Parsing Strategies in L1 and L2 Sentence Processing:

A study of relative clause attachment in Greek[*]

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ABSTRACT

To contribute to a better understanding of L2 sentence processing, the present study examines how second language (L2) learners parse temporary ambiguous sentences containing relative clauses. Results are reported from both off-line and on-line experiments with three groups of advanced learners of Greek, with Spanish, German or Russian as native language (L1), as well as results from corresponding experiments with a control group of adult native speakers of Greek. We found that despite their native-like mastery of the construction under investigation, the L2 learners showed different relative clause attachment preferences than the native speakers. Moreover, the L2 learners did not exhibit L1-based preferences in L2 Greek, as might be expected if they were directly influenced by attachment preferences from their native language. We suggest that L2 learners integrate information relevant for parsing differently from native speakers, with the L2 learners relying more on lexical cues than the native speakers and less on purely structurally-based parsing strategies.

INTRODUCTION

Previous second language (L2) acquisition studies have focused on linguistic knowledge in language learners. By contrast, relatively little is known about the strategies L2 learners employ to process sentences in real time (see Juffs, 2001; Klein, 1999). It is surprising that the question of how language learners process the target language has received little attention in the past, given that a learner's ability to process an input string appears to be a crucial prerequisite for the acquisition of linguistic knowledge (see Fodor 1998 for relevant theoretical discussion). Some researchers have recently begun to use reaction-time data and on-line experimental techniques such as sentence matching, eye tracking or self-paced reading to investigate L2 acquisition and parsing (Clahsen & Hong, 1995; Duffield & White, 1999; Eubank, 1993; Fernández, 1999; 2000; Frenck-Mestre & Pynte, 1997; Juffs, 1998; Juffs & Harrington, 1995; 1996 among others). The results obtained thus far are still rather scarce, and not yet conclusive, and as Klein (1999, p. 210) points out, many of these studies must be replicated before firm conclusions can be drawn.

Against this background, a research team at the University of Essex has recently started to conduct a detailed experimental psycholinguistic study of sentence processing in child L1 and adult L2 learners, investigating two core aspects of sentence processing, (i) the parsing of temporarily ambiguous sentences and (ii) the processing of filler-gap dependencies. The present study examines parsing preferences in temporarily ambiguous sentences of Greek, specifically preferences in the attachment of relative clauses. In the following, we will first present a brief summary of the psycholinguistic literature on attachment preferences in a person's native language (section 2) and in L2 learners (section 3). After an overview of some relevant grammatical properties of Greek in section 5 and of the materials and experimental methods

(section 6), we will present the experimental results from Greek native speakers and three groups of L2 learners.

ATTACHMENT PREFERENCES IN NATIVE SPEAKERS[1]

Consider sentences such as (1) in which the relative clause can be attached either high, to the first noun phrase (DP-1, the servant), or low, to the second noun phrase (DP-2, the actress):

(1)   Someone shot [the servant]$_{DP-1}$ of [the actress]$_{DP-2}$ who was on the balcony

Several studies have employed acceptability judgment tasks and reaction-time (RT) experiments to examine attachment preferences in such sentences across different languages. Most studies examining native speakers of English found a DP-2 preference, i.e. the bracketed relative clause is preferably associated with the lower DP, i.e. with actress (Carreiras & Clifton, 1999; Cuetos & Mitchell, 1988; Frazier & Clifton, 1996, among others). This preference has been ascribed to a general parsing strategy[2] dubbed Right Association (Kimball, 1973), Late Closure (Frazier, 1978) or Recency (Gibson, Pearlmutter, Canseco-Gonzalez & Hickock, 1996), according to

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1   The literature referred to in this section is concerned with adults parsing in 'monolingual mode' (see Grosjean 1997). It is assumed in this literature (though not always made explicit) that what is under study is the language the participants have acquired in childhood. This means that even though they may have acquired a second language (typically in a school setting when they were adults), simultaneous bilinguals (who have learned two languages simultaneously before the age of 5 to 6 years) are normally not included.
2   We will use the term 'parsing strategy' to refer to an operation by which a new node is attached or associated to previously processed nodes or domains in the left-to-right parse of a sentence. Parsing strategies make use of different sources of information, e.g. syntactic, semantic, prosodic and discourse information. For our purposes, the distinction between structure-based parsing strategies (which make use of phrase structure information) and lexically-based strategies (which make use of lexical-semantic information) is particularly important.

which new phrases are attached to the phrase currently being processed, i.e. to the most recent phrase if grammatically possible.

Cross-linguistic differences in RC attachment

Results from studies examining languages other than English have shown, however, that the Late Closure/Recency preference does not hold universally. For example, a high DP-1 attachment preference was found in sentences equivalent to (1) in languages including Spanish (e.g. Cuetos & Mitchell, 1988), German (Hemforth, Konieczny, Scheepers & Strube, 1998; Hemforth, Konieczny & Scheepers, 2000), Dutch (Brysbaert & Mitchell, 1996), French (Zagar, Pynte & Rativeau, 1997), and Russian (Radach and Kempe, personal communication). On the other hand, a DP-2 preference was not only found in English, but also in Norwegian, Swedish, and Romanian (Ehrlich, Fernandez, Fodor, Stenshoel & Vinereanu, 1999), as well as in Brazilian Portuguese (Miyamoto, 1998), and in Arabic (Abdelghany and Fodor, 1999). These findings might mean that at least some parsing strategies are language-specific rather than universal. There are three main attempts to explain the cross-linguistic attachment differences in these terms. Within Gibson & Pearlmutter's (1998) multiple-constraint model of sentence processing, attachment preferences are determined by the relative strength of a number of interacting parsing strategies in a given language. It is argued that in addition to the universal Recency strategy, the parser may employ a second structurally-based parsing strategy dubbed Predicate Proximity, according to which ambiguous modifiers will preferentially be attached to constituents as structurally close as possible to the predicate, i.e. to the S/IP node, hence favouring attachment of the relative clause to the overall object DP in example (1) above (Gibson & Pearlmutter, 1998; Gibson & Schütze, 1999). They further argue that the relative strength of the Predicate Proximity

strategy is linked to the degree of (non-)configurationality of a given language. That is, in languages such as Spanish, German, or Russian that allow verbs and their complements to be non-adjacent, the verb may be more 'active' during processing and hence may be more likely to attract ambiguous modifiers. By contrast, configurational languages such as English, Norwegian, or Swedish, and even Brazilian Portuguese (which as Miyamoto (1998) pointed out does not allow adverbs to intervene between verb and object) give less weight to Predicate Proximity. Greek patterns with Spanish, German, and Russian in that it allows verbs and their complements to be non-adjacent; from Gibson and colleagues' account we would therefore expect Predicate Proximity to be strong enough to outrank Recency, yielding a DP-1 preference in the Greek equivalents of example (1) above.

The second proposal is the attachment-binding hypothesis of Hemforth and colleagues (Hemforth et al., 1998; Hemforth et al., 2000; Konieczny, Hemforth, Scheepers & Strube, 1997). They argue that in languages in which the RC is introduced by a relative pronoun, e.g. German, attachment preferences are sensitive to more general constraints on pronouns, in particular, to a discourse constraint on anaphoric binding according to which pronouns have to be attached to salient discourse entities. Arguably in sentences such as (1), the head of DP-1 is a more salient discourse entity than DP-2, since it is an argument of the verb. Consequently, in the German equivalent of sentences such as (1) the RC is preferably attached high, due to constraints on anaphoric binding. In English, however, in which RCs may be headed by a complementizer or appear without any overt introducing element, RC attachment is not sensitive to such constraints, and hence the lack of a high-attachment preference in English. In this regard, Greek patterns with English in that it allows RCs to be headed by complementizers. Given the attachment-binding

account, we would therefore expect to find a low (DP-2) attachment preference in Greek sentences corresponding to (1).

