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# Transfer of L1 processing strategies to the interpretation of sentence-level L2 input: A cross-linguistic comparison on the resolution of relative clause attachment ambiguities

Onur Uludağ [a*]

[a] *Yildiz Technical University, Istanbul 34220, Turkey*

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## Abstract

The present study aims to investigate the role of L1 transfer effects on L2 sentence processing strategies during the interpretation of relative clause (RC) attachment ambiguities. The main body of the study is divided into two sections. The first section describes Experiment 1, which is designed to test the resolution of RC attachment ambiguities by Turkish learners of L2 English both in Turkish and English through the use of an off-line task (i.e., paper-and-pencil comprehension tests) and compare their processing preferences to those of native English speakers. The second section presents Experiment 2, which aims to investigate the real-time processing of the RC attachment ambiguities by the same participant groups employing eye-tracking methodology. The results indicated that L1 Turkish and L1 English RC attachment preferences differed and that Turkish learners of L2 English tended to transfer their Turkish sentence processing pattern to real-time interpretation of the English RC attachment ambiguities.



***Keywords:*** sentence processing; parsing; ambiguity resolution; eye-tracking; attachment

## 1. Introduction

Unlike children acquiring their first language (L1), adults start their endeavor of learning a second language (L2) with an entirely developed and fully functional underlying language system and this issue remains to be the most fundamental difference between L1 and L2 learning. Thus, the question of whether and to what extent transfer from L1 influences the development of subsequent language systems has been one of the longest-standing concerns of research on L2 acquisition. Transfer

* Corresponding author. Tel.: +90-212-383-4915
*E-mail address*: ouludag@yildiz.edu.tr
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in L2 acquisition has been defined as the impact of L1 (either in the form of facilitation or, more often, interference) on the L2 due to similarities and differences between the two (Odlin, 1989). In fact, previous research has documented that transfer features in essentially all levels of underlying L2 system including phonological (Hancin-Bhatt, 1994; Thompson, 1991), lexical-semantic (Jiang, 2004; Palmberg, 1987), syntactic (Montrul, 2001; White, 1985) and pragmatic (Yu, 2004) aspects of the language. More recently, the role of L1 transfer on L2 sentence processing and comprehension has been debated with differing viewpoints on the information sources claimed to be utilized by L2 learners to comprehend L2 sentences. To illustrate, there are those researchers who ascribe a minimal role for L1 during real-time L2 processing and argue that sentence comprehension at the initial stages is costly in terms of processing/attentional resources available; therefore, processing is not guided by morhpo-syntactic parameters, but instead depends more heavily on universal strategies concerning the processing of lexico-semantic and pragmatic features (e.g., Clahsen & Felser, 2006a; Jackson, 2007, 2008; VanPatten, 2007), or other strategies pertaining to considerations such as processability (Pienemann, 2005) or structural distance and amelioration (O'Grady, 2010). Other researchers attribute a more prominent role for the L1 transfer during real-time L2 processing, arguing that since L2 acquisition develops through the form-to-function mappings of the L1 (MacWhinney, 2005), the processing mechanism of the L1 acts as a filter for all components of the developing L2 system including syntax to morphology to lexicon. In this respect, it is assumed that L2 learners initially transfer some L1-specific processing strategies to comprehend L2 input (Carroll, 2001; Dussias, 2001, 2003; Frenck-Mestre, 2002, 2005; Juffs, 2005).

A mainstream research interest with regard to examining the L1 influence on L2 has been the processing of structural ambiguities, more specifically relative clause (RC) attachment ambiguities. In this strand of examinations, researchers have been intrigued to find out how speakers of different languages would interpret sentence constructions of the following type: '*Somebody hit the father of the author who was at the café*'. This sentence is ambiguous as the RC, *who was at the café*, could modify either noun phrase (NP), *the father* or *the author* in the complex genitive NP. When prompted to resolve this sort of ambiguity with the question '*Who was at the café? The father or the author?*, the answers have varied across languages, with native speakers of English, Norwegian, Romanian and Swedish opting for the answer '*the author'* to attach the RC, also known as low attachment preference, while L1 speakers of languages such as German, Dutch, Russian, Spanish, Brazilian, European Portuguese, Japanese and Greek preferring the answer '*the father*', which is often referred to as high attachment preference in the relevant literature (see VanPatten & Jegerski, 2010, p. 9 for the references). Within the context of L2 acquisition, the investigations of similar stimulus sentences have attracted considerable attention from researchers because possible evidence for cross-linguistic variation in processing preferences could offer insights into several issues including how L2 syntactic processing takes place, whether and to what extent the transfer of L1 processing

routines could influence real-time L2 sentence comprehension and whether native-like processing is possible for L2 learners to achieve. In an attempt to contribute to the discussion of these issues, the present study is designed to compare L1 and L2 processing of the RC attachment ambiguities employing Turkish speakers of L2 English. What makes the present study particularly relevant in this context is that the target language, English, has been reported to be a low-attaching language (Carreiras & Clifton, 1999; Frazier & Clifton, 1996). However, Turkish bears resemblance to other high-attaching languages such as Spanish and German (Cuetos & Mitchell, 1988 for Spanish and Hemforth, Konieczny, Scheeper, & Strube, 1998 for German) in the sense that they allow for relatively free word order, which was reported to be a parameter influencing processing preferences. Admittedly few studies, to the author's knowledge, examined sentence processing preferences of Turkish subjects either in their L1 (e.g. Kirkici, 2004) or in L2 English (e.g. Dinctopal-Deniz, 2010) and these studies generated somewhat inconclusive findings. With a design that controls for the methodological issues raised in the previous research (see Section 3 for the details), the present study presents an interesting case to investigate whether Turkish speakers would elicit a similar high attachment preference in their L1 as in Spanish or German and whether this processing tendency could be observed during the comprehension of L2 English sentences in real time.

