table>
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<th>Subjects</th>
<th>G-High</th>
<th>G-Low</th>
<th>P-High</th>
<th>P-Low</th>
</tr>
</thead>
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<tr>
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</tr>
<tr>
<td>Russians</td>
<td>0.81</td>
<td>0.69</td>
<td>0.74</td>
<td>0.83</td>
</tr>
</tbody>
</table>
```

Table 6.11. Experiment 7: Performance on the comprehension question for each language group.
‘Antecedent’ and Attachment’ \( (F1(1,54) = 5,141, \ p < 0,03; F2(1,54) = 7,749, p < 0,03) \).

6.2.4.2. Summary The overall results of the SPR task are parallel to those of the acceptability judgement task. In both experiments, the L2 learners showed the same attachment preferences as the native speakers in the PP condition, but not in the genitive condition. That is, when the RC antecedent had a DP + PP structure with the lexical preposition me ‘with’, all participant groups preferred to attach the RC to second noun. By contrast, when the RC antecedent contained a genitive, the native speakers showed a clear preference to attach the RC to the first DP, whereas the L2 learners of Greek did not show any statistically significant preference for either attachment type. Moreover, the three groups of L2 learners exhibited similar attachment patterns irrespective of their different first languages in both self-paced reading and acceptability judgement tasks.

6.2.5. General discussion Recall that the first research question of this study was whether L2 learners display native-like parsing routines. For the data from the preposition condition the answer to this question is positive. Both the native speakers and the L2 learners of Greek manifested the same parsing patterns as far as the PP condition was concerned. On the other hand, the data from the genitive condition indicated the answer to this question is negative, since the robust high-attachment preference observed in the native speakers of Greek for the genitive condition was not obtained in the groups of L2 learners. This raises the question of why the L2 learners exhibit different parsing routines than the native speakers.

One possibility is that the divergent parsing strategies between native speakers and L2 learners of Greek are due to the L2 learners’ incomplete acquisition of Greek. However, I think that this is a rather unlikely explanation. Note that it was established independently (through grammaticality and acceptability judgement tests) that the L2 learners who participated in the present study are competent in Greek. First, all the subjects have been exposed to Greek for a long time (11,21, 14 and 4,3 years for the Spanish, German and Russian group respectively) and they all reported that they were using Greek in their everyday life. Second,
their performance on the proficiency test was very good (75.30, 73 and 71.90 out of 80 for the Spanish, German and Russian group respectively). Third, the Grammaticality Judgement test on the RCs showed that the L2 learners were able to judge the grammaticality of sentences containing RCs and to detect errors associated with the well-formedness of RCs in Greek. Though the subjects did not perform equally well on all the structures tested in the Grammaticality Judgement task, their performance on Subject-RCs that were used in the SPR task was very good (correct performance on S-RCs: 98.9%, 96.8% and 94% 80 for the Spanish, German and Russian group respectively). In addition, the Grammaticality Judgement task also showed that RCs with two antecedents form part of the L2 learners’ grammar of Greek (correct performance: 93.35%, 88.4% and 85% for the Spanish, German and Russian groups respectively). Finally, the Acceptability Judgement task also indicated that the L2 learners were able to detect gender agreement violations between the nouns that preceded the RC and the past participle, which is a crucial element for the comprehension and the attachment of the RC. Hence, it is unlikely that the observed differences between native speakers and L2 learners in their processing preferences can be directly attributed to corresponding differences in their knowledge of grammar. On the contrary, our result suggests that parsing mechanisms may be dissociated from grammatical knowledge in L2 learners.

Another possibility might be that L2 learners are influenced by the parsing mechanisms of another L2, e.g. their knowledge of English, and that they transfer parsing mechanisms from their L2 English to their L2 Greek. Off- and on-line studies on RC attachment preferences have shown that English manifests either a low-attachment preference even with antecedents involving the non theta-assigning preposition of or no preference for either type of attachment. Hence, one might argue that the results obtained in the present experiments are due to the influence of English. However, this possibility is not very likely, for four reasons. First, all participants’ knowledge of Greek is more advanced than their knowledge of English. Transfer of parsing mechanisms from the weaker L2 towards the stronger L2 would not be expected. Second, the subjects are heterogeneous with respect to their knowledge of English. Recall from section 6.3.1 that the L2 learners have different levels of proficiency
in English. Third, all participants were living in Greece and used Greek in their everyday life when the experiments took place. On the contrary, English was not used in everyday communication and was not an ‘active’ language when the experiments were conducted. Therefore, it is unlikely that parsing strategies are transferred from a language that is not used at all towards a language that an L2 learner uses on a daily basis. Finally, if English was responsible for the processing differences found between the native speakers and the L2 learners of Greek, then one would expect to find a positive correlation between the knowledge of English and the tendency to attach RCs low. However, this is not supported by the results, because, though the Spaniards’ proficiency in English is much lower than the one of Germans, the tendency to attach low was greater for the Spanish than the German subjects (cf. Table 6.5).

The possibility that linguistic differences could account for the data from the L2 learners can also be ruled out. More particularly, German (Hammer, 1983) and Russian (Wade, 1992) have a post-nominal morphologically expressed genitive similar to the one existing in Greek, as shown below:

\[(47)\]  
\[\text{a. i steghi tu spitju} \]  
\[\text{the roof the-GEN house-GEN} \]  
\[\text{b. das Dach des Hauses} \]  
\[\text{the roof the-GEN house-GEN} \]  
\[\text{c. крьша дома (krisha doma)} \]  
\[\text{roof house-GEN} \]  
\[\text{‘the roof of the house’} \]

However, German can also express possession by the von (of), as indicated below:

\[(48)\]  
\[\text{a. das Dach vom Haus} \]  
\[\text{‘the roof of the house’} \]

Spanish does not have morphologically expressed genitives (De Bruyne and Pountain, 1995); rather the equivalent construction is formed with the preposition de (of), as illustrated below:

\[(49)\]  
\[\text{el techo de la casa} \]  
\[\text{‘the roof of the house’} \]
One might argue that Spanish/German/Russian learners of Greek showed no preference for either type of attachment in the genitive condition because of the difficulties the subjects experienced in processing RCs with a genitival complex antecedent since the subjects’ first languages have different kinds of genitives. Either they do not have morphologically expressed genitives, like Spanish, or they have other means of expressing genitival relationships, like German. However, I do not think that such an account covers the whole range of the results adequately. Notice that if the L2 learners had experienced difficulty with genitives in Greek, then this effect should have been emerged from the second segment onwards where the complex DP appeared. However, such an effect was not found. Moreover, even though Russian has only one post-nominal genitive like Greek, Russian subjects showed parallel patterns to those of Spanish and German subjects. Besides, the results from the acceptability judgement task do not support such an interpretation since it was the preposition condition that yielded the lowest acceptability scores.

Consider, finally, the possibility that the lack of an attachment preference for constructions with genitives results from L1 transfer. The studies conducted in German and Russian (Hemforth et al., 1996; 1998; Kempe and Radach, 1993) thus far have shown an N1-attachment preference for RCs with these constructions. In Spanish, many studies have also reported a high-attachment preference, at least for sentences disambiguated via gender information as the ones tested in the present experiments (Carreiras and Clifton, 1993; 1999; Cuetos and Mitchell, 1988; Cuetos et al., 1996; Gilboy et al., 1995). If adult L2 learners directly transferred their L1 processing preferences to the L2, they should have shown a high-attachment preference for the test sentences with genitive antecedents. Notice, however, that the L2 group did not show an attachment preference for either site, and hence a simple direct transfer explanation can be ruled out.

Therefore, the lack of attachment preferences for the L2 learners cannot be due to incomplete acquisition of the relevant grammatical constructions, intervention of processing strategies from another second language, transfer effects or the different ways used to express genitive in the subjects’ first languages. Let us now turn to the predictions of the
various parsing models and see whether they can account for the present findings.