The third attempt to explain cross-linguistic differences in RC attachment is Mitchell and colleagues' Tuning Hypothesis (see e.g. Mitchell, 1994; Mitchell, Cuetos, Corley & Brysbaert, 1995) according to which the parser's attachment preferences in temporarily ambiguous sentences directly correspond to the frequency distribution of adjunct attachments. That is, a person who is exposed to a language in which RCs are typically interpreted as high attachments will be more likely to prefer a DP-1 attachment in an ambiguous sentence, while a person who is most frequently exposed to low-attachment input will prefer DP-2 attachment. To support this account, Mitchell et al. (1995) present data showing that RC attachment preferences obtained from experimental studies are positively correlated with the frequency distribution of attachments obtained from corpus data; see, however, Gibson & Schütze (1999) for some conflicting evidence. Unfortunately, there are no corpora available that would allow us to examine the frequency distribution of RC attachments in Greek and to test the Tuning Hypothesis for native speakers of Greek. We will, however, examine a prediction derived from the Tuning Hypothesis for the L2 data. Recall that previous research on RC attachment has shown that the native languages of our L2 participants (Spanish, German, Russian) exhibit a DP-1 attachment preference in sentences such as (1). Likewise, our findings from native speakers of Greek to be reported below also show a clear DP-1 preference in these kinds of sentences. Thus, it is reasonable to suppose that our L2 participants have been exposed to a DP-1 preference in both their L1 and their L2. From the perspective of the Tuning Hypothesis, we would therefore expect that when faced with an ambiguity they choose the option that has been encountered most often in the past, i.e. high (DP-1) attachment for the RC.

Lexical biases in RC attachment

Another set of findings concerns lexical biases in RC attachment. Several studies found that when DP-2 is introduced by a thematic preposition the RC tends to be attached low; see e.g. Gilboy, Sopena, Clifton & Frazier (1995), Frenck-Mestre & Pynte (2000), Traxler, Pickering & Clifton (1998), Felser, Marinis, Clahsen (2002):

(2)   The doctor recognized [the pupil]$_{DP-1}$ with [the nurse]$_{DP-2}$ who was feeling very tired

Interestingly, this also holds for languages such as Spanish and French in which the equivalents of (1) show high attachment. Thus, the presence of a thematic preposition such as <u>with</u> or <u>con</u> seems to affect RC attachment preferences. Frazier & Clifton's (1996) Construal theory is an attempt to capture these facts. They argue that so-called non-primary phrases, i.e. non-obligatory constituents including RC adjuncts, are construed or associated with the closest thematic processing domain. That is, when the DP-2 receives a theta-role from a preposition (as in (2) from <u>with</u>), the RC is processed within this thematic domain and is consequently attached low. In this way, the Construal theory accounts for the fact that in sentences such as (2) low attachment is preferred across languages. However, in sentences such as (1) the closest thematic processing domain is the entire DP (<u>the servant of the actress</u>), which includes both DP-1 and DP-2. Consequently, the Construal strategy does not yield an attachment preference in such sentences.

PREVIOUS STUDIES ON ATTACHMENT PREFERENCES IN L2 LEARNERS

There is a small number of previous studies which have examined attachment preferences in L2 learners (Fernández, 1999; Frenck-Mestre, 1997; Frenck-Mestre & Pynte, 1997). Other studies have explored attachment preferences in bilinguals; see Fernández (2000) for a review of these studies. Our focus here will be on studies examining adult learners who acquired the L2 after puberty.

Frenck-Mestre & Pynte (1997)

In two eye-tracking experiments, PP-attachment and main/subordinate clause ambiguities were examined in advanced French learners of English and English learners of French[3]. In the first experiment, Frenck-Mestre & Pynte addressed the question of whether L2 learners' parsing strategies differ from the ones native speakers use 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 a DP, such as Brutus hit the gladiator with the shield with his bare hands. This sentence is ambiguous up to the PP with the shield, since this PP could be attached either to the entire VP or to the DP-object. It is the PP with his bare hands that disambiguates the sentence towards DP-attachment. It was found that for both native speakers and L2 learners, attachment preferences were dependent on the argument structure of the verb; for sentences with ditransitive verbs (such as hit), VP-attachment was preferred and for those with monotransitive verbs (e.g. reject) DP-attachment. This was

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3   The only information that is provided about the participants of this study is that the English L2 learners of French were students who studied French for at least five years in a school environment in the US and who had been living in France for approximately 9 months, and that the French L2 learners of English were students studying to become English teachers who had recently lived in the US or the UK for 9 to 12 months. Unfortunately, the study does not provide any measure of the participants' L2 proficiency.

interpreted as supporting a lexically-driven parser in both L2 learners and native speakers in which subcategorization information of the verb affects parsing decisions.

The second experiment examined whether L2 learners transfer lexical properties from their L1 when processing temporarily ambiguous L2 input. Sentences such as Every time the dog obeyed the pretty little girl showed her approval were used with verbs such as to obey (= obéir) that are optionally transitive in English and obligatorily intransitive in French. Consequently, whereas in English the DP the pretty little girl can be parsed either as the direct object of the verb or as the subject of the subsequent main clause, in the French translation of the above sentence (Chaque fois que le chien obeissait la jolie petite fille montrait sa joie) the DP la jolie petite fille cannot be constructed as a direct object of the embedded verb. These kinds of sentences were compared with parallel sentences in which obéir and the like were replaced by verbs such as aboyer 'to bark' which are most typically intransitive in both English and French. The experimental results indicated that French learners of English took longer to read sentences with verbs such as to obey than corresponding sentences with verbs such as to bark. Frenck-Mestre & Pynte interpret this finding as an effect of the L1 transfer; the L2 learners took extra time 'to reflect upon a verb's usage in cases where information from their native language conflicted with that from their second language' (p.141f.). Note, however, that a delay effect is to be expected for verbs such as obey (compared to bark), on independent grounds. Optionally transitive verbs make available a greater number of structural options for on-line processing than intransitive verbs, and this difference may have caused the longer reading times for sentences with obey-type verbs. This would also be compatible with the fact that a similar (albeit smaller) difference in reading times was found for native speakers. Moreover, the L2 learners were tested in French and English in the same experiment, which required them to switch back and forth between L1 and L2, and such

a design may have produced arbitrary effects. For these reasons, we think that the L1 transfer explanation offered by Frenck-Mestre & Pynte is not particularly convincing.

Fernández (1999)

This study examined RC attachment preferences in English in two groups of Spanish L2 learners and in adult native speakers using an off-line questionnaire. The experimental materials consisted of ambiguous sentences such as <u>Roxanne read the review of the play that was written by Diane's friend</u> containing RCs preceded by complex DPs linked by the prepositions <u>of</u> or <u>with</u>. There were 15 'early' learners, Spanish speakers who started to learn English before the age of 10, and 15 'late' learners who started to learn English after age 10[4]. A clear low-attachment preference was found in the native speakers, but not in the L2 learners. Instead, both early and late learners produced more high-attachment answers than the native speakers. Fernández interprets this as a result of L1 transfer, reflecting the fact that Spanish prefers high attachment in cases in which English prefers to attach low. Note, however, that whereas native speakers of Spanish exhibit a clear low-attachment preference for DP-<u>con</u>-DP (see e.g. Cuetos & Mitchell, 1988; Cuetos, Mitchell & Corley, 1996), the L2 learners showed no clear preference for either high or low attachment (see Fernández, 1999, p.227, Tab.1), indicating that the L2 learners' responses <u>cannot</u> be accounted for in terms of L1 transfer. It should also be mentioned that a direct comparison between the two conditions (<u>of</u> vs. <u>with</u>) is not possible, since the DPs used in both conditions were different.