The organization of the present study is as follows: First, the background of the study will be presented with an emphasis on the previous research on the role of transfer in L2 learning and more specifically L2 sentence processing research on the RC ambiguity resolution. The following section will introduce the details of the present study including the specific predictions, methodology and findings and discussion of each experiment. Finally, the paper will conclude with a general discussion of the results and suggestions for future research.

## 2. Review of Literature

The debate concerning the role of L1 transfer in L2 processing is essentially similar to the discussion that has dominated the second language acquisition (SLA) research in more general terms. For instance, in the discussion regarding the mental representation of L2 in learners' mind, some scholars have argued in favor of full transfer, suggesting that during the initial stages of the L2 development, the entirety of the morhpo-syntactic features in L1 provide a basis for the newly developing L2 mental representation along with the contribution of the Universal Grammar (e.g., Schwartz & Sprouse, 1996; White, 2003). On the other hand, others who attribute a rather partial or restricted role for transfer in the initial phases have suggested only the transfer of lexical and functional categories (e.g., Eubank, 1996; Vainikka & Young-Scholten, 1996) or favor the argument that only those linguistic forms that can be processed by L2 learners are conducive to be transferred (see Processability Theory; Hakansson, Pienemann, & Sayehli, 2002; Pienemann, 1998). Also, there have been scholars who ascribe little or no role for L1 transfer, asserting that it is only the general cognitive learning strategies that could be associated with L2 acquisition (e.g.,

Clahsen & Muysken, 1989). However, it should be noted that this viewpoint has not been supported by findings from studies employing L2 learners with different L1 backgrounds and at different L2 proficiency levels. In fact, the evidence from those studies showed that transfer of the syntactic features takes place not only from L1 to L2 (e.g., Harrington, 1987; Sasaki, 1994) but also in the opposite direction provided L2 use is more predominant (e.g., Liu, Bates, & Li, 1992).

Based on the theoretical frameworks discussed above, it is also possible to ascribe a more selective role for L1 because there are some aspects of processing that could be considered universal or common to all learners, regardless of the L1 and the context, while there are some aspects that are subject to L1 influence more readily. For instance, in an investigation that addressed the resolution of conflicts between the verbal morphology and lexical adverbs in sentence constructions pairing '*is cleaning'* with '*yesterday'* and '*was cleaning'* with '*right now'*, VanPatten and Keating (2007, as cited in VanPatten & Jegerski, 2010, p. 10) found that native Spanish speakers depended on verbal morphology whereas native English speakers relied on lexical adverbs to resolve conflicts. When English speaking L2 Spanish learners were tested on the same sentence constructions in L2, they displayed reliance on lexical adverbs, hinting a possible transfer effect from the L1. Nevertheless, when Spanish speaking L2 English learners were tested, we were found to rely on lexical adverbs as well without displaying their L1 Spanish strategy to rely on verbal morphology. The researchers concluded that the strategy applied in English suggested a universal or default processing strategy known as Lexical Preference Principle while the strategy in Spanish was accounted for with the notion of markedness. In another study, Jegerski, VanPatten and Keating (2011) found L2 processing not to be impacted by the L1 during the syntactic processing of overt and null subjects by English-speaking learners of L2 Spanish, whereas the participants displayed marginal transfer effects from the L1 for discourse structure, that is, coordination or subordination of clauses. Given these findings, it is more conceivable to argue that the debate on L1 transfer effects could benefit more from the investigations specifying transfer under what circumstances and for processing of what sort of language features rather than arguing for strict dispositions of L1 transfer or no L1 transfer.

In this context, the examinations on the role of L1 influence in processing preferences have focused on the resolution of RC attachment ambiguities, which has attracted the most attention in sentence processing research as these constructions are conducive to investigate cross-linguistic variations in sentence processing preferences as suggested above. The evidence that native speakers of different languages display differing processing preferences upon the resolution of RC attachment ambiguities presents a peculiar case to investigate whether L2 learners transfer processing strategies or preferences from their L1 to the target language. Several studies have attempted to refer to this question comparing different pairs of languages such as English-Spanish, English-German, English-French, Spanish-Greek and Spanish-French (see Uludag, 2018 for a review) using a variety of off-line methods such as question-answering accuracy or recall tasks (e.g. grammaticality or

acceptability judgement tests) that focus on the outcome of sentence processing procedure or on-line methods that measure reaction/reading times or probability of regressions during real-time processing (e.g. self-paced reading, eye-tracking methodology, etc.). The findings from these investigations have been comparatively inconclusive with a body of research displaying no clear attachment preference and those offering evidence for the transfer of attachment preferences during the processing of the RC attachments in L2.

The investigations run by Clahsen, Felser and their fellow researchers on RC ambiguity resolution tasks have mostly reported no observable attachment preferences with learners from various L1 backgrounds and their findings have set the ground for formulation of a rather popular proposal known as Shallow Structure Hypothesis (SSH) (2006a, 2006b, 2006c, 2017). The SSH suggests that the syntactic representations that learners formulate for the interpretation of L2 are shallower and less detailed than those of native speakers, yet L2 learners can utilize lexical, semantic and pragmatic information comparatively well to construct a semantic representation of the sentence (Clahsen & Felser, 2006a, p.32). As for the approach of the SSH to L1 transfer, it is claimed that in the domain of language processing there seems to be very little or no transfer from L1 and therefore, regardless of their L1s, L2 learners are predicted to behave more similarly to each other than native speakers of the target language.