Recall that the Tuning theory predicts that Spanish, German and Russian learners of Greek should show a low-attachment preference for constructions with PPs and a high-attachment for genitive constructions. The results of the SPR task verified only part of this prediction, namely the one regarding the PP condition. Thus, according to Tuning, the low-attachment preference that the L2 learners showed in the PP condition can be attributed to the fact that the subjects’ accumulated experience in both their native and target languages indicated that the RC is most frequently attached low when preceded by an antecedent incorporating a PP. However, the predictions of Tuning were falsified by the results from the L2 learners on the genitive condition. More specifically, in the genitive condition a high-attachment preference was not obtained, as Tuning predicted. Of course, one might argue that a preference exists, which the present experiment was unable to detect. Notice, however, that a strong low-attachment preference was obtained for all L2 groups in the preposition condition, which ensures that the task was sensitive enough to capture the subjects’ RC attachment preferences. The fact that the high-attachment sentences did not show an advantage in either language group is problematic for an exposure-based account such as Tuning, because it cannot be attributed to frequency data from the subjects’ experience in their first and second languages. Hence, I think these results indicate that the L2 processing strategies cannot be, at least totally, determined by the accumulation of statistical records in the two languages.

Furthermore, the Anaphor Resolution model cannot account for the data for the genitive condition. Recall that the Anaphoric Binding strategy should incur low-attachment preference. However, such a result was not obtained, as the L2 learners manifested no preference for either high or low-attachment. Nevertheless, one might argue that the Anaphoric Binding was not found to operate in this study merely because the subjects have not acquired the properties of *pu* (that) as a complementizer and they rather treat it as a relative pronoun. Notice that if this was true then a high-attachment preference should be obtained, which was not found either. In addition, the grammaticality
judgement task showed that the subjects were able to deal with *pu*-RCs in Greek and actually in some conditions the Germans were even better than the Spanish subjects were. This undermines the possibility that the operation of the Anaphoric Binding principle accounts for the data from the L2 learners.

Consider now the predictions of the Recency/Predicate Proximity model. Recall that this model predicted high-attachment preferences for both the genitive and the PP conditions. Neither condition yielded high-attachment preference and, thus, the competition of Recency and Predicate Proximity cannot explain the L2 data.

One parsing model that can account for the L2 data is Construal. Construal predicts that the thematic domain hypothesis should be operative in L2 processing since it is supposed to be a universal component of the parser. This prediction was confirmed by the data in two respects. First, L2 learners’ processing choices were found to be affected by thematic considerations in the same way as native speakers were. Thus, these findings indicate that the L2 learners provide evidence in support of the universality of the thematic domain hypothesis. Moreover, the L2 learners’ data from the genitive condition can be accounted for by Construal, because the preference for neither attachment site can be due to the fact that both nouns belong to the same thematic domain and, therefore, both nouns are available to host the RC. Notice, however, that if the L2 learners’ preference for neither attachment site in the genitive condition is due to the postulation of the thematic domain hypothesis, it is not clear how the native speakers’ clear high-attachment should be explained. One possible solution is to suggest that the N1-attachment preference found with native speakers is due to the early effects of Relativised Relevance (cf. section 4.2.3). On the other hand, such factors did not affect the L2 learners’ decisions, because L2 sentence processing is slower and maybe also less automatised than L1 parsing, in that the integration of various information types is more costly, slower and more conscious in L2 than in L1 sentence processing (cf. Favreau and Segalowitz, 1982; 1983; Fernández, 2003; Segalowitz, 1986; 2003).

A recent account for L2 sentence processing is the ‘shallow’ structure hypothesis (Clahsen and Felser, 2006), according to which there are qualitative differences between L1 and L2 processing, in that the syntactic
representations produced by L2 learners during sentence comprehension are ‘shallower’ and less detailed than those of native speakers. This hypothesis is based on the observation that L2 sentence processing seems to be guided by lexical/semantic cues rather than syntactic information. For illustration purposes consider the present findings and also those from Felser et al. (2003) study. Clahsen and Felser (2006) and Papadopoulou and Clahsen (2003) attribute the native speakers’ attachment preferences in the genitive condition to structural parsing principles, namely Late Closure (for English) and Predicate Proximity (for Greek). On the other hand, in the same condition, L2 learners of both English and Greek were found to have no preference for either analysis. Clahsen and Felser, also based on parallel findings from filler-gap dependencies (Marinis et al., 2005), argue that this result is due to the fact that structural information does not guide L2 ambiguity resolution strategies.

Finally, let us now see how the model put forward in section 4.2.3 can accommodate the L2 findings. It has been argued that in highly inflected languages like Greek the parser makes extensive use of lexical and morphological cues to process the input, whereas as a locality principle like Late Closure is used as a ‘last-resort’ strategy and only when such information is not available. Assuming that when processing a second language the parser follows similar mechanisms, the L2 data can be interpreted if the effects from morphological information on parsing are not as automatic as they are in L1 parsing. To make this more explicit, let us assume that the parser’s accessibility to information activated by morphological analysis – i.e. activation of arguments – is not as automatic when parsing L2 input as is when processing sentences in the first language. In the PP condition, lexical cues favour N2-attachment and this is shown in the actual low-attachment preference found for this condition with L2 learners. Notice that in this condition morphological cues do not have an effect on the parsing choices, because any biases supported by other sources of information, like morphological or pragmatic, are ruled out by the low-attachment preference favoured by the thematic domain hypothesis. On the other hand, in the genitive condition, the cues provided from the Lexicon do not offer any biases for either attachment site. In the case of native speakers, it is the immediate and automatic effects that morphological information has on sentence
processing that result in the attested N1-attachment preference. L2 learners, however, might not be able to use morphological cues automatically and immediately so that other routines get activated, and as a result, they process the ambiguous RCs indeterministically, as they are not assisted by lexical cues to choose between the two alternatives. Papadopoulou and Tsimpli (2005b) also found that L2 learners of Greek, though able to use morphological information to detect ungrammaticalities, did not employ such information to resolve structural ambiguities in the same way as native speakers did. Such a result supports the hypothesis that the processing routines adopted due to morphological cues are not as active in L2 parsing as they are in L1. The role of morphology in L2 has also been emphasised by some accounts for L2 acquisition (cf. Lardiere, 1998a; 1998b; Prévost and White, 2000), which argue that in the L2 acquisition process the mapping between the syntactic and the morphological module is indirect resulting in the persistently incorrect production of certain grammatical properties.

Based on the evidence that is thus far available it is difficult to distinguish among the possible explanations of the L2 data offered in this section. However, what all three accounts have in common is the fact that L2 learners use lexical cues to process sentences on-line in the same way as native speakers do, whereas when no such information is available they seem to be unable to make use of other sources of information, whether this information is purely structural, morphological or related to the interpretation of the sentence. Undoubtedly more research is needed to further examine possible differences between L1 and L2 sentence processing, to investigate the development of parsing mechanisms in a second language and to explore the role of morphology in L2 parsing.

6.3. SUMMARY

In this chapter, off-line and on-line experiments on RC attachment preferences with L2 learners of Greek have been presented and discussed. The L2 learners of Greek who participated in the experiments were highly proficient, as this was evident in biographical questions, proficiency scores, performance on the grammaticality and acceptability judgement tasks as well as on the questions to the filler items in the SPR
task. The results from the acceptability judgement and SPR tasks with the L2 learners were directly compared with those of native speakers. The comparison showed that, though there was a certain amount of overlap in the attachment decisions of the native and L2 speakers of Greek, there were also differences despite the fact that both the native and the target languages exhibit the same attachment preferences. The same pattern of results was found in two different tasks, namely an acceptability judgement and a SPR task. Moreover, the differences between the L1 and L2 data could not be attributed to direct transfer parsing mechanisms, incomplete knowledge of the L2 grammar, different constructions existing in the native and target languages or interference of parsing strategies from another second language. The results from the L2 learners also suggested that parsing decisions in the second language were not determined by the accumulated experience of the way ambiguities are resolved in the first and the target language. Such a result is problematic for the Tuning theory, which has to modify its claims regarding L2 processing at least. In addition, it was also shown that the Anaphoric Binding principle failed to explain the data from Greek as L2 as it did so with the L1 data, whereas the Recency/Predicate proximity did not provide an account for the entire data set either.