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4   Fernández (1999) does not provide a measure to decide whether her participants have acquired the relevant constructions and have proficient control over them. She mentions, however, that none of her participants had any trouble understanding the content of the questionnaire producing, for example, not more than one incorrect answer in the filler items. From this, she concludes that the subjects' English proficiency is 'intermediate to advanced' (Fernández 1999: 224).

Frenck-Mestre (1997)

This study examines RC attachment preferences in temporarily ambiguous sentences of French in native speakers and 'beginning' adult L2 learners with English or Spanish as L1s[5]. RC antecedents consisted of complex DPs with non-theta-assigning prepositions (DP-<u>de</u>-DP). An overall high-attachment preference was found for native speakers and Spanish L2 learners, and no preference for English L2 learners. Frenck-Mestre interprets this finding in support of L1 transfer, reflecting the fact that a high-attachment preference is found in L1 Spanish but not in L1 English. Note, however, that since Frenck-Mestre does not provide any background information on the L2 participants (except that they are 'beginning'), we cannot rule out the possibility that the Spanish and the English participants are at different proficiency levels in their L2 and therefore not directly comparable with each other. Moreover, most studies of native speakers of English have shown a low-attachment preference; L1 transfer in the case of English learners should therefore produce a low-attachment preference (rather than no preference).

Summarizing, the studies mentioned above have not produced conclusive results. They are also hard to interpret because the L2 learners' proficiency in the second language, and particularly, their grammatical knowledge of the constructions under study was not independently assessed. It is therefore possible that differences observed between native speakers and L2 learners in the experiments are, at least in part, due to the L2 learners' incomplete acquisition of the relevant grammatical constructions.

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5   Again, as in the previously mentioned studies, the information provided about the participants' linguistic background in the L2 is rather scarce. It is mentioned that the subjects of Frenck-Mestre (1997) were 'considerably less skilled in their second language'

THE PRESENT STUDY

Building on the findings summarized in sections 2 and 3, we investigate RC attachment preferences in native speakers and L2 learners of Greek. Greek has some morphological and structural properties that are advantageous for studying RC attachment preferences. For example, Greek has (a) relatively free word order, (b) RCs introduced by complementizers, and (c) morphologically marked genitives. Given (c), genitive antecedents[6] in Greek are therefore clearly distinct from PP antecedents (unlike, for example, in English, French or Spanish). Moreover, data from Greek allow us to assess different models of RC attachment. For example, given property (b), the attachment-binding model of RC attachment (Hemforth et al. 1998) predicts a low-attachment preference for Greek, whereas (given (a)) the multiple constraint account of Gibson and colleagues predicts a high-attachment preference for the same sentences. The experimental results reported below show that native speakers of Greek prefer high attachment of the RC in sentences with genitive antecedents thus providing support for Gibson et al.'s parsing model.

To examine L2 sentence processing, we have investigated RC attachment in three groups of advanced learners of Greek, with Spanish, German or Russian as their L1s using both off-line and on-line experiments on RC attachment. Additionally, the L2 participants underwent a grammaticality judgment test to ensure that they can handle the kinds of sentences tested in the two main experiments. With respect to RC attachment preferences, our results from native

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than those studied in Frenck-Mestre & Pynte (1997). No further details about the participants are provided.

6   In line with the psycholinguistic literature on this topic, we use the terms 'genitive and PP (relative clause) antecedents' as shortcuts for the difference between the kinds of sentences (see e.g. (1) and (2)) under study. Even though we have adopted this terminology, it should not be forgotten that from a linguistic perspective it is not very accurate. Clearly, relative clauses do not have (genitive or PP) antecedents in the sense that reflexive pronouns do. Instead, they modify heads and combine with NPs (or DPs).

speakers of Greek show that Greek patterns with Spanish, German and Russian in that these languages prefer high attachment of the RC in sentences with genitive antecedents. As the source languages and the target language of our L2 participants exhibit the same attachment preferences, one might expect them to perform like native speakers of Greek in these constructions. This would, at least, be consistent with experience-based parsing models such as the Tuning Hypothesis (see section 2) as well as with the idea that language-particular attachment preferences of the L1 are transferred to the L2. Our results do not confirm this prediction, however. Despite native-like performance in the grammaticality judgment test and despite parallel attachment preferences in both their L1s and in Greek, the L2 learners showed different RC attachment patterns than native speakers of Greek. We will argue that these results provide evidence against exposure-based models of parsing and against L1-transfer of language-particular attachment preferences in L2 sentence processing.

RESTRICTIVE RELATIVE CLAUSES, GENITIVES AND PPs IN GREEK

In this section, we will provide a brief description of relevant grammatical properties of the materials used in our experiments. There is an extensive linguistic literature on relative clauses and the structure of nominals in Greek (see e.g. Alexiadou, 1999; Holton, Mackridge & Philippaki-Warburton, 1997; Theophanopoulou-Kontou, 1989; Varlokosta 1999), which will not be discussed here. Rather, the following remarks are just meant as background information for those unfamiliar with the Greek language.

To examine attachment preferences in Greek, we constructed experimental sentences with a grammatical structure similar to those in (1) and (2). These sentences have a transitive verb in the main clause with an overt subject and a direct object followed either by a genitive DP or a

PP; the main clause is followed by a restrictive relative clause which is always introduced by the complementizer pu 'that':

(3)   Enas   antras   kitakse ton   dhaskalo

a-masc-nom man-masc-nom looked   the-masc-acc-sg   teacher-masc-acc

tis   mathitrias   pu   itan   stin avli.

the-fem-gen-sg   pupil-fem-gen-sg   that   was   in-the-fem-

schoolyard

'A man looked at the teacher of the pupil who was in the schoolyard.'

Mackridge (1985, p. 253) points out that the invariant complementizer pu is the most common element for introducing relative clauses and that it is used more frequently than the relative pronouns o opios - i opia- to opio 'who – which' in both colloquial speech and in writing. This is particularly the case for subject relative clauses such as those used in our experiments. In addition to relative clauses, *pu* is also used to introduce exclamatives and complements of factive verbs.

As regards the RC antecedents, the experimental materials contain complex (object) DPs with possessive genitives as in (3) or PPs with the preposition me (= with). Similarly to previous studies on attachment preferences in languages other than Greek, the two DPs in the genitive condition of our experiments express a functional or professional relationship, e.g. teacher of the pupil, which Tzartzanos (1991) labels dependency genitive. Even though the genitive DP may precede the head DP for purposes of contrast (Holton et al., 1997, p. 264), the typical order for such complex DPs is for the genitive DP to follow the head DP, as illustrated in (3).