One of the studies that lent support for the SSH was conducted by Felser, Roberts, Marinis and Gross (2003). The researchers tested advanced level Greek L1 – English L2 and German L1 – English L2 learners on sentence constructions similar to the following: *The dean liked the secretary of / with the professor who was reading a letter*. The results indicated that in the absence of a lexical information, which was assumed to be provided by the preposition *with* in the test sentences, both learners groups showed no attachment preference, thus no sign of transfer from L1.

More interesting findings indicating no particular attachment preferences in L2 learners were reported by Papadopoulou and Clahsen (2003), which examined advanced level German, Spanish and Russian learners of L2 Greek. Even though the L1 of all participants were documented to show the same processing preference pattern to that in Greek, no participant group displayed an obvious RC attachment preference during the comprehension of sentences in Greek.

In a more recent investigation, which also motivated the present study, Dinctopal-Deniz (2010) examined the processing of the RC attachment preferences of monolingual Turkish speakers and Turkish learners of L2 English and also native English speakers in off-line paper-and-pencil comprehension tests and on-line self-paced reading tasks. The test sentences included both globally ambiguous RC constructions and temporarily ambiguous ones that were manipulated using animacy information. The results demonstrated that in both on-line and off-line tasks, the native speakers of English and monolingual Turkish speakers displayed low attachment preference. However, Turkish learners of L2 English did not process the

test sentences like either L1 Turkish speakers or L1 English speakers in their on-line and off-line attachment preferences. While they indicated a high attachment preference when the NPs were animate, they did not seem to present statistically significant attachment preference when the NPs were inanimate. On the other hand, the off-line comprehension test results indicated a high attachment preference irrespective of the animacy information that the NPs carried. In her discussion of the results, Dinctopal-Deniz (2010) maintained that the data from the Turkish learners of L2 English indicating no attachment preference in the absence of lexical information during on-line processing was congruent with the predictions of SSH concerning shallow L2 processing and lack of transfer effects.

There is also a growing body of research suggesting that during the processing of RC attachment ambiguities, L2 learners transfer attachment preferences from their L1. For instance, Frenck-Mestre and Pynte (1997) investigated the RC attachment preferences in L2 French, a high attaching language, with a group of participants including native speakers of French, beginner English learners of French, beginner Spanish learners of French. The results showed that Spanish learners of French preferred high attachment similar to what was reported before for the attachment of RCs in L1 Spanish. On the other hand, the beginner English learners of French preferred low attachment, a preference that was previously observed for L1 English. The researcher suggested that the set of findings could be interpreted to result from the impact of L1 on the L2 sentence processing. In a later study, Frenck-Mestre (2002) indicated that advanced level English learners of French demonstrated a tendency to attach RCs to the high NP, an attachment preference similar to that of French monolinguals. Thus, it was argued that increasing proficiency in the L2 might bring about a change in the parsing strategies, from processing based on the L1 of the L2 learners to that relatively associated with the processing of native speakers of the target language.

Fernandez (2002) also examined the effects of L1 on the L2 processing of ambiguities involving RC attachments with English-Spanish bilinguals through the use of off-line and on-line tasks. Two groups of bilinguals, namely L1 English-L2 Spanish and L1 Spanish-L2 English were employed and their processing decisions were evaluated in comparison to monolingual speakers of Spanish and English. The findings of the off-line task showed that the attachment preferences were influenced by the dominant language of participants because they preferred the attachment site which was in line with that of the monolingual L1 speakers. More specifically, the English dominant group favored the low attachment preference, whereas the Spanish dominant group preferred high attachment. Interestingly enough, the findings of the on-line task did not coincide with the data from the off-line task as both groups of bilinguals did not show any significant tendency to attach the RC to either of the NPs displaying no clear attachment preference, unlike monolinguals, who uniformly attached the RC to the low attachment site. The researcher maintained that the difference in the outcome of the on-line task could be attributed to the lack of sensitivity in the experimental procedure which taps into initial processing choices.

Similar findings of transfer effects in the processing of RC attachments were also reported by Rah (2009), who examined two groups of German learners of English at differing proficiency levels and native English speakers through off-line and on-line measures. The researcher developed test sentences similar to those used in Felser et al. (2003) with two designated attachment sites connected by the prepositions *of* and *with*. Congruent with the previous findings from monolingual English speakers, the native English speakers showed low attachment preference regardless of the preposition information. As for the German learners of English in the advanced level group, they did not indicate any attachment preference with the sentences in the *of*-condition, yet in the *with*-condition they preferred the low attachment site. This finding was in line with that of Felser et al. (2003) for the learner group in the same proficiency level. Nevertheless, learners in the intermediate level group preferred the high attachment site in the *of*-condition, which the researcher took to interpret as a transfer effect as German has been documented to be a high-attaching language (e.g. Hemforth et al., 1998).

Finally, in a more recent study Witzel, Witzel and Nicol (2012) investigated processing patterns of native English speakers and advanced Chinese learners of English on three sentence types including temporarily ambiguous RC constructions. The results from the on-line eye-tracking task indicated that both Chinese learners of English and native English speakers indicated a preference for a particular attachment site. More specifically, unlike native English speakers who showed a low attachment preference, Chinese learners of English preferred the high attachment site. This particular finding could be argued to result from the transfer effects from Chinese as previous research indicated evidence for a high attachment preference with the native speakers of Chinese (Cai, 2009, cited in Witzel et al., 2012).