In addition, the results obtained in the present experiments are compatible with previous findings reported in the literature. First of all, the fact that speakers of an L2 are slower readers than L1 speakers has been widely reported in the literature (Favreau and Segalowitz, 1982; 1983; Fernández, 2003; Juffs and Harrington, 1995; 1996). In addition, Frenck-Mestre and Pynte (1997) found that L2 learners whose first and second languages exhibited the same parsing behaviour slightly differed from native speakers in the parsing routines they used. Notice that this result is parallel to the findings of the experiments reported here. Fernández (2003), Dussias (2001; 2003), Roberts (2003), Felser et al. (2003) also found that in certain conditions L2 learners exhibited not clear processing preferences.

Finally, the data from the L2 learners of Greek also indicated that parsing mechanisms are dissociated from grammatical knowledge. It was found that advanced learners of Greek who have acquired the relevant grammatical properties of the construction involved still differ
from native speakers in the way they parse sentences. This suggests that parsing strategies may develop independently from grammatical knowledge. This, however, needs to be interpreted with caution, because it is controversial whether subjects’ grammaticality judgements reflect their underlying grammatical knowledge. Nonetheless, the examination of the L2 learners’ grammatical knowledge with respect to the phenomena under investigation is essential. Unfortunately, this is an aspect that has been neglected by psycholinguistic studies on L2 processing and is worth further investigation.

Finally, it has been argued that L2 sentence processing is similar with L1 parsing, in that both first and second language speakers base their attachment preferences on lexical considerations as these are defined by universal constraints such as the thematic domain hypothesis. On the other hand, when such information is not offered, the L2 readers experience difficulties to make use of other informational resources whether these are assumed to be structural, morphological or interpretative.

NOTES

1 I use the term ‘L2 learners’ to refer to individuals who grew up as monolinguals and who started acquiring the second language at school and/or after puberty, that is after the ‘critical period’ (for critical period effects on L2 acquisition see Bialystok, 1997; Eubank and Gregg, 1999; Johnson and Newport, 1989 among others). Furthermore, in this chapter I will only review studies that investigated the ambiguity resolution strategies employed by L2 learners and not by bilinguals. For bilingual sentence processing see Dussias (2001) and Fernández (2003).


3 Sentences (24a’) and (24b’) are the French translations of sentences (24a) and (24b).

4 The order of the two DPs within the complex DP was reversed in the PP condition to make the sentences sound more natural in English. For more details on the design of the experiments see Felser et al. (2003).

5 Part of the results reported in this chapter has been published in Papadopoulou and Clahsen (2003).

6 AFE stands for age of first exposure.

7 TI stands for time spent in Greece and INS for formal instruction in Greek. Both the time the subjects spent in Greece and the amount of formal instruction they got in
Greek are calculated in years.

The Proficiency test has been developed by and is available from the Teaching Centre of Greek as a Foreign Language at the University of Athens.

PR.LEV. stands for Proficiency Level.

See Appendix I for the entire set of the materials in Greek and their English translations.

For the relativization process in Greek, see chapter 5, section 5.2.1.

The entire list of the materials can be found in Appendix III.

The acceptability judgement scores for each particular individual can be found in Appendix III.

The results from the native speakers are the same as the ones reported in section 4.2.2, Table 4.3.

The closer the figures are to 1 the better their performance was.

Notice that, if Spanish is assumed to exhibit low-attachment preferences (cf. Fernández, 2003; Carreiras, Betancort and Meseguer, 2001), one might, then, argue that the preference for neither attachment site found with Spaniards for genitives is attributed to the fact that the Spanish learners are in a transitional stage, in which, due to the divergent frequency records received in the two languages, they no longer apply the L1 parsing strategies but they have not fully adopted the processing routines of the target language either (see also Dussias, 2001: 175–175; Dussias, 2003; Frenck-Mestre, 2005: 192). Even though this possibility cannot be totally excluded, such an explanation does not offer an account for the findings from the Germans and the Russians. In other words, if the Spanish learners rely on frequency records to process L2 input, then the German and the Russian learners should do the same. But they do not.
The main objective of this study was to explore whether there are cross-linguistic differences in parsing by providing evidence from the attachment preference patterns that speakers of Greek manifest in sentences such as (1) and (2):

(1) Mja kiria kitakse ton ekdhoti
   a-NOM-SG-F woman-NOM-F looked the-ACC-SG-M editor-ACC-M
   tu sighraftea pu itan sto dhomatio.
   the-GEN-SG-M writer-GEN-M that was in-the-ACC-SG-N room-ACC-N
   ‘A woman looked at the editor of the writer who was in the room.’

(2) Mja kiria kitakse ton ekdhoti
   a-NOM-SG-F woman-NOM-F looked the-ACC-SG-M editor-ACC-M
   me to sighraftea pu itan sto dhomatio.
   with the-ACC-SG-M writer-ACC-M that was in-the-ACC-SG-N room-ACC-N
   ‘A woman looked at the editor with the writer who was in the room.’

Off-line and on-line experiments were carried out with native speakers as well as L2 learners of Greek in order to examine RC attachment preferences. The findings were used to assess universal, parameterised and experience-based models of sentence processing. Moreover, the implications of the results for the universality of the parser were considered and discussed. Furthermore, the experiments with L2 learners have been used to compare L1 and L2 sentence processing and to provide explanations for possible differences. In addition, the possibility that discourse factors affect attachment preferences was investigated by carrying out experiments in which the target sentences were incorporated in appropriately biasing contexts. These results were used to differentiate between modular and interactive models of parsing.

CHAPTER 7

CONCLUSION
Moreover, the grammatical properties of Greek offered a nice example to test the divergent predictions of two ‘parameterised’ models of sentence processing, Anaphor Resolution and Recency/Predicate Proximity. The RCs tested in this study were all headed by the complementiser *pu* (that) and, according to the predictions of the Anaphor Resolution model, languages in which RCs are not obligatorily introduced by a relative pronoun should exhibit a low attachment preference. This contrasts with the claims of Recency/Predicate Proximity model, which predicts a high attachment preference for both (1) and (2) due to the fact that in Greek distance is allowed between the verb and its complements.

The results from the native speakers with sentences presented in isolation showed that sentences such as (1) yielded a high attachment preference whereas the reverse was found with sentences such as (2). This clearly showed that neither Anaphor resolution nor Recency/Predicate Proximity could account for the data. In principle, these results are compatible with Construal and are accounted for by the thematic domain hypothesis and the Relativised Relevance principle. However, an alternative explanation has been offered, which builds on the work by Frazier and Clifton (1996; 1997) and Gibson et al. (1996a; 1999) and attempts to provide a more plausible account for the Greek data. More specifically, it has been argued that the routines adopted to parse L1 input are affected by language-specific properties. In highly-inflected languages, morphological cues are extensively employed by the parser to analyse the material and this results in the activation of semantically-oriented strategies on one and in ‘flatter’ structures on the other. Furthermore, lexical cues also guide parsing choices and their effects, at least when they relate to the segmentation of the input into thematic domains, are assumed to be universal. The fact that cross-linguistic variation does exist in sentence processing is further supported by the fact that in Greek even primary phrases do not seem to be processed along the lines of a universal parsing strategy like Late Closure but instead divergent processing mechanisms are observed (cf. Papadopoulou and Tsimpli, 2005a). Whether such mechanisms are triggered by morphological information or rather they are related to some other effects remains to be seen.

The L2 study examined RC attachment preferences with L2 learners whose first languages manifest the same pattern of attachment prefer-
ences as Greek. Hence, the L2 learners tested in the present study were exposed to languages in which the RC attachment ambiguity was resolved in parallel ways and, consequently, the L2 learners’ statistical records about the resolution of the RC attachment ambiguity should not differ from those of the native speakers. However, the results indicated that the L2 learners differed from the native speakers in their attachment preferences. This finding argues against experience-based models of sentence processing, such as Tuning, and suggests that the parsing choices cannot be totally determined by exposure facts.