Most syntactic accounts of Greek have argued that genitive DPs are base-generated postnominally (Alexiadou & Stavrou, 1999; Horrocks & Stavrou, 1987, Theophanopoulou-Kontou, 1989). In contrast to these no-movement analyses, Alexiadou (1999) has argued that the possessor DP dhaskalo 'teacher' in (3) is base-generated after the possessum DP mathitrias 'pupil' in (3), from which it is moved to the left of the possessum noun (to check agreement and case features), yielding a derived structure ([DP$_i$] DP$_{GEN}$ t$_i$]) with a trace for the moved DP. Here is not the place to discuss the syntactic arguments for and against these conflicting proposals. It is, however, important to point out that the predictions for parsing sentences such as (3) are dependent on which syntactic analysis is assumed for complex DPs. Consider, for example, the Late Closure/Recency strategy according to which new material is attached to the most recent phrase. Under the no-movement analysis, the most recent phrase for the attachment of the RC in (3) is the genitive DP. However, under Alexiadou's account the most recent syntactic element before the RC is the trace of the moved possessor noun. Thus, Late Closure/Recency paired with Alexiadou's analysis would yield RC attachment to the DP containing the possessor noun, while under the no-movement analysis the same parsing strategy would yield RC attachment to the DP with the possessum noun. When discussing the experimental results, we will have to consider both possibilities.

The second type of complex DP used in the experimental materials contains PPs with the preposition me 'with', e.g. ton kirio me to koritsi 'the man with the girl', in which the PPs denote spatial or temporal accompaniment. Complex DPs of this kind are straightforwardly right-branching and (in contrast to genitive DPs) have not been argued to involve any kind of reordering.

METHOD

Participants

Three groups of advanced learners of Greek, all residents of Greece, were tested; some background information about these three groups is given in Tab.1:

- 18 adult L2 learners (L2-S) with Spanish as L1, mean age 38.8 years. All the Spanish subjects were first exposed to Greek after 12 years of age.

- 19 adults (L2-G) with German as L1, mean age 42.9 years. Two of these subjects reported to have had some occasional contact with Greek during childhood, through grandparents and other relatives. The remaining 17 subjects were first exposed to Greek in their adulthood.

- 10 adults (L2-R) with Russian as L1, mean age 27.3 years. All these subjects were first exposed to Greek when they were adults.

Tab. 1: Characteristics of the L2 groups

	L2-S		L2-G		L2-R	
	Mean	SD	Mean	SD	Mean	SD
Length of residence in Greece (in years)	11.21	6.90	13.73	12.16	4.30	3.40
Years of formal instruction in Greek	2.06	1.59	1.42	0.58	2.35	2.54
Greek Language Proficiency scores (max. score = 80)	75.33	3.27	72.63	5.96	71.90	4.89
Age of first exposure to Greek	26.39	4.62	23.74	9.22	22.10	6.47

All the learners had attended language courses in Greek, and when the experiments took place, all of them were living and working in Athens. All the subjects reported using Greek on a daily basis for interaction with native and non-native speakers, i.e., all the subjects use Greek in their

work environment, and all of them have Greek friends or partners, and they communicate with them in Greek.

To obtain a general measure of the L2 learners' proficiency in Greek, we tested them on the Greek Language Proficiency Test used at the University of Athens[7]. The maximum score in this test is 80. As can be seen from the proficiency scores in Tab.1, all of the recruited L2 learners achieved very high scores in this test indicating that their knowledge of Greek is at an advanced level.

In addition, some of the subjects knew a third language (L3) which was either English, French or Italian, but none of the subjects reported themselves being fluent in any of these languages. Within the Spanish group, 6 participants reported knowing English at an intermediate level and 6 at an elementary level. However, only one participant was actively using English when the experiments took place, in that she was taking English language courses at the university. The remaining 6 subjects had not studied or learnt English at all. A similarly mixed picture regarding their knowledge of English holds for the Russian L2 learners; 3 reported having advanced knowledge of English, 3 intermediate, 2 elementary, and 2 no English at all. Only the group of German L2 learners was relatively homogeneous in this respect; 5 subjects reported having advanced, and the remaining 14 intermediate knowledge of English.

All the L2 learners participated in a grammaticality judgment task and in the two main experiments. In addition, the two main experiments were administered to two different control groups of adult native speakers of Greek. For the acceptability judgment task, the control group consisted of 16 native speakers (mean age: 24.2 males: 6, females: 10), all of them students at the

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7   The Greek Language Proficiency Test is available from the Teaching Center of Greek as a
     Foreign Language at the University of Athens.

University of Athens. The self-paced reading task was administered to a group of 20 native

speakers (mean age: 24.1, males: 7, females: 13), all of them students at the University of Essex[8].

All the subjects were naïve with respect to the purpose of the experiments.

Experimental tasks

The purpose of the <u>grammaticality judgment task</u> was to test, independently of the two main

experiments, whether the L2 learners could handle the constructions under study, in particular

relative clauses with complex antecedents. The task consisted of 50 sentences, all of which

contained relative clauses of various types. There were 25 grammatical sentences with subject,

object, indirect object, or genitive RCs (5 each), and 5 RCs with two antecedents. The 25

ungrammatical sentences had doubly-filled complementizers, sentences without an overt

complementizer, genitive RCs with complementizers but without the required resumptive

pronouns, RCs with preposition stranding and RCs with two antecedents (5 each). The format of

the grammaticality judgment task was adopted from Hawkins & Chan (1997).

The materials used in the <u>two main experiments</u>[9] were similar. The critical sentences were all

grammatical, consisted of 14 to 16 words, and contained a main clause plus a subject-RC with

two possible antecedents introduced by the complementizer <u>pu</u> 'that' (see (4)). The two DPs

preceding the RC were always animate, had different genders (either feminine or masculine), and

expressed a functional/professional relationship. To examine the role of lexical biases, the form

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8   The participants of the two control experiments acquired Greek during childhood. They also
have some knowledge of an L2, typically English acquired in a school setting when they
were adults. None of the participants was a simultaneous bilingual having learned two
languages simultaneously before the age of 5 to 6 years. We therefore assume that in
contrast to the three groups of L2 learners, the control participants are processing Greek as a
native language, i.e. in 'monolingual mode' (Grosjean 1997).

9   A complete list of all experimental stimuli for each task can be found in Papadopoulou
(2002) and can be made available upon request.

of the RC antecedent was manipulated (see 4a/4b vs. 4c/4d). The critical sentences were disambiguated by the form of the participle/adjective, through gender/number agreement, yielding either high or low RC attachment. In this way, the factors Antecedent (DP+DP$_{genitive}$ vs. DP+PP) and Attachment (high vs. low) lead to four experimental conditions as shown in (4). Otherwise, i.e. apart from the different antecedent and attachment types, the experimental sentences were identical.

(4)   Experimental conditions

(a)   Condition Gen-high (gh)

Enas   kirios   fonakse ton   fititi

a-masc-sg-nom man-masc-sg-nom   called   the-masc-sg-acc student-masc-sg-acc

tis   kathighitrias   pu itan apoghoitevmenos   apo to neo

the-f-sg-gen teacher-f-sg-gen that was disappointed-masc by   the new

ekpedheftiko sistima.

educational system.

(= A man called the student (masc) of the teacher (fem) who was disappointed (masc) by the new educational system.)

(b)   Condition Gen-low (gl)

Enas kirios fonakse ton fititi tis kathighitrias pu itan apoghoitevmeni apo to neo ekpedheftiko sistima.

(= A man called the student (masc) of the teacher (fem) who was disappointed (fem) by the new educational system.)

(c)   Condition PP-high (ph)

Enas kirios fonakse ton fititi me tin kathighitria pu itan apoghoitevmenos apo to neo ekpedheftiko sistima.

(= A man called the student (masc) with the teacher (fem) who was disappointed (masc) by the new educational system.)

(d)   Condition PP-low (pl)

Enas kirios fonakse ton fititi me tin kathighitria pu itan apoghoitevmeni apo to neo ekpedheftiko sistima.

(= A man called the student (masc) with the teacher (fem) who was disappointed (fem) by the new educational system.)