The bilingual participants reported in the above investigations possess their own circumstantial characteristics. In order to contribute to a more comprehensive account of L2 sentence processing, it is imperative to provide supplementary evidence to the existing data from other bilingual participant groups. In this respect, the comparison of Turkish speakers' L1 and L2 processing preferences to native English speakers can shed further light on the issues as to whether and to what extent the transfer of L1 processing routines could influence L2 sentence comprehension and whether it is possible for L2 learners to achieve native-like processing in the L2.

## 3. The Present Study

The main body of the present study is divided into two sections. The first section describes Experiment 1, which primarily aims to test the RC attachment ambiguity resolution of L1 Turkish-L2 English bilinguals and compare their processing preferences to that of native English speakers through the use of an off-line task (i.e., paper-and-pencil comprehension tests). The second section presents the details of Experiment 2, which has been designed to investigate the real-time processing of the RC attachment ambiguities by the same participant groups employing on-line eye-

tracking methodology. It is important to note that the studies that have been unable to detect any consistent sentence processing patterns have employed either off-line comprehension questionnaires (e.g. Kirkici, 2004, among others) or on-line self-paced reading methodology (e.g. Dinctopal-Deniz, 2010; Felser et al., 2003, Fernandez, 2002, Papadopoulou & Clahsen, 2003), while those that have shown a certain processing pattern have incorporated eye-tracking methodology (e.g. Frenck-Mestre, 2002, Witzel et al., 2012). Even in studies examining processing preferences in L1, no specific processing pattern is observed as the differences in reading times recorded through self-paced reading methodology are often subtle. Therefore, the present study is designed to compare the findings from an off-line task to those from on-line eye-tracking methodology, which has been demonstrated to reveal more consistent reading time patterns than self-paced reading. For the purposes of the study, the off-line task of the Experiment 1 was run initially. The on-line task for the Experiment 2 started to be conducted eight days after the administration of Experiment 1 and completed in three days.

As can be noted in the previous section, cross-linguistic transfer effects were indicated by a great many of the investigations. Similarly, transfer effects are anticipated in the present experiments. Since Turkish bears resemblance to other high-attaching languages such as Spanish and German in that they allow for relatively free word order, Turkish speakers of English are anticipated to show a high attachment preference in their L1, unlike native English speakers who have been reported to display low attachment preference. Turkish learners of English are also expected to transfer this processing tendency to their off-line and on-line comprehension of sentences in the target language English. The details of both experiments are reported as follows:

### *3.1. Experiment 1*

This experiment examined off-line processing of globally ambiguous Turkish and English sentences including a complex genitive NP of the type of *NP₁ of NP₂* followed by a RC modifier. Turkish learners of L2 English at advanced proficiency level indicated their RC attachment preferences for globally ambiguous sentences both in L1 Turkish and L2 English on paper-and-pencil comprehension tests. In order to make a direct comparison, native English speakers were also tested to express their RC attachment preferences for globally ambiguous English sentences in the present experiment. The research questions addressed in the present experiment are as follows:

1. Do the processing preferences in L1 Turkish differ from those in L1 English during off-line interpretation of globally ambiguous statements including RC constructions?
2. Do the Turkish learners of L2 English transfer their L1 processing preferences during the off-line interpretation of globally ambiguous statements including RC constructions in L2 English?

*3.1.1. Participants*

The participants included Turkish learners of L2 English in the experimental group and a control group consisting of native English speakers. Those employed in the experimental group were all students majoring in English-medium instruction (EMI) programs at a public university in Turkey and they ranged in age from 19 to 22. Before the study was conducted, all students had received formal instruction by attending a preparatory program and studied English for a year. The participants' level of proficiency in English had been assessed at the end of the preparatory program by an in-house proficiency exam which was a conceptual equivalent of Cambridge First Certificate Exam in terms of the content and the difficulty level. Having successfully passed the proficiency test, they were enrolled in their EMI major programs and also had to take an English class during the first semester of their disciplinary education in their own departments. Advanced level students were selected as they would have familiarity and prior experience of practice with target structures.

The control group consisted of native English speakers who were living in Turkey at the time of the experimentation. They were all graduates of a university with a mean age of 36 and they were comparable to the Turkish participants with regard to their cognitive abilities and socio-linguistic background.

All subjects participated in the experiment on a voluntary basis and gave a written informed consent. The final number of participants were fifty, distributed as follows: advanced L2 English learner group ($n$=26) and control ($n$=24).

*3.1.2. Materials*

Two different sets of materials were developed for the purposes of the present experiment, the first being designed to test RC attachment preferences for globally ambiguous Turkish sentences and the other for globally ambiguous English sentences. By global ambiguity, it is implied that the target sentences are constructed to allow for inference of at least two distinct interpretations without the reader being unaware of the presence of the ambiguity.

Each set of sentences for both languages consisted of twenty-four test sentences and twenty-five unambiguous fillers. The fillers were used to distract the participants from the purposes of the study and to avoid the use of reading strategies. The filler sentences were intermingled in such a way that no two test sentences directly followed one another. Both nouns in the complex genitive NP held the same lexical information concerning the animacy of the noun. Namely, the complex genitive NPs in half of the experimental sentences (n=12) were constructed using animate nouns, as in (3) and (5), whereas in the other half (n=12) they were constructed by using inanimate nouns, as in (4) and (6) below. The target items were designed so that the participants would not be lexically biased to attach the RC to either NP host. All test items were followed by a comprehension question inquiring which noun the RC modified. The answer choices given in (a) and (b) were counterbalanced in a way that

the first and the second NP equally appeared as option (a) and (b) as illustrated below:

(3) Alkol bağımlısı olan komşunun oğlu hastanede tedavi gördü.

*[Alcohol addict be-RC neighbor-GEN son-POS hospital-LOC treatment see-PAST]*

- Alkol bağımlısı olan kimdir?