The results from the L2 learners revealed that in sentences like (2) L2 learners exhibited processing patterns similar to the ones of native speakers, namely a low attachment preference. This suggests that L2 sentence processing is guided by lexical cues as is L1 parsing. On the other hand, in sentence like (1) the L2 learners’ processing routines differed from the ones of native speakers, in that they exhibited no preference for either attachment site, which contrasts with the clear high attachment preference found with native speakers. Even though it is not easy to explain why a certain effect has not appeared, several possibilities have been offered in chapter 6. Thus, the no preference for either attachment site with L2 learners might be due either to the fact that the syntactic representations produced by L2 learners on-line are ‘shallower’ as opposed to those of native speakers (cf. Clahsen and Felser, 2006) or to the difficulties L2 learners experience when they have to rapidly integrate various informational sources, i.e. Relativised Relevance, in their analysis. Alternatively, it has been proposed that the differences between L1 and L2 parsing might be due to the fact that surface morphological cues are not used by L2 learners in the same way as by native speakers, in that the link between these cues and the activation of certain processing mechanisms might not be fast and direct. Needless to say that more research is needed to further investigate the role of morphology in parsing and also to explore possible morphological effects on the establishment of syntactic relations during on-line sentence comprehension.

Furthermore, the L2 learners were found to use different parsing routines from the native speakers, even though their responses in the grammaticality judgement task showed that they knew the relevant
constructions. This indicates that the parser might be dissociated from the grammar in the second language.

Finally, the results from sentences presented in appropriately biasing contexts suggested that sentence processing is multiple-stage. Namely, discourse-level information affects final interpretations, whereas the way it influences initial parsing choices is constrained by lexical cues.
In Appendix I the experimental sentences from experiments 1, 2, 3 and 4 are presented. In experiment 1 and 3 the sentences were presented in isolation, whereas in experiment 2 and 4 they were incorporated into appropriately biased contexts. In both experiments the complex DP incorporated either a genitive or a PP. Moreover, the gender of the adjective/past participle agreed either with the first or the second noun via morphological information. The texts included two referents either for the first or the second DP, resulting in a high and low attachment bias respectively. The Greek items are presented together with their literal English translations.

ITEM 1

Text

Η αυλή του σχολείου ήταν γεμάτη κόσμο. Παιδιά, γονείς και δάσκαλοι περίμεναν ν’ αρχίσει η γιορτή. Η ώρα ήταν 10:30 και η γιορτή έπρεπε να είχε αρχίσει από τις 10. Μια μαθήτρια συζητούσε με δύο δασκάλους της / Ένας δάσκαλος συζητούσε με δύο μαθητριές του. Η μαθήτρια και ο ένας δάσκαλος / Ο δάσκαλος και η μία μαθήτρια φαίνονταν φανερά εκνευρισμένοι. Ο άλλος δάσκαλος / Η άλλη μαθήτρια παρακολούθησε τη συζήτηση χωρίς να μιλάει.

Target sentence

Ο διευθυντής κοίταξε τον δάσκαλο της μαθήτριας / με τη μαθήτρια που φαίνόταν πολύ εκνευρισμένος/η με την καθυστέρηση της γιορτής.
Text
The schoolyard was crowded. Kids, parents and teachers were waiting for the celebration to start. It was 10:30 and the celebration had to have started at 10. One pupil was talking with two of her teachers / A teacher was talking with two of his pupils. The pupil and one of the teachers / The teacher and one of the pupils seemed very upset. The other teacher / The other pupil followed the conversation without speaking.

Target sentence
The headmaster looked at the teacher (masc) of / with the pupil (fem) that seemed very upset (masc / fem) because of the delay of the celebration.

ITEM 2
Text
Όταν η τελευταία μέρα για το αγώνισμα της ενόργανης γυμναστικής και το στάδιο ήταν γεμάτο κόσμο. Μετά τα επεισόδια μεταξύ φιλάθλων και αστυνομικών η επιτροπή αποφάσιζε αν θα συνεχιστούν οι αγώνες. Μία αθλήτρια και δύο προπονητές της / Ένας προπονητής και δύο αθλήτριες του κάθονταν στο πάγκο της ομάδας τους. Η αθλήτρια και ο ένας προπονητής / Ο προπονητής και η μία αθλήτρια φαίνονταν πολύ αγχωμένοι για την απόφαση της επιτροπής. Ο άλλος προπονητής / Η άλλη αθλήτρια προσπαθούσε να τους καθησυχάσει.

Target sentence
Ο επόπτης παρακολουθούσε τον προπονητή της αθλήτριας / με την αθλήτρια που φαινόταν αρκετά αγχωμένος / η για την απόφαση της επιτροπής.

Text
It was the last day for the game of gymnastics and the stadium was crowded. After the fights between fans and policemen, the committee board was making their mind whether the games would go on. An
athlete and two of her trainers / A trainer and two of his athletes were sitting on the bench of their team. The athlete and one of the trainers / The trainer and one of the athletes seemed very stressed about the decision of the committee board.

Target sentence
The supervisor was looking at the trainer (masc) of the athlete (fem) that seemed enough preoccupied (masc/fem) because of the decision of the committee board.

ITEM 3

Text
'Ήταν Σάββατο απόγευμα και στο κομμωτήριο είχε πολύ κόσμο. Οι υπάλληλοι έτρεχαν από δω κι από κει για να ικανοποιήσουν όλους τους πελάτες. Μία πελάτισσα και δύο κομμωτές της / 'Ένας κομμωτής και δύο πελάτισσές του κοιτούσαν σ’ ένα περιοδικό το χτένισμα μιας διάσημης ηθοποιού. Η πελάτισσα και ο ένας κομμωτής / Ο κομμωτής και η μία πελάτισσα φαίνονταν φανερά απογοητευμένοι. Ο άλλος κομμωτής / η άλλη πελάτισσα έβρισκε το χτένισμα υπέροχο.

Target sentence
'Ένας υπάλληλος πλησίασε τον κομμωτή της πελάτισσας / με την πελάτισσα που φαινόταν μάλλον απογοητευμένος/η από το χτένισμα.

Text
It was Saturday evening and the hairdresser’s salon was crowded. The clerks were very busy trying to serve the customers. One customer and two of her hairdressers / One hairdresser and two of his customers were looking at the hairstyle of a famous actress in a magazine. The customer and one of the hairdressers / The hairdresser and one of the customers seemed very disappointed. The other hairdresser / The other customer really liked the hairstyle.
Target sentence

A clerk watched the hairdresser (masc) of/with the customer (fem) that seemed rather disappointed (masc/fem) by the hairstyle.

ITEM 4

Text

The entrance of the university was closed. The student union had decided the occupation of the building as protest for the new educational measures. A professor and two of her students / A student and two of his teachers were having an argument. The professor and one of the students / The student and one of the professors seemed very angry. The other student / The other professor was trying to find a compromise.

Target sentence

The journalist approached the student (masc) of/with the professor (fem) that seemed very angry (masc/fem) because of the new educational measures.
ITEM 5

**Text**

Everybody in the company was preoccupied because of the government's new economical measures. Everybody was worried about the consequences of these measures. A manager and two of his secretaries / Two managers and one of their secretaries were speaking in whispers. The manager and one of the secretaries / The secretary and one of the managers seemed very pessimistic about the future of the company. The other secretary was more optimistic.

**Target sentence**

*The head smiled at the secretary (fem) of/with the director (masc) that seemed rather pessimistic (masc/fem) for the future of the company.*

ITEM 6

**Text**

Στο στούντιο γινόταν χαμός. Το έργο που ετοίμαζαν ήταν μια μεγάλη παραγωγή και όλοι είχαν άγχος για την επιτυχία του.