With respect to the acceptability judgment task, we expect the subjects' acceptability judgments to be affected by their attachment preferences. Specifically, sentences in which the disambiguating gender information confirms the initial, preferred attachment of the relative clause should receive higher scores than sentences in which the gender cue is incompatible with the initial attachment. This is because in the latter case the initial interpretation has to be revised, and in a scaled judgment task this is likely to affect the scores assigned to the sentences; see also Birdsong (1992) for pointing out that scaled judgment tasks are sensitive to degrees of acceptability. There were 20 experimental sentences, 5 for each of the four conditions shown in (4). In addition to the critical sentences, we constructed 40 filler sentences for the judgment task involving a variety of constructions (e.g. reflexive, control, raising, gerund and wh-extraction

constructions). 10 filler sentences were grammatically well formed. 20 filler sentences were made ungrammatical by a gender/number mismatch between the antecedent DP and the past participle; the structure of these sentences was parallel to the experimental sentences. 10 other filler sentences included other kinds of ungrammaticality. Participants were instructed to read the sentences and to judge the acceptability of each sentence on a five-point scale 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 judgments and not on prescriptive grammatical rules. In addition, the participants were instructed to give the lowest score '1' to a sentence they thought is ungrammatical. The task was completed in less than half an hour.

The rationale for the self-paced reading task (SPR) is that increased reading times to a particular segment (relative to the same segment in a control condition) indicate a relatively higher processing difficulty at this point during the parse. That is, reading times to the disambiguating segment should be higher for those conditions that force the dispreferred attachment, reflecting the time it takes comprehenders to revise their initial (i.e., preferred) analysis of the sentence. There were 24 critical sentences, 6 for each condition, plus 72 filler sentences with different syntactic constructions, all of which were grammatical. The experimental sentences were parallel to the ones in (4) except that the auxiliary form itan was replaced by a finite form of the verb fenome 'to seem'. This was done to avoid a temporal ambiguity that might result from the fact that itan is a syncretic form meaning either was or were. The verb fenome has two different forms for singular (fenotan) and plural (fenodan) in the past continuous and thus avoids this

ambiguity[10]. All experimental and filler sentences were divided into five segments as illustrated in (5)[11].

(5)   Enas   kirios   fonakse

        a-masc-sg-nom man-masc-sg-nom   called

        ton   fititi   tis   kathighitrias

        the-masc-sg-acc student-masc-sg-acc of-the-f-sg-gen teacher-f-sg-gen

        pu   fenotan

        that seemed-sg.

        apoghoitevmenos

        disappointed-masc

        apo to neo ekpedheftiko sistima.

        by the new educational system.

        (= A man called the student (masc) of the teacher (fem) who seemed disappointed (masc)

        by the new educational system.)

The critical region is the fourth segment, i.e. apoghoitevmenos 'disappointed-masc', since it is here where the disambiguation occurs. A low-attachment preference would be evident from shorter reading times for the fourth segment of conditions Gen-low and PP-low (4b, 4d) in

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10 The syncretism of the itan form is less problematic for the acceptability judgment task, as the participants are required to provide an off-line judgment at the end of the sentence at which the disambiguating gender information has been encountered. The SPR task, however, provides a continuous on-line measure of reading. The number ambiguity resulting from the itan form should therefore be avoided.

11 The format of the SPR task with phrase-by-phrase segmentation was similar to the one used by De Vincenzi & Job (1993; 1995). A word-by-word presentation was not chosen as the

comparison to <u>Gen-high</u> and <u>PP-high</u> (4a, 4c), because in the former two conditions the form of the gender marking on the adjective is compatible with the initial (low) attachment, whereas in (4a) and (4c) it is not. If, on the other hand, subjects prefer high (DP-1) attachment, reading times should be shorter for (4a) and (4c) than for (4b) and (4d) on the fourth segment.

The stimuli were presented on a 17'' computer monitor in white letters (Arial 24pt) on a dark background. The subjects were instructed to read the sentences as quickly and as carefully as they could. Sentences were read in a segment-by-segment fashion in which the presentation of each new segment is triggered by the subjects' pressing a pacing button. The times between button presses provide the crucial experimental measure. To make sure that subjects paid attention to the contents of the sentences, they were also required to answer a yes-no content question after having read each sentence. Questions eliciting 'yes' and 'no' answers were evenly distributed across the four conditions. The whole experiment lasted between 45 and 60 min. per subject.

RESULTS

Grammaticality judgments

Tab. 2 presents the grammaticality judgment scores for the kinds of constructions that were tested in the two main experiments, namely for subject relative clauses with complex (DP+DP) antecedents. Tab. 2 shows mean scores and standard deviations for correct responses. 'Hits' are grammatically well-formed sentences that were accepted, 'correct rejections' are ungrammatical sentences that were rejected.

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separation of the two RC antecedents may have biased the subjects towards low attachment; see De Vincenzi & Job (1995) and Gilboy & Sopena (1996) for discussion.

Tab. 2: Mean grammaticality judgment scores (and standard deviations)
for relative clauses with complex antecedents

	L2-S		L2-G		L2-R	
	Score	SD	Score	SD	Score	SD
Hits	4.33	0.84	4	1	3.70	1.16
Correct rejections	5	0	4.84	0.50	4.80	0.42

Note: The maximum score in each cell is 5. SD stands for Standard Deviation. L2-S refers to the L2 group with Spanish as L1, L2-G to the L2 group with German as L1 and L2-R to the L2 group with Russian as L1.

The three groups of L2 learners achieved high scores in this task, both in terms of hits and correct rejections. Moreover, the scores in Tab. 2 do not significantly differ between language groups, showing that the three groups of L2 learners performed similarly in this task ($F(2,44) = 1.415$; $p = 0.254$ for 'hits'; $F(2,44) = 1.227$; $p = 0.303$ for correct rejections). These results indicate that the L2 learners we tested have acquired the grammatical properties necessary for dealing with relative clauses with complex antecedents, such as those used in our main experiments.

Acceptability judgments

Recall that in this task, participants were confronted with grammatical sentences such as those in (4), to test their attachment preferences, and with ungrammatical sentences involving gender/number agreement mismatches (see (6)), to test whether the L2 learners can handle the kind of long-distance subject-verb agreement between an antecedent DP and a participle or adjective which is required for correctly interpreting the experimental sentences.

(6) *O ipiretis hamoghelase ston vioghrafo   tis ithopiu   pu

'The servant smiled   at the biographer-masc-sg of the actress-fem-sg who

itan   hamena   stis skepsis tus.

was   lost-neut-pl in their thoughts.'

The results from L2 learners' judgments of the ungrammatical sentences were parallel to those of the native speakers; the L2-S group correctly rejected 95%, the L2-G group 95.3%, the L2-R group 96%, and the Greek native speakers 99.3% of the ungrammatical sentences with gender mismatches. These figures indicate that the L2 learners were sensitive to gender/number agreement mismatches.

With respect to the acceptability scores for the four experimental conditions (see (4)), Tab. 3 presents mean scores and standard deviations:

Tab. 3: Mean acceptability judgment scores (and standard deviations)

	GEN-HIGH		GEN-LOW		PP-HIGH		PP-LOW	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
native speakers	4.24	1.10	3.05	1.53	1.62	1.10	2.97	1.67
L2-(Spanish)	3.26	1.72	3.17	1.71	2.06	1.44	3.02	1.76
L2-(Germans)	3.82	1.24	3.54	1.38	2.50	1.40	3.17	1.36
L2-(Russians)	3.50	1.50	2.70	1.53	2.42	1.39	3.04	1.51

Note: A score of '5' stands for completely acceptable and '1' for non- acceptable.