  *[Alcohol addict be-RC who-VERB]*

  a. komşu b. (komşunun) oğlu

  *[neighbor]* *[(neighbor-GEN) son-POS]*

(4) Yurt dışından getirilen makinanın parçaları testi başarıyla geçti.

*[Homeland outside-ABL bring-PAS-RC machine-GEN part-PLU-POS test-ACC successfully pass-PASS]*

- Yurt dışından getirilen nedir?

  *[Homeland outside-ABL bring-PAS-RC what-VERB]*

  a. (makinenin) parçaları b. makine

  *[(machine-GEN) part-POS]* *[machine]*

(5) The father of the author that was killed in the robbery was very rich.

- Who was killed in the robbery?

  a. the father b. the author

(6) The furniture of the room that had bright colors amazed the guests.

- What amazed the guests?

  a. the room b. the furniture

*3.1.3. Procedure*

The off-line task was administered as a paper-and-pencil comprehension test after regular class hours by the researcher. At no time were the participants involved in any work concerning the experiment outside of class. They were first given the comprehension test that examined their RC attachment preferences for globally ambiguous Turkish sentences and then the test with the English items followed*. The native English speakers in the control group were only given the questionnaire that investigated their tendency to attach RCs in globally ambiguous English sentences.

The participants were instructed to read each ambiguous sentence and decide which of the two possible interpretations they would opt for. They were also asked to

* An anonymous reviewer commented that since the participants read the Turkish items first and then the English items, they could have developed a test taking strategy by the time they read the English items, which could have skewed the results for English items. However, the author believes that this could not have been the case as the English items were novel sentences, which were not the exact translations of the Turkish items and therefore required distinctive interpretations. Additionally, in order to ensure that the participants were not merely applying a test taking strategy and paying due attention to the items, the distractor filler sentences with only one correct interpretation were employed so that the participants not being able to answer these accurately could be removed from the final analysis.

make their choices as spontaneously as possible. In order to decrease the level of anxiety for making mistakes, the participants were told that both interpretations were possible for some sentences. Nevertheless, to make sure that they paid attention to the task, filler sentences with only one correct interpretation were included so that the ones who did not answer these correctly could be excluded from the analysis.

*3.1.4. Results*

The findings from the off-line task which examined the processing of globally ambiguous Turkish sentences by Turkish learners of L2 English indicated that they tended to attach the RC modifier to the high NP (68%) instead of the low NP (32%) and the difference in the attachment preference between high and low reached statistical significance: $t(25) = 6.419$, $p < .001$. In an attempt to see the effect of the use of inanimate and animate NPs in the complex genitive NPs, which was reported to influence the processing preferences in the previous research (see Dinctopal-Deniz, 2010 and Kirkici, 2004 for details), a further analysis was conducted and the same preference appeared when the RC modified inanimate NPs (67% high, 33%low) $t(25) = 5.493$, $p < .001$ and when the RC modified animate NPs (61% high, 39% low): $t(25) = 4.201$, $p < .005$.

A further 2 X 2 ANOVA was conducted with Attachment Preference (low vs. high) and Condition (animate vs. inanimate) to examine whether the attachment preferences differed in inanimate and animate conditions. The results of the ANOVA indicated a main effect for Attachment Preference: $F(1, 25) = 33{,}011$, $p < .001$. There was no significant interaction between Attachment and Preference Condition: $F(1,25) = 2{,}021$, $p < .902$. These findings suggest that regardless of the animacy information manipulated in the test items Turkish learners of L2 English showed a statistically significant tendency to attach the RC modifier to the high attachment site in the complex genitive NP.

As for the results from the off-line task investigating the processing of globally ambiguous English sentences, the table below illustrates the percentages of RC attachment preferences for Turkish learners of L2 English and native English speakers of the control group:

Table 1. Percentages of offline attachment preferences for the attachment of RC modifiers

| | RC Attachment Preferences in Ambiguous Sentences | |
|---|---|---|
| | % High Attachment | % Low Attachment |
| Native English Speakers | 20.8 | 79.2 |
| Turkish Learners of L2 English | 53.5 | 46.5 |

As can be seen in the table, native English speakers displayed a statistically significant attachment preference for the low NP (79.2%) instead of the high NP (20.8%): $t(23) = -10.581$, $p < .0001$. On the other hand, the results for the Turkish learners of L2 English did not indicate a similar attachment preference. In fact, they displayed a statistically unreliable preference for high attachment (53.5%) over low attachment (46.5%): $t(25) = -7.585$, $p < .872$. The difference regarding the overall

attachment choices for the two groups was statistically significant: $t(49) = -7.103$, $p < .001$.

In order to examine whether the attachment preferences differed in test items with animate and inanimate NPs, a 2 x 2 x 2 mixed design ANOVA was run with Group (native English speakers vs. Turkish speakers of L2 English) as between-subjects variable and with Attachment Preference (low vs. high) and Condition (animate vs. inanimate) as within-subject variables. The analysis yielded a significant interaction between Group and Attachment Preference: $F(1, 48) = 41.012$, $p < .001$, which suggested that there was a significant difference between the groups in terms of their preferences of RC attachments. There was no significant main effect for Attachment Preference ($p > .05$) and Condition ($p > .05$) and there was no significant interaction between Condition and Group ($p > .05$).

Overall, the analysis of the results to the off-line tasks revealed that only the native English speakers displayed a low attachment preference in their processing of the RC attachment ambiguities in English test items. As for the Turkish learners of L2 English, even though they displayed a strong high attachment preferences in Turkish test items, their attachment preferences in English did not attain statistical significance and thus they did not show a clear processing tendency in their resolution of RC attachment ambiguities.