Everybody in the studio was very busy. The film they were preparing was a big production and everybody was stressed for its success. A director and two of her assistants / Two directors and one of their assistants re-saw a scene. The director and one of the assistants / The assistant and one of the directors seemed displeased with it and wanted to re-shoot the scene. The other assistant / The other director was trying to convince them that the scene was not bad.

The actress asked the assistant (fem) of/with the director (masc) that seemed very displeased (masc/fem) with the scene.

ITEM 7

Text

Μέσα στο γραφείο του πρωθυπουργού ήταν συγκεντρωμένα όλα τα μέλη της κυβέρνησης. Η κατάσταση ήταν κρίσιμη, διότι η χώρα είχε παραλύσει από τις συνεχείς απεργίες. Μία υπουργίνα και δύο σύμβουλοι της / Δύο υπουργίνες και ένας σύμβουλός τους σχολίαζαν τα γεγονότα. Η υπουργίνα και ο ένας σύμβουλός / Ο σύμβουλός και η μία υπουργίνα φαίνονταν απογοητευμένοι από την κατάσταση. Ο άλλος σύμβουλος / Η άλλη υπουργίνα τους άκουγε χωρίς να μιλάει.
All the members of the government were in the Prime Minister’s office. The situation was crucial since the country was falling apart because of a series of strikes. One minister and two consultants / Two ministers and one of their consultants commented on the events. The consultant and one of the ministers / The minister and one of the consultants seemed disappointed by the situation. The other consultant / The other minister was listening without saying anything.

A woman observed the consultant (masc) of/with the deputy (fem) that seemed enough disappointed (masc/fem) by the situation.

ITEM 8

Text

'Htan para'mon'ēs Xristou'gēnnon. Olo'i mēsa sto 'graffeio perimēn an teleio'soun tì doulei'ā tōu kai na pānē gia tα teleu'tai'ā tōu' ψōnía. Mía upallēl'ōs kai dúo proi'stάme'nōi tēs / 'Enas proi'stάme'nos kai dúo upallēl'ōi tōu' mi'ōsān gia ta skē'di'ā tōu' gia tis diakopē'z. H upallēl'ōs kai o 'enas proi'stάme'nos / O proi'stάme'nos kai' mía upallēl'ōs' fainontan polū ikanopoimitē'menoi me ta skē'diα tōu'. O állo's proi'stάme'nos / H álλ̉̆h upallēl'ōs'' den eīχε i'daítera skē'diα gia tis diakopē'z.

Target sentence

'Enas kýrios apodokǐ'mase to'n proi'stάme'nο to'n upallēl'ōu / me tīn upallēl'ō open'ousan arke'tā ikanopoimē'menōs / η me ta skē'diα to'n diakopwν to'n/της.
Text
It was Christmas. Everybody in the office was looking forward to finishing with their work and going shopping. One clerk and two of her supervisors / One supervisor and two of his clerks were discussing their holidays plans. The clerk and one of the supervisors / The supervisor and one of the clerks seemed to be very satisfied with their plans. The other supervisor / The other clerk did not have any particular plans for Christmas holidays.

Target sentence
A man frowned-at the supervisor (masc) of/with the clerk (fem) that seemed enough satisfied (masc/fem) with his/her holidays plans.

ITEM 9

Text
Everybody in the lab was looking forward to the results from the last experiment. These results would judge the progress of the research. A chemist and two of his collaborators / Two chemists and one of their
collaborators had to measure the results. The chemist and one of the collaborators / The collaborator and one of the chemists seemed to be absorbed by the measuring of the results. The other collaborator / The other chemist was watching with excitement.

Target sentence

The dean asked-for the collaborator (fem) of/with the chemist (masc) that was totally absorbed (masc/fem) in the measuring of the results.

ITEM 10

Text

Everybody in the hospital was very busy. An urgent case had just arrived and they were making all the preparations to perform a very difficult operation. One doctor and two of his nurses / Two doctors and one of their nurses were talking about the operation. The doctor and one of the nurses / The nurse and one of the doctors seemed very stressed. The other nurse / The other doctor was trying to calm them.

Target sentence

A relative looked-at the nurse (fem) of/with the doctor (masc) that was very stressed (masc/fem) because of the operation.
ITEM 11

Text
A Christmas party had been organised by the centre of Psychological Health. Everybody was eating, drinking, singing and dancing. A patient and two of his psychiatrists / A psychiatrist and two of her patients were sitting together. The patient and one of the psychiatrists / The psychiatrist and one of the patients seemed to be very happy. The other psychiatrist / The other patient was watching the party without speaking.

Target sentence
A woman approached the psychiatrist (fem) of the singer (masc) that seemed very happy (masc/fem) with the party.

ITEM 12

Text
To γήπεδο ήταν γεμάτο κόσμο. Ήταν ο τελευταίος αγώνας για το πρωτάθλημα του μπάσκετ γυναικών. Στα αποδυτήρια οι αθλήτριες ετοιμάζονταν πυρηνικώς. Μία παίκτρια και δύο φυσιοθεραπευτές της / Δύο παίκτριες και ένας φυσιοθεραπευτής τους συζητούσαν για τον αγώνα. Η παίκτρια και ο ένας φυσιοθεραπευτής / Ο φυσιοθεραπευτής και η μία παίκτρια φαινόταν
The stadium was crowded. It was the last game for the championship of women basketball. In the locker-room, the athletes were getting ready. One player and two of her physiotherapists / Two players and one of their physiotherapists were talking about the game. The player and one of the physiotherapists / The physiotherapist and one of the players seemed to be quite optimistic about the result. The other physiotherapist / The other player was not sharing their optimism.

Target sentence

The coach watched the physiotherapist (masc) of/with the player (fem) that seemed enough optimistic (masc/fem) about the results of the game.

The coach watched the physiotherapist (masc) of/with the player (fem) that seemed very preoccupied (masc/fem) about something. (used in Experiment 2)
The fashion house, in which the most famous artists ordered their
clothes, was as usually full of people. A singer and two of her tailors /
Two singers and one of their tailors were examining an extremely
expensive piece of cloth. The singer and one of the tailors / The tailor
and one of the singers seemed excited about the cloth. The other tailor /
The other singer frowned on it.

A customer asked for the (masc) of/with the singer (fem) that
seemed very excited (masc/fem) about the cloth.
The discussion was intense in the office. A new issue had complicated things. An actress was talking with two of her solicitors / Two actresses were talking with one of their solicitors about the trial. The actress and one of the solicitors seemed to be optimistic about the case. The other solicitor / The other actress expressed her doubts.

Target sentence

A clerk looked-at the solicitor (masc) of/with the actress (fem) that seemed enough optimistic (masc/fem) about the case.

ITEM 15

Text

The participants of the conference were discussing the talks. One scientist and two of his research assistants / Two scientists and one of their research assistants were commenting on the talk of a well-known researcher. The scientist and one of the research assistants / The research assistant and one of the scientists seemed disappointed by the talk. The other research assistant / The other scientist really liked it.
Target sentence

A man looked-at the research assistant (fem) of/with the scientist (masc) that was rather disappointed (masc/fem) about the talk.

ITEM 16

Text

The shooting course was over. In the training room, there was a policeman who was talking with two of his trainers / there were two policemen who were talking with one of their trainers about a dangerous mission he/they was/were engaged in. The policeman and one of the trainers seemed very worried. The other trainer / The other policeman insisted that the mission was ordinary.

Target sentence

The Chief approached the trainer (fem) of/with the policeman (masc) that seemed very worried (masc/fem) about the mission.

ITEM 17

Text

An και η ώρα ήταν ήδη 10 το βράδυ, το προσωπικό του εμπορικού καταστήματος δεν είχε φύγει ακόμα. Ο ιδιοκτήτης και δύο
Even though it was already 10 o’clock in the evening, the personnel of the commercial enterprise were still there. The owner and two of his accountants were examining the books, because the tax assessment was due for the following day. The owner and one of the accountants were very preoccupied. The other accountant thought there was no reason to worry about.