In order to determine whether there are reliable differences between the three groups of L2 learners, we first performed a preliminary ANOVA[12] on the acceptability judgment scores with 'Antecedent' (PP vs. Gen) and 'Attachment' (high vs. low) as within-subjects factors and 'L2 Group' as between-subjects factor. This analysis revealed no significant interactions for any of the three L2 groups (L2-S, L2-G, L2-R), indicating that the three groups of L2 learners exhibit the

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12 The data from both the acceptability judgment and the self-paced reading tasks pass the customary tests for normality (Kolmogorov-Smirnov test), sphericity (Mauchly test) and homoscedasticity (Levene test), and are therefore suitable for ANOVA analyses.

same attachment preferences in the L2, irrespective of their native language. For further statistical analyses, we therefore collapsed them into one L2 group.

To compare the L2 learners to the native speakers control group, a repeated-measures 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, p<0.001)[13]. On the other hand, there was no significant main 'Attachment' effect, which shows that overall there was no bias towards low or high attachment. We also found a significant interaction between 'Antecedent' and 'Attachment', which indicates that genitives were treated differently from PPs with respect to RC attachment (F_1(1,60) = 80.203, p<0.001; F_2(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: F_1(1,60) = 8.398, p<0.01; F_2(1,78) = 8.930, p< 0.01). Finally, there was a significant interaction of 'Antecedent', 'Attachment', and 'Group' F_1(1,60) = 13.096, p<0.01; F_2(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.

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13 This effect might be caused by PP constructions of the kinds we examined being less frequent than corresponding constructions with genitives, but since we do not have any reliable frequency database, this remains speculative. Note also that if the reduced acceptability of the PP construction was due to its low frequency, one would expect to find longer reading times in segment 2 for PP constructions than for genitives in the self-paced reading task. However, as will become clear in the next section, this was not the case, suggesting that the experimental results are unlikely to reflect a frequency difference of the two types of construction.

Further examination of these interactions using matched *t*-tests revealed significant differences between the two <u>GEN conditions</u> (Gen-high vs. Gen-low) for the native speakers ($t1_N(15) = 4.442$, $p < 0.001$; $t2_N(19) = 5.923$, $p < 0.01$), but not for the L2 learners ($t1_{L2}(45) = 1.714$, $p = 0.093$; $t2_{L2}(59) = 1.877$, $p = 0.066$). This means that the natives judged the high attachment sentences as more acceptable than the low attachment ones in the GEN conditions, whereas the L2 learners showed no such preference. In the <u>PP conditions</u> (PP-high vs. PP-low), on the other hand, there was a significant low-attachment preference for both participant groups ($t1_N(15) = 4.635$, $p < 0.01$; $t2_N(19) = 4.586$, $p < 0.01$; $t1_{L2}(45) = 5.451$, $p < 0.001$; $t2_{L2}(59) = 5.474$, $p < 0.001$).

In summary, we found that the form of the RC antecedent affected both the native speakers' and the L2 learners' attachment preferences, yet in different ways. The native speakers exhibited a clear high-attachment preference in sentences with genitive antecedents and, conversely, a low-attachment preference for antecedents with PPs. The L2 learners also preferred low attachment in the PP condition, but in the genitive condition there was no statistically significant attachment preference. It is also important to point out that the three groups of L2 learners performed in similar ways in this experiment. Before drawing any conclusions from these findings, we will report the results of the second main experiment, the self-paced reading task, which will provide evidence for attachment preferences in <u>on-line</u> processing.

Self-paced reading

Recall from section 5 that in this experiment, each sentence was followed by a comprehension question to make sure that the participants paid attention to the contents of the sentences. That this was indeed the case can be seen from the low percentages of erroneous responses to the filler

items: Natives 7.7%, L2-S 11.7%, L2-G 7.1%, L2-R 7.4%. The percentages of erroneous responses to the experimental items were higher, particularly for the L2 learners (Natives: 8.5%, L2-S: 14.6%, L2-G: 18.2%, L2-R: 22.7%), probably because overall the experimental sentences were more complex than the filler sentences. Trials that produced erroneous responses to the comprehension questions were excluded from any subsequent analysis. For the native speakers, RTs that were two standard deviations above or below the mean of an experimental condition were eliminated and removed from the data set before any further statistical analysis, which resulted in the removal of 4.6% of the data set. For the L2 learners, the cut-off point was 2.5 standard deviations, as the data from L2 learners are more susceptible to variation than those from native speakers, resulting in the elimination of 2.1% for the L2-S group, 3.2% for L2-G, and 2.3% for L2-R. The reading times per segment and condition are shown in Tab.4.

Recall from example (5) that the first segment is identical in all experimental conditions. The second one contains the complex DP and the third one the beginning of the RC, i.e. the ambiguous region. The fourth segment is the critical one, because it contains the disambiguating gender marking. The end of the sentence is presented as the fifth segment, and the sixth segment contains the comprehension question.

We performed the same statistical analyses on the mean reading times as on the acceptability judgment scores reported in the previous section. For the first three segments as well as for the sixth segment, these analyses did not reveal any statistically reliable interactions in either participant group. For the other segments, however, there were significant effects. These will be reported here focussing on the results from the critical (fourth) segment.

Tab. 4: Mean reading times (in milliseconds)

SEGMENTS	SUBJECTS	CONDITIONS			
		Gen-high	Gen-low	PP-high	PP-low
1st	Greeks	873.38	900.74	816.12	840.18
	Spaniards	1876.03	1987.28	1784.97	1851.88
	Germans	3000.52	2753.70	3174.88	2919.64
	Russians	2085.63	2196.24	2137.43	2156.65
2nd	Greeks	1419.36	1516.41	1594.86	1618.11
	Spaniards	3018.37	3322.55	3230.45	3432.95
	Germans	5515.01	5209.07	5241.24	4848.40
	Russians	4459.79	4603.49	4868.03	4861.16
3rd	Greeks	970.58	1011.88	1000.27	1086.73
	Spaniards	1558.59	1599.23	1718.54	1621.09
	Germans	1977.86	2288.31	2111.94	2053.23
	Russians	1956.03	2013.10	1864.65	1745.48
4th	Greeks	882.64	1222.12	938.38	864.32
	Spaniards	1915.85	1821.26	2035.71	1818.23
	Germans	2648.49	2894.40	3225.31	2654.04
	Russians	2285.79	2484.87	2649.23	2223.62
5th	Greeks	875.78	961.17	1022.01	872.11
	Spaniards	1844.01	1758.26	1766.47	1582.99
	Germans	2209.39	2476.83	2252.47	2086.57
	Russians	1653.10	1844.54	1868.19	1513.20
6th	Greeks	2645.62	2821.98	3043.62	2708.08
(Question)	Spaniards	4075.27	4013.82	4012.02	3888.85
	Germans	5225.79	4624.76	5531.66	4811.26
	Russians	4601.09	4128.93	4382.88	4898.45

Reading times on the fourth segment

To determine whether there are statistically significant differences between the three groups of L2 learners, a repeated-measures ANOVA with 'Antecedent' and 'Attachment' as within-subjects factors and 'L2-group' as between-subjects factor was performed. This analysis showed that the factor 'L2-group' did not significantly interact with either 'Antecedent' or 'Attachment', indicating that the three learner groups showed the same attachment preferences in the L2. For further statistical analyses, we 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. We found a main effect of 'Group' ($F1$ (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 ($t1_N(19) = 4.57$, $p< 0.01$; $t2_N(23) = 4.56$, $p < 0.01$), but not for the L2 learners ($t1_{L2}(35) = 0.872$, $p = 0.389$; $t2_{L2}(71) = 0.768$, $p = 0.445$), 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 Tab. 4), 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 (t1$_N$(19) = 2.49, p< 0.04; t2$_N$(23) = 1.407, p = 0.173; t1$_{L2}$(35) = 3.859, p< 0.001; t2$_{L2}$(71) = 3.760, p< 0.001).