*3.1.5. Discussion*

The Experiment 1 tested the processing of globally ambiguous Turkish and English test sentences including RC attachment ambiguities with complex genitive NPs (i.e. $NP_1$-of-$NP_2$-RC constructions) through a set of off-line tasks based on paper-and-pencil comprehension tests. The results from native English speakers indicated that they tended to attach the RC to the $NP_2$, thus displaying a low attachment preference. With respect to the specific considerations offered for the resolution of RC attachment ambiguities, it is evident that the data from native English speakers is congruent with the previous findings on RC attachment preferences in English (e.g. Carreiras & Clifton, 1999; Frazier & Clifton, 1996, among others). This preference has been interpreted in terms of a structure-based universal processing principles called Predicate Proximity and Recency. Gibson, Pearlmutter, Canseco-Gonzalez and Hickok (1996) suggested that the differences in the RC attachment preferences observed cross-linguistically could be ascribed to the activation of either Recency or Predicate Proximity. The principle of Recency poses a bias for the processing mechanism to attach the upcoming information to the most recently processed constituent wherever it is grammatically applicable as a consequence of the need invoked by the working memory constraints. The application of this principle in sentences involving RC attachment ambiguities results in low attachment preference. In this regard, the findings from native English speakers that are indicative of low attachment preference are compatible with the propositions of Recency principle and also the previous research results.

The results concerning the processing of RC attachment ambiguities in Turkish demonstrated that Turkish learners of L2 English also displayed a strong processing tendency in their first language, but it was in the opposite direction to that of native English speakers. More specifically, they tended to attach the RC to the $NP_1$, thus showing high attachment preference and their preference for high attachment did not differ in accordance with the animacy information manipulated in the test items. When we return to the first research question of Experiment 1, the findings revealed that the processing preferences in L1 Turkish did differ from those in L1 English during off-line interpretation of globally ambiguous statements including RC constructions.

It is conceivable to interpret the L1 Turkish results from the viewpoint of universal processing principles such as Predicate Proximity (Gibson et al., 1996). In this model, it is argued that it is more probable for Predicate Proximity to vary cross-linguistically as the strength of Predicate Proximity differs across languages. The relative strength of Predicate Proximity is identified by "the average distance from the head of a predicate to its arguments" (Gibson et al., 1996, p. 49). Unlike languages, such as English, that have strict word order and necessitate comparatively low average distance between the verb and its arguments, in languages such as Spanish, German and Turkish, which allow comparatively greater distance between the predicate and its arguments, the activation of Predicate Proximity is stronger and the cost associated with attaching to non-complement sites is very high. This particular account explains the strong high attachment preference displayed by the Turkish learners of L2 English in their first language. The free word order structure of Turkish language might have been the grammatical characteristic leading to the activation of Predicate Proximity as the weight of the Pedicate Proximity displays stronger effects on parsing and can override Recency when the language allows arguments to be far away from the verb.

As for the Turkish participants' resolution of RC attachment ambiguities in L2 English, they demonstrated neither high attachment preference as they did in their L1 Turkish nor low attachment preference like the native English speakers. That is to say, Turkish learners of L2 English did not show statistically significant preference for either $NP_1$ or $NP_2$ disambiguation for complex genitive NP construction in English. Given that adult L2 learners already have a fully developed L1 processing mechanism, it wouldn't be unreasonable to think that the processing strategies from their first language can be transferred to the L2. However, the present findings did not suggest evidence to support that argument. Thus, the answer to the second research question is that Turkish learners of L2 English employed in this experiment did not transfer their L1 high attachment preference during the off-line interpretation of globally ambiguous statements including RC constructions in L2 English.

One possible explanation to account for the results comes from the proponents of the Competition Model through a consideration known as Amalgamation (Hernandez, Bates, & Avila, 1994). According this account, the L2 learners could have been at a phase in between acquiring the nativelike low attachment preference from the target

language and transferring the high attachment preference from their first language. This explanation, however, is called into question when the findings from Papadopoulou and Clahsen (2003) are taken into consideration. The results of the study argue against an intermediary phase in L2 processing because the participants did not show any attachment preferences even though the participants' first language (i.e., Spanish, German, and Russian) and the target language (Greek) show a processing tendency for low attachment preference.

Another explanation to the present findings also comes from the predictions of the SSH (Clahsen & Felser, 2006a, 2006b, 2006c, 2017) which suggests that, L2 learners, irrespective of their proficiency level, tend to experience problems when making abstract syntactic representations in real-time comprehension; and compared to native speakers, they are guided more strongly by semantic, pragmatic, plausibility or surface level information during sentence processing. Put it differently; while processing target language, L2 learners "underuse syntactic information" and they do not rely on syntactic or structure-based parsing strategies (e.g. Recency or Predicate Proximity) to the same extent as native speakers during real-time processing although they can use lexical-semantic information in a native-like manner. The predictions of the SSH are based on a number of experimental reports indicating that when processing ambiguous sentences L2 learners rely on lexical, semantic and pragmatic information to guide their RC attachment preferences, therefore, the decisions of RC attachments are randomly made based on the non-syntactic sources of information (i.e., lexical, semantic, pragmatic information) at the disposal of L2 learners (Clahsen & Felser 2006a, p. 18). Regarding the role of transfer effects from L1, the SSH attributes little or no role for transfer in the domain of language processing. Consistent with these predictions, the lack of statistically significant attachment preference and transfer effects in the present findings can be explained with reference to the propositions of the SSH as the present data indicate that the Turkish participants neither transferred the L1-specific high attachment preference, nor did they acquired the use of L2-specific low attachment preference.