A clerk observed the accountant (fem) of the owner (masc) that seemed very preoccupied (masc/fem) because of the tax assessment.
Target sentence
Ένας κύριος χαμογέλασε την οδηγό του ταξιδιώτη / με τον ταξιδιώτη που φαινόταν μάλλον αισιόδοξης για τον καιρό.

Text
The mountain refuge was crowded with travelers, who had to postpone their travel due to the bad weather. A traveler was talking with his two guides / Two travelers were talking with one of their guides about the bad weather. The traveler and one of the guides / The guide and one of the travelers seemed very optimistic about the weather. The other guide / The other traveler was not convinced.

Target sentence
A man smiled-at the guide (fem) of/with the traveler (masc) that seemed rather pessimistic (masc/fem) for the weather.

ITEM 19

Text
Μέσα στο γραφείο ήταν συγκεντρωμένοι πολλοί από τους οικονομικούς παράγοντες του τόπου για να συζητήσουν για τη μεγάλη οικονομική κρίση. Ένας επιχειρηματίας μιλούσε με τις δύο οικονομολόγους του / Δύο επιχειρηματίες μιλούσαν με μία οικονομολόγο τους για την τύχη αυτής της συνάντησης. Ο επιχειρηματίας και η μία οικονομολόγος / Η οικονομολόγος και ο ένας επιχειρηματίας φαίνονταν απαισιόδοξοι γι’ αυτή τη συνάντηση. Η άλλη οικονομολόγος / Ο άλλος επιχειρηματίας δε συμμετείχαν στην απαισιοδοξία τους.

Target sentence
Ένας κύριος πλησίασε την οικονομολόγο του επιχειρηματία/ με τον επιχειρηματία που φαινόταν κάπως απαισιόδοξης για τη συνάντηση.
Text
The rulers of the town had been gathered in the office to discuss the financial crisis. A businessman was talking with two of his economists. Two businessmen were talking with one of their economists about the fate of this meeting. The businessman and one of his economists seemed optimistic. The other economist and one of the businessmen seemed optimistic. The other businessman did not share their optimism.

Target sentence
A clerk approached the economist of with the businessman that seemed somehow pessimistic about the meeting.

ITEM 20
Text
Many editors had gathered in the well-known publishing house in order to decide about the final format of the encyclopaedia they were preparing. One editor with two of his sketchers. Two editors and one of their sketchers with were commenting on some sketches of the encyclopaedia. The editor and one of the sketchers. The sketcher and one of the editors
seemed displeased by the sketches. The other sketcher / The other editor found them pretty good.

Target sentence
A clerk watched the sketcher (fem) of/with the editor (masc) that seemed enough displeased by the sketches.

ITEM 21
Text
Στο χώρο της πυρκαγιάς είχαν μαζευτεί όλα τα τηλεοπτικά συνεργεία και προσπαθούσαν να καλύψουν το γεγονός. Ένας δημοσιογράφος με δύο φωτογράφους του / Δύο δημοσιογράφοι με μία φωτογράφο τους παρακολουθούσαν την εξέλιξη της φωτιάς. Ο δημοσιογράφος και η μία φωτογράφος / Η φωτογράφος και ο ένας δημοσιογράφος φαίνονταν ταραγμένοι. Η άλλη φωτογράφος / Ο άλλος δημοσιογράφος προσπαθούσε να τους ηρεμήσει.

Target sentence
Ένας κύριος φώναξε τη φωτογράφο του δημοσιογράφου / με τον δημοσιογράφο που φαινόταν πολύ ταραγμένη/ος από την πυρκαγιά.

Text
All the TV channels had gathered in the place fire and were reporting he event. A journalist with two of his photographers / Two journalists and one of their photographers were watching the progress of the fire. The journalist and one of the photographers / The photographer and one of the journalists seemed very upset. The other photographer / The other journalist was trying to calm them

Target sentence
A man called-to the photographer (fem) of the journalist (masc) that was very shocked (fem/masc) because of the fire.
ITEM 22

Text
The office of the Head was full of workers who were angry because of the delay of their payment. One worker was talking with two of her supervisors / Two workers were talking with one of their supervisors. The worker and one of the supervisor / The supervisor and one of the workers were shouting and seemed very angry. The other supervisor / The other worker was trying to calm them

Target sentence
A man looked-at the supervisor (masc) of the worker (fem) that seemed very angry (masc/fem) because of the delay of the payment.

ITEM 23

Text
Στο γραφείο του εκδότη ήταν μαζεμένοι ποιητές και εικονογράφοι για να αποφασίσουν για την τελική μορφή της ποιητικής ανθολογίας που ετοίμαζαν. Μία ποιήτρια με τους δύο εικονογράφους της / Δύο ποιητριες και ένας εικονογράφος τους
σχολίαζαν την εικονογράφηση του βιβλίου. Η ποιήτρια και ο ένας εικονογράφος / ο εικονογράφος και η μία ποιήτρια φαίνονταν απόλυτα ικανοποιημένοι. Ο άλλος εικονογράφος / η άλλη ποιήτρια διαφωνούσε μαζί τους.

Target sentence
Μία κοπέλα ζήτησε τον εικονογράφο της ποιήτριας / με την ποιήτρια που φαινόταν πολύ ικανοποιημένος / η από το βιβλίο.

Text
Many poets and illustrators had gathered in the editor’s office in order to decide about the final format of the poetic anthology they were preparing. A poet with her two illustrators / Two poets with one of their illustrators commented on the illustration of the book. The poet and one of the illustrators / The illustrator and one of the poets seemed absolutely satisfied. The other illustrator / The other poet disagreed with them.

Target sentence
A girl asked for the illustrator (masc) of / with the poet (fem) that seemed very satisfied with the book.

ITEM 24

Text
Ήταν η τελική πρόβα του έργου και στη σκηνή του θεάτρου επικρατούσε πανικός. ‘Ολοι ήταν φοβερά αγχωμένοι. Μία πρωταγωνίστρια και οι δύο ενδυματολόγοι της / Δύο πρωταγωνίστριες και ένας ενδυματολόγος τους κοιτούσαν το κουστούμι που θα φορούσε στην παράσταση. Η πρωταγωνίστρια και ο ένας ενδυματολόγος / ο ενδυματολόγος και η μία πρωταγωνίστρια φαίνονταν φανερά απογοητευμένοι από το κουστούμι. Ο άλλος ενδυματολόγος δεν το έβρισκε και τόσο κακό.

Target sentence
Ένας κύριος έψαχνε τον ενδυματολόγο της πρωταγωνίστριας / με την πρωταγωνίστρια που φαινόταν αρκετά απογοητευμένος / η από το κουστούμι.
It was the day of the final rehearsal and the stage of the theatre was crowded. Everybody was very stressed. One protagonist and two of her costume designers / Two protagonists and one of their costume designers were examining the costume she/they would wear for the performance. The protagonist and one of the costume designers / The costume designer and one of the protagonists seemed disappointed by the costume. The other costume designer / The other protagonist did not find it too bad.

Target sentence

A man was looking-for the costume designer (masc) of the protagonist (fem) that seemed enough disappointed (masc/fem) by the costume.

A man was looking-for the costume designer (masc) of the protagonist (fem) that seemed a bit tired (masc/fem) because of the intensive work.
In this Appendix, I will first present the Greek sentences used in the Grammaticality Judgement task (Experiment 5). The literal English translations will also be provided. In addition, the grammaticality scores per each particular individual for all the three L2 groups will be given.

A. EXPERIMENTAL SENTENCES

- Grammatical sentences
  - Subject RCs
  1. Αγόρασα το βιβλίο που προκάλεσε τόσες συζητήσεις στον Τύπο.
     I bought the book that was so much discussed by the Press.
  2. Χτες συνάντησα την τραγουδίστρια που μένει κοντά στο σπίτι μου.
     Yesterday I met the singer that lives close to my house.
  3. Ο άνθρωπος που ήρθε το πρωί στο γραφείο είναι ο πρώην άντρας μου.