Other statistical analyses

The same ANOVA (with 'Antecedent' and 'Attachment' as within-subjects factors and 'Group' as a between-subjects factor) that was performed on the fourth segment was also performed on the reading times of the fifth segment. The results from this analysis are summarized in Tab.5. For each comparison, the results from the subject and the item analyses are reported, with the former to the left and the latter to the right in each cell.

Tab. 5: Results from statistical analyses of the RTs of the fifth segment

MAIN EFFECTS / INTERACTIONS	Results
Antecedent	n.s. / n.s.
Attachment	n.s. / n.s.
Group	** / **
Antecedent × Group	* / n.s.
Attachment × Group	n.s. / n.s.
Antecedent × Attachment	* / **
Antecedent × Attachment × Group	n.s. / n.s.

Note: The asterisks (*) indicate significant main effects or interactions at p < 0.05, two asterisks (**) indicate main effects or interactions at p < 0.01 and 'n.s.' stands for non-significant.

The significant main effects and interactions shown in Tab.5 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, (Attachment × Group and Antecedent × 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.

Summarizing, the overall results of the SPR task are parallel to those of the acceptability judgment 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 low attachment of the RC to the PP. By contrast, when the RC antecedent contained a genitive (DP+DP$_{Gen}$), 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, we found that in both self-paced reading and acceptability judgment, the three groups of L2 learners exhibited similar attachment patterns irrespective of their different first languages.

GENERAL DISCUSSION

Attachment preferences in Greek native speakers

Native speakers showed a clear low-attachment preference for the RC in sentences with DP+PP antecedents and a high-attachment preference in sentences with DP+DP$_{GEN}$ antecedents. As pointed out in section 5, the explanation of these parsing preferences depends upon the syntactic structure posited for complex DPs in Greek. Consider first Alexiadou's (1999) movement account according to which possessive genitives are derived structures ($[[DP_i] DP_{GEN} t_i]$) that involve possessor movement. Under this syntactic analysis, the RC attachment preferences could be explained in terms of Late Closure/Recency. This is obviously the case for DP+PP

antecedents, but more interestingly, also for DP+DP$_{GEN}$ antecedents in which case Late Closure/Recency paired with Alexiadou's analysis would yield RC attachment to the trace of the moved DP. This account provides a simple and straightforward analysis of the present set of results, but it presupposes Alexiadou's analysis of the Greek DP, which might turn out to be incorrect on independent syntactic grounds. On top of that, the idea that high-attachment preferences for genitive antecedents reflect a disguised low-attachment preference (due to possessor movement) probably does not hold cross-linguistically. For example, possessive constructions in Romance languages are syntactically very similar to each other, and yet in terms of RC attachment, Romance languages behave rather differently from one another. The high-attachment preference for genitive antecedents that was found for Spanish and French might perhaps be attributed to possessor movement, but then it remains unclear why equivalent constructions in (Brazilian) Portuguese and Romanian (Ehrlich et al., 1999) yielded a low-attachment preference.

This raises the question of how the native speakers' attachment preferences can be explained in terms of the no-movement analysis of Greek DPs. Given these syntactic accounts, attachment preferences in Greek native speakers turn out to depend upon antecedent types, i.e. high attachment for genitive antecedents and low attachment for PPs. Thus, native speakers' attachment preferences appear to be influenced by both lexical biases of the antecedents and the structural relationship between the RC and its antecedent. As regards the lexical biases, our results from Greek replicate previous findings from other languages showing that when the second DP is introduced by a theta-role assigning lexical preposition, the RC tends to be attached low (see section 2). On the other hand, for genitive antecedents such as ton fititi tis kathighitrias 'the student of the teacher', the local thematic processing domain is the entire DP, which means

that the RC can be associated with DP-1 or DP-2 within this domain. Yet our experiments revealed a clear DP-1 attachment preference in these sentences, indicating that lexical or thematic biases provide only a partial account of Greek RC attachment preferences.

The second relevant factor is structurally-based preferences, such as <u>Late Closure/Recency</u> strategy and <u>Predicate Proximity</u> (see section 2). Recall that (according to Gibson and colleagues' account) languages may differ as to how much weight they give to proximity, depending essentially on a language's (non)-configurationality. In terms of this property, Greek patterns with Spanish, German or Russian in that it allows adjuncts and other material to occur between the head of a predicate phrase and its objects. Consequently, we predicted Predicate Proximity to outrank Recency in Greek yielding a high-attachment preference in sentences with genitive antecedents. Our results confirm this prediction.

The <u>attachment-binding hypothesis</u>, on the other hand, is not supported by our findings. Recall that according to this model, attachment preferences should depend on whether a RC is introduced by a relative pronoun or by a complementizer. Only in the former case should there be a preference for high attachment as has been found, for example, for German. However, in our experimental materials, RCs were always introduced by the complementizer *pu*, and still native speakers of Greek exhibited a clear high-attachment preference in sentences with genitive antecedents. The attachment-binding hypothesis cannot explain these data.

Attachment preferences in L2 learners of Greek

The L2 learners showed an overall RC attachment pattern that was different from that of native speakers, low attachment in sentences with PP antecedents (like native speakers), and no preference in sentences with genitive antecedents (unlike native speakers). In addition to the

present set of findings, a recent study of RC attachment in English (Felser, Roberts, Gross & Marinis, 2002) yielded parallel results. Felser et al. examined two groups of L2 learners of English, 40 advanced learners with Greek as L1 and 28 advanced learners with German as L1, using a questionnaire and a self-paced reading task. Felser et al. found that both groups of L2 learners preferred low attachment in sentences with lexical PP-antecedents, such as <u>The dean observed the professor with the researcher who was never happy</u>. In corresponding sentences with DP-<u>of</u>-DP antecedents, however, the L2 learners did not show any attachment preference. This is different from English native speakers who showed a low-attachment preference for the RC in sentences with DP-<u>of</u>-DP antecedents. Thus, despite the fact that Felser et al. examined a different target language and L2 learners with a different L1 background, their experiments revealed the same RC attachment patterns that we found for L2 Greek. Moreover, both studies examined advanced L2 learners, and yet their attachment patterns were found to be different from those of native speakers of Greek and English, respectively. In the following, we will discuss various factors that might be responsible for this difference.

Transfer and experience-based parsing

From the perspective of experience-based parsing models such as the Tuning Hypothesis (Mitchell et al., 1995) and the Competition Model (MacWhinney, 1987; 1997), one would expect that attachment preferences in the learners' L1 directly influence their L2 performance. The specific hypothesis derived from the Tuning Hypothesis (see section 2) was that the L2 participants of our study should easily get 'attuned' to the high-attachment preference of Greek in RCs with genitive antecedents, because this is the option the learners are exposed to in both their L1 native languages (Spanish, German or Russian) and in the target language (Greek). Our

results do not confirm this prediction. However, proponents of experience-based accounts might argue that L1 parsing preferences only influence L2 parsing during early stages of L2 development and that the advanced L2 learners we have studied have developed out of that stage. This would mean that (due to L1 influence) Spanish, German or Russian L2 learners of Greek initially prefer high attachment of a RC to a DP containing a genitive antecedent and that at later stages of L2 acquisition, they give up this preference. That is, the L2 learners would initially exhibit the same attachment preferences as native speakers of Greek, and later, when they have acquired more knowledge of Greek, they would perform differently on the same constructions. This kind of developmental progression is not what one would expect from the perspective of experience-based parsing models. According to the Tuning Hypothesis, for example, the advanced L2 learners' persistent exposure to Greek should have strengthened the putative (L1-based) high-attachment preference of the initial stages. Yet none of the three groups of advanced L2 learners we studied showed a high-attachment preference for genitive constructions.