At this point it is important to note that in contrast to the on-line methods, which collect data about sentence interpretation in real time as each word or phrase is read or heard, off-line methods gather information after participants read or hear a sentence in its entirety. In addition, participants can make their interpretation decisions without being timed in off-line methods, so this gives them the chance to go back and reanalyze the test items through the use of plausibility information or explicitly learned linguistic knowledge or conscious linguistic problem solving skills. Therefore, the findings from off-line measures do not entirely reflect participants' initial processing tendencies. This could very well be the reason why the data from Turkish learners of L2 English did not indicate any specific processing tendency in the resolution of RC attachment ambiguities in English. In order to increase the possibility of detecting early processing decisions, making use of on-line measures such as eye tracking methodology would be instrumental as it can provide more

sensitive indications of initial processing preferences in the real-time processing of target test sentences.

### *3.2. Experiment 2*

Experiment 2 aimed to investigate the resolution of the RC attachment ambiguities in real time through temporarily ambiguous test sentences that were structured in a way to force the attachment of the RC modifier to either of the NPs (i.e. $NP_1$ or $NP_2$) in the complex genitive NP. Unlike globally ambiguous sentences (i.e. similar to those tested in Experiment 1) in which one of the two alternative interpretations is preferred over the other, usually without the reader/hearer being unaware of the presence of the ambiguity, temporarily ambiguous sentences include lexical or structural information that would guide the parser into a certain path to resolve the ambiguity. The test sentences in the present experiment were manipulated with the use of animacy information in the complex genitive NP and in the disambiguating RC modifier. The rationale to do this manipulation was that if the language processor tended to attach the RC to $NP_1$ in compliance with the high attachment preference, forcing the attachment of the RC modifier to the $NP_2$ to test low attachment preference would require a reanalysis of the statement to change the attachment of the RC from the preferred $NP_1$ to the dispreferred/forced $NP_2$. Since the reanalysis demands additional processing, the forced processing of the dispreferred attachment site is expected to take longer to read than a comparable sentence including a structural ambiguity resolved in favor of high attachment. The measures of those reading times were recorded by the eye-tracking device employed in the present experiment. These steps were taken to help induce more robust processing decisions and facilitate the possibility of detecting any initial parsing tendency as the structural ambiguity in the globally ambiguous test sentences could possibly go unnoticed by L2 learners, which might have brought about the pattern of findings from the Turkish learners of L2 English in Experiment 1. Therefore, in the present experiment it is predicted that the initial processing preferences of Turkish participants in L2 will be influenced by their default processing preferences in their L1 Turkish and thus they will tend to display a similar high attachment preference during the resolution of RC attachment ambiguities in L2 English. The research questions addressed in the present experiment are as follows:

1. Do the processing preferences of Turkish learners of L2 English differ from native English speakers during real-time interpretation of temporarily ambiguous statements including English RC constructions?
2. Do the Turkish learners of L2 English transfer their L1 processing preferences during the real-time interpretation of temporarily ambiguous statements including English RC constructions?

#### *3.2.1. Participants*

The same sampling group participating in Experiment 1, i.e. a group of Turkish learners of L2 English at advanced proficiency level and a control group consisting of

native English speakers took part in the present experiment. The L2 learner group consisted of 26 participants and the control group included 24 native English speakers.

*3.2.2. Materials*

Twenty-four experimental test items were developed for the purposes of the present experiment. Animacy information expressed in the genitive complex NP and semantic plausibility of the lexical information expressed in the RC modifier were used as a disambiguating cue to resolve the temporary RC attachment ambiguity. One of the reasons for manipulating this sort of disambiguating information results from the concern for achieving equivalent testing conditions across Turkish and English languages. To be more precise, much research on the L2 sentence processing manipulated either gender or number agreement as a disambiguating cue (e.g. Dussias, 2003; Felser et al., 2003; Fernández, 2002; Papadopoulou & Clahsen, 2003), however, Turkish is a gender-neutral language, requiring no gender agreement and the attachment of the plurality marker to the verb is relatively nonobligatory, which is essentially prescribed by contextual aspects. These features make it impossible to compare Turkish test sentences to their equivalents in English. Furthermore, previous investigations indicated that L2 learners might be impervious to violations of subject-verb agreement during real-time L2 sentence processing (see Chen, Shu, Liu, Zhao & Li, 2007; Jiang, 2004 for details), or they could only show sensitivity to local gender agreement while being impervious to nonlocal long-distance violations of gender agreement (e.g. Keating, 2009). These issues call into question the use of gender or number agreement as a disambiguating cue for the present experiment, therefore, animacy information was manipulated in the development of test items to control for the confounding effects of agreement aspects and to render comparability across Turkish and English. In this respect, the sentences of particular interest were as in (7) and (8) below (boldface marking shows the direction of disambiguation):

(7) Low Attachment Forced

a. The truck of **the driver that apologized for reckless driving** caused the accident.

b. The designer of **the building that comprised of luxurious suites** had the style.

(8) High Attachment Forced

a. **The driver** of the truck **that apologized for reckless driving** caused the accident.

b. **The building** of the designer **that comprised of luxurious suites** had the style.