     The man that came to the office this morning is my ex husband.
  4. Το κτίριο που καταστράφηκε από τον σεισμό ήταν ένα νεοκλασσικό του 19ου αιώνα.
     The building that was destroyed by the earthquake was a neo-classic building of the 19th century.
  5. Το άγαλμα της Νίκης που βρίσκεται στο μουσείο της Ολυμπίας είναι πράγματι εντυπωσιακό.
     The statue of Victory that is in the museum of Olympia is indeed impressive.
– Object RCs
1. Το ρολόι που έχασε χτες ήταν ένα πανάκριβο Rolex.
   The watch that (s)he lost yesterday was an extremely expensive Rolex.
2. Το νέο εκπαιδευτικό νομοσχέδιο που πρότεινε η κυβέρνηση προκάλεσε πολλές αντιδράσεις.
   The new educational law that the government proposed caused many reactions.
3. Η κοπέλα που συναντήσαμε πριν από λίγο είναι συμφωνητική μου.
   The girl that we met a few minutes ago is one of my classmates.
4. Αναγκάστηκε να ματαιώσει το ταξίδι που σχεδίαζε όλο τον χρόνο.
   (S)He had to cancel the journey that (s)he has been planning for a whole year.
5. Ποτέ δε μου έδωσαν πίσω τα χρήματα που τους είχα δανείσει.
   They never gave me back the money that I had lent them.

– Indirect Object RCs
1. Ο φοιτητής που του έδωσα το βιβλίο δεν έρχεται πια στα μαθήματα.
   The student that I gave the book to does not come any more to the lectures.
2. Δείξε μου το παιδί που του αγόρασες την τυρόπιτα.
   Show me the boy that you bought him the cheese-pie.
3. Δεν υπάρχει γυναίκα που να μην της αρέσουν τα παιδιά.
   There is no woman that does not like kids.
4. Ο καθηγητής που του έστειλα την αίτησή μου είναι γνωστός σ’όλο τον κόσμο.
   The professor that I sent him my application is known all over the world.
5. Ο φίλος που του έφερα από την Ινδία εκείνο το υπέροχο ύφασμα εγκαταστάθηκε στη Θεσσαλονίκη.
   The friend that I brought him an excellent cloth from India is in Thessaloniki.

– Genitive RCs
1. Ο κύριος που γνωρίσαμε τη γυναίκα του είναι γιατρός.
   The man that we met his wife is a doctor.
2. Συνάντησα πάλι τον γείτονά μου που πάντα ξεχνάω το όνομά του.
   I met again my neighbour that I always forget his name.

3. Ο μαθητής που οι γονείς του τραυματίστηκαν σοβαρά σε αυτοκινητιστικό ατύχημα έχει υποστεί φοβερό σοκ.
   The pupil that his parents were severely hurt in a car accident is under horrible shock.

4. Η ηθοποιός που η μορφή της είχε σημαδέψει μια ολόκληρη εποχή τιμήθηκε τελικά με Oscar.
   The actress that her figure is related to a whole period was finally awarded with Oscar.

5. Κλάπηκε από την Εθνική Πινακοθήκη ο πίνακας που η αξία του ήταν ανυπολόγιστη.
   The painting that his value was inestimable was stolen from the National Gallery.

--- 2 DPs

1. 'Αφήσε μέσα στο κουτί το δαχτυλίδι του αρραβώνα που δε σήμαινε τίποτα γι' αυτήν.
   She put the ring of engagement that did not mean anything to her in the jewellery-box.

2. Πήγα το πρωί στη βιβλιοθήκη του πανεπιστημίου που στεγάζεται σε ένα παλιό κτίριο.
   In the morning I went to the library of the university that is located in a very old building.

3. Κοιτούσε επίμονα το εγγονάκι του κυρίου που καθόταν στον καναπέ.
   (S)He looked insistently at the grandchild of the man that was sitting on the sofa.

4. Έπαθε ένα σοβαρό ατύχημα ο προϊστάμενος της υπαλλήλου που πήγε στην 'Ανδρο για διακοπές.
   The supervisor of the clerk who went to Andros for holidays had a serious accident.

5. Οι ντόπιοι ήξεραν τον συγγραφέα με την κοπέλα που κάθε πρωί έκανε βόλτα στην παραλία.
The locals knew the writer with the girl that used to go for a walk on the beach every morning.

- **Ungrammatical sentences**
  - No CP
  1. * Ο διευθυντής ο Γιάννης δανείστηκε το αυτοκίνητο έφτασε πολύ αργά στο γραφείο.
     The manager John borrowed the car arrived very late at the office.
  2. *Το αγόρι ο Πέτρος τρέχει πιο γρήγορα είναι αθλητής.
     The boy Peter runs faster is an athlete.
  3. *Μπήκε στο νοσοκομείο η γιαγιά κρατούσα συντροφιά τα βράδια.
     The old lady I kept company in the evenings went to the hospital.
  4. *Ένας ἁγνωστός χαιρέτησε τον ράφτη της τραγουδίστριας ἦταν ενθουσιασμένος με το ύφασμα.
     Someone greeted the tailor of the singer was enthusiastic about the cloth.
  5. *Ένας νοσοκόμος κάτι ψιθύρισε στον ψυχίατρο της ασθενούς φαινόταν πράγματι ευχαριστημένη από τη γιορτή.
     A male nurse whispered something to the psychiatrist of the patient seemed really happy about the celebration.

- **PP pied-piping**
  1. *Το θέμα που είναι αφοσιωμένη η Ελένη με έχει ιδιαίτερο ενδιαφέρον.
     The topic that Helen is devoted to is very interesting.
  2. *Έμαθα ότι προσέλαβαν κάποιον άλλον στη δουλειά που ενδιαφέρεσαι για.
     I heard that someone was hired for the job you are interested in.
  3. *Το κορίτσι που τόσα χρόνια αλληλογραφούσα με έχει πολύ καιρό να μου στείλει γράμμα.
     The girl that I have been corresponding with for so many years has not sent me a letter for a long time.
  4. *Παντρεύτηκε η συμφοιτήτριά μας που ο Γιώργος ήταν κάποτε παράφορα ερωτευμένος με.
     Our classmate that George was once in love with got married.
5. * Δεν υπάρχει κανείς άλλος που να μπορώ να στηριχτώ σε εκτός από τον εαυτό μου.
   There is none else that I can depend on except for myself.

   – Double-filled CP
   1. * Το κορίτσι που το οποίο έχασε το δρόμο του έκλαιγε.
      The girl that which lost her way was crying.
   2. * Ο συγκάτοικος τον οποίο που μισώ είναι φοβερά εγκυριστής.
      The flatmate which that I hate is extremely selfish.
   3. * Το βάζο που το οποίο έσπασα ήταν πολύ ακριβό.
      The vase that which I broke was very expensive.
   4. * Είδα στην πλατεία τη δασκάλα την οποία που είχα στο Δημοτικό.
      On the square I saw the teacher which that I had in the primary school.
   5. * Εξαφανίστηκε από τη γειτονιά η γάτα στην οποία που έδωσα γάλα.
      The cat to which that I gave milk disappeared from the neighbourhood.

   – Preposition omission
   1. * Ο άνθρωπος που τόσο τυφλά εξαρτάσαι είναι ανεύθυνος.
      The man that you so blindly depend is irresponsible.
   2. * Το άρθρο που αναφέρεται ο καθηγητής συνέχεια δεν υπάρχει στη βιβλιοθήκη.
      The paper that the professor refers always is not in the library.
   3. * Η αύξηση που αποβλέπεις δε θα έρθει ποτέ.
      The raise that you are aiming will never come.

   – No pronoun retention
   1. * Ο συμμαθητής που στη μητέρα πάντα στέλνω μια Χριστουγεννιάτικη κάρτα μετακόμισε πρόσφατα στην Πάτρα.
      The classmate that I always send a Christmas card to the mother has recently moved to Patra.