Consider also the possibility that attachment preferences in L2 Greek might be influenced by the learners' knowledge of a third language, specifically their knowledge of English. Even though we cannot completely rule out this possibility, it is not very likely, for the following reasons. First, all participants' knowledge of Greek is more advanced than their knowledge of English. Moreover, all participants were living in Greece and used Greek (rather than English) in their everyday life when the experiments took place. From an exposure-based perspective, one would not expect an L3 to having any substantial influence on the learners' attachment preferences in their relatively strong L2, i.e. in Greek. Finally, if knowledge of English had any effect, then those participants who are relatively proficient in English should exhibit other attachment patterns in their L2 Greek than learners who are less proficient in English. The former might, for

example, prefer low attachment in Greek sentences with genitive antecedents corresponding to English. This was not the case, however. The group of German L2 learners was more proficient in English than the Spanish and Russian groups, and yet the attachment patterns in L2 Greek were similar across these three groups. We therefore conclude that our findings are hard to explain in terms of transfer and experience-based parsing models[14].

Another possibility that needs to be considered is that language-particular differences precluded the use of transfer. Consider, for example, Spanish versus Greek in the domain of possessive constructions. While Greek employs a genitive construction such as <u>i steghi tu spitju</u> 'the roof of the house', the equivalent construction in Spanish (<u>el techo de la casa</u>) contains a PP and no genitive. Thus, one might speculate that there is no linguistic basis for Spanish learners of Greek to transfer attachment preferences from their L1, since the two languages make use of different means of expression in possessive constructions. As regards German and Russian learners of Greek, however, their native languages have genitive constructions; the German equivalent would be <u>das Dach des Hauses</u> and the Russian one <u>КРЫША ДОМА</u> (krisha doma). Thus, if these linguistic differences played a role for L2 attachment patterns, L1 transfer in the genitive

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14 Here we examined the issue of transfer in the context of experience-based parsing models. That is, we asked the question of whether language-particular parsing preferences in the learners' native language are the source of their attachment preferences in L2 Greek. Given the terminology introduced by Dekydtspotter, Sprouse & Anderson (1997), this corresponds to an extensional construal of transfer. As Dekydtspotter et al. (1997: 307) point out, there is an alternative intensional view of transfer, at least with respect to L2 grammar development, according to which L1 knowledge is conceived of as a direct instantiation of U(niversal) G(rammar) and hence constructing an L2 grammar 'on the basis of L1 knowledge' is tantamount to constructing an L2 'on the basis of UG'. Likewise, L1 parsing might be taken to be a direct instantiation of a U(niversal) P(arser), and one might, for example, hypothesize that L1 transfer (conceived of as an instantiation of UP) represents the initial state of L2 processing, similarly to what Schwartz and Sprouse (1996) have argued for with respect to L2 grammar development. While we do not wish to exclude this possibility in principle, it is unclear to us whether this account is empirically distinguishable from the alternative (i.e., extensional) view of L1 transfer mentioned above for the phenomenon under study.

construction should be more likely for the German and Russian learners than for the Spanish ones, i.e. at least the German and Russian learners should show a high-attachment preference in the genitive construction. Our results show that this was not the case. Indeed, none of the L2 learner groups showed a reliable high-attachment preference in the genitive construction. We can therefore rule out the possibility that the lack of L1 transfer is due to linguistic differences between the particular languages involved.

Grammatical knowledge and parsing strategies in L2 learners

Another possibility that needs to be considered is that the differences between L2 learners and native speakers in RC attachment are due to the L2 learners' incomplete acquisition of the Greek grammar. For example, gender/number agreement information was used in the critical experimental sentences for disambiguation, and it is likely that an L2 learner who has not properly acquired agreement in Greek cannot use the disambiguating cues in the same way as a native speaker.

To assess this possibility, we can rely on the grammaticality judgment and proficiency tests that were performed with the L2 learners. In the general Greek Language Proficiency Test, the L2 learners came out as being highly proficient in Greek with scores of 72 to 75 (out of a maximum of 80), see section 6. More importantly, in judgment tasks of the grammatical constructions under study they also achieved high correctness scores. For subject-RCs with complex (DP+DP or DP+PP) antecedents such as those used in the main experiments, the L2 learners had mean grammaticality judgment scores of over 90% correct (see Tab.2). Similarly, in the task that examined gender/number agreement, the L2 learners achieved correct judgment scores of 95% to 96%, similar to those of the native speakers (see section 7.2). These results indicate that with

respect to their knowledge of Greek in the relevant grammatical domains, the L2 learners performed at native-speaker levels. The differences between native speakers and L2 learners with respect to RC attachment are therefore unlikely to result from the L2 learners' incomplete acquisition of the Greek grammar.

CONCLUSION

We found that advanced L2 learners of Greek with Spanish, German or Russian as L1s exhibited the same low-attachment preference for RC in sentences with PP-antecedents as native speakers of Greek, while they did not show any attachment preference in sentences with genitive antecedents, in which native speakers of Greek showed a clear high-attachment preference. Parallel results were obtained by Felser et al. (2002) for Greek and German L2 learners of English. Taken together, these results show that in different target languages, L2 learners with different L1 backgrounds exhibit the same RC attachment patterns, namely a clear low-attachment preference in sentences with lexical PP-antecedents and no preference in sentences with genitive or DP-of-DP antecedents.

There are various possible reasons as to why the L2 learners' attachment preferences are different from those of native speakers. One factor could be the learners' incomplete acquisition of the target language. L2 learners may have underspecified representations in their lexicon, or other gaps in their L2 grammars that may affect their ability to parse particular kinds of sentences. Note, however, that all our participants had scored very highly on both the language proficiency and the grammaticality judgment tests, which does not make this possibility seem very likely. Another potentially relevant factor is that when L2 learners process a sentence in the L2, grammatical representations and parsing strategies of the learners' L1 might not completely

be suppressed and affect their attachment preferences in the L2. We do not wish to completely exclude the possibility of L1 transfer in L2 sentence processing, but our findings indicate that at least in the case of RC attachment to genitive antecedents the advanced learners we studied were not directly influenced by the attachment preferences in their L1s.

A more feasible possibility is that learners may have difficulty integrating different sources of information when processing their L2. We argued that attachment preferences in native speakers of Greek are influenced by both structurally-based parsing strategies and lexical/thematic biases, while L2 learners' relative clause attachment preferences are mainly guided by lexical cues. More generally, this difference might mean that, in contrast to the L1 parser which integrates incoming ambiguous elements *immediately* into the current parse during on-line processing, the L2 parser *delays* integration until sufficient lexical (and perhaps other) information has been received for attaching an ambiguous word or phrase. Under this account, our finding that in sentences with PP-antecedents the L2 learners showed the same low-attachment preference as the native speakers can be attributed to the presence of a lexical cue (i.e. the lexical PP) that biases them towards low attachment. When there is no such cue, i.e. in sentences with genitive antecedents, the L2 learners do not show any disambiguation preference. However, further experimentation is needed to determine whether our findings on relative clause attachment generalize to other kinds of ambiguous sentences and to answer the broader question of whether L2 parsing is in any fundamental way different from parsing in a native language.

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