   2. * Σταμάτησε πια να δίνει συναυλίες ο τραγουδιστής που η φωνή είχε συνδεθεί με το πολιτικό τραγούδι.
      The singer that the voice was connected to the political song does not give concerts any more.
– 2 DPs

1. * Συνάντησα το πρωί του ποδοσφαιριστή που απολύθηκε πρόσφατα τον γιατρό.
   I met the morning the-gen football-player-gen that was fired recently
   the-acc doctor-acc.

2. * Επισκέφτηκε χτες από περιέργεια το γραφείο που ανήκε της εταιρείας κάποτε στον πατέρα του.
   Yesterday (s)he visited the office that belonged the-gen company-
   gen once to his father.

3. * Το κουτάλι που πάνω στο τραπέζι ήταν του γλυκού ήθελε η μητέρα.
   The-acc spoon-acc that on the table was the-gen sweet-gen wanted
   the mother.

4. * Ο δάσκαλος μιλούσε με το παιδιού που είχε τη μητέρα παρουσιαστικό ευγενικό.
   The teacher was talking with the-gen child-gen that had the-acc
   mother-acc kind face.

5. * Με το κορίτσι τον κύριο που καθόταν στο παγκάκι όλοι κοιτούσαν.
   With the girl the-acc man-acc that was sitting on the bench everybody
   was looking.
1. Grammaticality scores for each condition per each individual Spanish subject:

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2. Grammaticality scores for each condition per each individual German subject:

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In Appendix III, I am providing the grammatical experimental sentences in the Acceptability Judgement task (Experiment 6) together with their English translations. In addition, the acceptability scores per each individual are also given for all L2 groups. Finally, the detailed statistical analyses are presented.

A. EXPERIMENT SENTENCES

Grammatical sentences

1. Ο πρώτος πλησίασε τον βοηθό της καθηγήτριας/με την καθηγήτρια που ήταν ικανοποιημένη από τα αποτελέσματα της έρευνας.
   ‘The dean approached the assistant (masc) of/with the professor (fem) that was satisfied (masc/fem) by the results of the research.’

2. Ένας άγνωστος κοίταξε τον καθηγητή της φοιτήτριας/με τη φοιτήτρια που ήταν αφοσιωμένος στην Επιστήμη.
   ‘Someone looked-at the professor (masc) of/with the student (fem) that was devoted (masc/fem) to Science.’

3. Μία κυρία έσαχε τον ψυχίατρο της τραγουδίστριας/με την τραγουδίστρια που ήταν απογοητευμένη από τα αποτελέσματα του τεστ.
   ‘A woman was looking-for the psychiatrist (masc) of/with the singer (fem) that was disappointed (masc/fem) by the results of the test.’
4. Ἐνας ὑπάλληλος παρατηροῦσε τη γραμματέα του διευθυντή/με τον διευθυντή που ἦταν δυσαρεστημένος από τις αποφάσεις του συμβουλίου.
‘A clerk was watching the secretary (fem) of the manager (masc) that was displeased (masc/fem) by the decisions of the committee board.’

5. Μία πελάτισσα πλησίασε τον κομμωτή της ηθοποιού/με την ηθοποιό που ἦταν ντυμένος πολύ περίεργα.
‘A customer approached the hairdresser (masc) of the actress (fem) that was dressed (masc/fem) very strangely.’

6. Ἐνας κύριος κορόιδεψε την προϊστάμενο του υπάλληλου/με τον υπάλληλο που ἦταν σχολαστικός στη δουλειά της.
‘A man made-fun-of the supervisor (fem) of/with the clerk (masc) that was fastidious (masc/fem) about his/her job.’

7. Ο διευθυντής φώναξε τον μαθητή της δασκάλας/με την δασκάλα που ἦταν απογοητευμένος από τα νέα εκπαιδευτικά μέτρα.
‘The head asked-for the pupil (masc) of/with the teacher (fem) that was disappointed (masc/fem) by the new educational measures.’

8. Ἡ οἰκονόμος φώναξε την υπηρέτρια του κόμη/με τον κόμη που ἦταν χαμένος στις σκέψεις της.
‘The asked for the maid (fem) of the count (masc) that was lost (masc/fem) in his/her thoughts.’

9. Ὅλοι κοιτούσαν τον προπονητή με την αθλήτρια/της αθλήτριας που ἦταν στενοχωρημένη λόγω της απόφασης της επιτροπής.
‘Everybody was looking-at the trainer (masc) of/with the athlete (fem) that was sad (masc/fem) because of the decision of the committee.’

10. Μία κυρία πλησίασε τη μοδίστρα /τον σχεδιαστή μόδας με τον σχεδιαστή μόδας που ἦταν εξουθενωμένη από την πολλή δουλειά.
‘A woman approached the seamstress of/with the clothes designer (masc) that was exhausted (masc/fem) due to the great amount of work.’
11. 'Ενας αστυνομικός κοίταξε τη δικηγόρο του επιχειρηματία/με τον επιχειρηματία που ήταν αγχωμένη με τη δίκη.
'A policeman looked-at the solicitor (fem) of/with the businessman that was nervous (masc/fem) because of the trial.'

12. Ο διοικητής συμπαθούσε την εκπαιδεύτρια του αστυνομικού/με τον αστυνομικό που ήταν ανησυχή για την αποστολή.
'The Chief liked the trainer (fem) of/with the policeman (masc) that was worried (masc/fem) about the mission.'

13. Ο εκδότης παρακολουθούσε τον εικονογράφο της ποιήτριας/με την ποιήτρια που ήταν ικανοποιημένος με το βιβλίο.
'The editor was watching the illustrator (masc) of/with the poet (fem) that was satisfied by the book.'

14. 'Ενας άγνωστος χτύπησε τον ενδυματολόγο της προταγωνίστριας/με την προταγωνίστρια που ήταν απογοητευμένη από το κουστούμι.
'Someone beat the costume designer (masc) of/with the protagonist (fem) that was disappointed (masc/fem) by the costume.'

15. 'Ενας υπάλληλος πείραξε τη σκιτσογράφο του εκδότη/με τον εκδότη που ήταν δυσαρεστημένος από τα σκίτσα.
'A clerk teased the sketcher (fem) of/with the editor (masc) that was displeased (masc/fem) by the sketches.'

16. 'Όλοι μιλούσαν για τον σερβιτόρο της ειδικότητας/με την ειδικότητα που ήταν μεθυσμένος συνέχεια.
'Everybody was talking about the waiter (masc) of/with the owner (fem) that was drunk (masc/fem) all the time.'

17. Ο ναύτης κοίταξε τον καπετάνιο της πλοιοκτήτριας/με την πλοιοκτήτρια που ήταν απασχολημένη με τα σχέδια του κανονάργιου καραβιού.
'The sailor looked-at the captain (masc) of/with the ship-owner (fem) that was busy (masc/fem) with the plans of the new ship.'

18. 'Ενας εργάτης χαιρέτισε την μηχανικό του αρχιτέκτονα/με τον αρχιτέκτονα που ήταν αντιθέτη με τα σχέδια του κτιρίου.
'A worker greeted the engineer (masc) of/with the architect (fem) that was opposed (masc/fem) to the plans of the building.'
19. Ἐνας ὑπάλληλος στραβοκοιτοῦσε τη συμβολαιογράφο του βιογράφου/με τον βιομήχανο που ἦταν ακουμπισμένος στὸν τοίχο.
‘A clerk frowned-at the notary of/with the businessman that was leaning (masc/fem) against the wall.’

20. Ἐνας κλητήρας πλησίασε τη συνήγορο του βουλευτή/ με τον βουλευτή που ἦταν ανήσυχη για την απόφαση του δικαστηρίου.
‘A bailiff approached the advocate of/with the deputy that was worried (masc/fem) about the decision of the court.’

B. ACCEPTABILITY JUDGEMENT SCORES PER EACH INDIVIDUAL

1. Acceptability Judgement scores for each condition per each individual Spanish subject:

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3. Acceptability Judgement scores for each condition per each individual Russian subject:

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