All of the twenty-four experimental test items were developed in two different conditions structured to force either low attachment as in (7) or high attachment as in (8) with the $NP_{high}$-*of*-$NP_{low}$-RC construction (see Appendix 3 for the entire list). In half of these test sentences, the RC modifier was constructed to disambiguate towards the animate noun in the complex genitive NP as presented in (7a) and (8a) above; while in the other half the RC modifier was disambiguated towards the inanimate noun as

presented in (7b) and (8b) above. The test sentences were balanced across two different lists so that each subject would see only one type of experimental item in each condition. The proper target for the RC attachment was determined by the semantic plausibility between the lexical information expressed in the RC modifier and the animacy information in the complex genitive NP. Two native English speakers who did not participate in the experiment were asked to make plausibility judgements on target test sentences and changes were applied when deemed necessary. Common nouns (with the article the) were used in the complex genitive NP constructions in subject position and the constituent nouns were connected with the preposition *of*. In addition to the experimental items, twenty-four (24) unambiguous fillers were created to distract participants from the purposes of the experiment. In total, there were forty-eight (48) sentences in the present experiment. Simple comprehension checks in the form of YES / NO questions followed half of these test items. Experimental test sentences and filler items were presented in a way that no more than two experimental items appeared successively.

Five regions were identified as indicated in the Table 2 below in the test sentences. The words that appeared in each region and the length of the experimental sentences were balanced for length across all experimental items. The third region including the RC was assigned as the critical region because the disambiguation took place there. If the participants tended to systematically attach the RC to low NP, they would be expected to have longer fixation durations in the third region in sentences, where high attachment was forced as they would have to reconsider their initial interpretation when the fragment including the disambiguating information in the RC was encountered. On the other hand, if they had default high attachment preferences, they would be expected to show longer fixation durations in the third region in sentences, where low attachment was forced.

Table 2. Identified Regions of the Target Experimental Items for RC Attachment

| Regions | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| *Low Attachment Forced* | | | | |
| The designer | of the building | that comprised of luxurious suites | had | the style |
| *High Attachment Forced* | | | | |
| The building | of the designer | that comprised of luxurious suites | had | the style |

### *3.2.3. Procedure*

Eye movements of the participants were recorded using an eye tracking equipment with a sampling rate of 120 Hz. The eye-tracking device was unobtrusively situated facing the participants below a 20" LED monitor with a resolution of 1600x900. The data was processed by using a software and exported from the device. The

participants were seated about 60 cm away from the monitor. In order to calibrate the eye-tracking device for the experimentation, the participants were instructed to follow a fixation mark (a hashtag symbol) which moved around the screen. After achieving an acceptable calibration, they were given instructions and prompted to take a practice session with a design which exactly matched that of the actual experimentation. Before the beginning of each trial, the fixation sign appeared at the center of the computer screen. Later, the test item followed the fixation sign on the same region. All test sentences were presented on the monitor as a single line of text with standard punctuation and capitalization. The participants' task was to read each sentence silently at their natural reading pace to make sure that they would correctly answer YES/NO questions which appeared occasionally on the screen after the test item disappeared. After participants finished reading the target sentence, they pressed the space key on the keyboard as instructed before and then the target sentence disappeared from the screen. When the target sentences were not followed by a YES/NO comprehension question, an arrow pointing right showed up on the screen, which signaled to continue with the next trial by pressing the space key again when ready. During the trials which did include a comprehension question, the participants' pressed the left arrow key on the keyboard for YES or the right arrow for NO and then automatically the next trial began.

For the data analysis, 20 % error rate in the comprehension questions was the criterion for inclusion. However, no participant scored below the eighty percent accuracy rate. Four eye-tracking measures were reported in the present study:

A. Total sentence time: the total of all fixation durations for the whole sentence.

B. Gaze duration: the total of the fixation durations made in a region after first entering that region until leaving it.

C. Go-past time: the fixation durations recorded during the time participants look at the target word (region) as well as any time spent rereading earlier regions of the sentence before going ahead to analyze new portions of the sentence.

D. Total time: the total of all fixation durations per region.

*3.2.4. Results*

Mean scores for the measure of total sentence time in milliseconds (ms) and standard deviations for the processing of the experimental test sentence by native English speakers in the control group and Turkish learners of L2 English appear in Table 3 below. This particular eye-tracking measure indicates an overall processing preference for the attachment of the RCs in the test sentences. The results for the control group from the analysis of variance (ANOVA) conducted with subject ($F1$) and with items ($F2$) as a random variable showed that there was a statistically significant difference between the total sentence time measures of low attachment-forced and high attachment-forced conditions, indicating elevated fixation durations for the high attachment sentences. ($F1(1, 22) = 11.128$, $p < .005$; $F2(1, 22) = 13.302$, $p < .005$). This could be taken to mean that sentences that forced attachment of RC to the high NP in

the complex genitive NP were read slower, implying a preference for low attachment by native English speakers. On the other hand, the results of the ANOVA for Turkish learners of L2 English demonstrated an attachment preference in the opposite direction of the native English speakers with significantly longer total sentence time measure for low attachment-forced sentences ($F1(1, 24) = 16.235$, $p < .001$; $F2(1, 22) = 18.115$, $p < .001$), which suggests that L2 learners took longer to process sentences that force disambiguation of the RC towards low NPs.

Table 3. Mean (standard deviations) total sentence time measure for the experimental test items

| | Participant Groups | | | | |
|---|---|---|---|---|---|
| | Native Speakers | | L2 Learners | | |
| | High | Low | High | Low | |
| Total Sentence Time | 3987 (749) | 3541 (731) | 5982 (751) | 7019 | (919) |

*Note: Boldface type indicates statistically significant difference between two measures.*

As for the analysis for the individual regions, which were demonstrated above in Table 4, two ANOVAs with subject ($F1$) and with items ($F2$) as a random variable were run and the mean gaze duration, go-past time, total time measures were presented in Table 4 for the native English speakers and Table 5 for the L2 learners below.

Table 4. Mean fixation durations (standard deviations) of native speakers in the individual regions

| | **Regions** | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| | ***Low Attachment*** | | | | |
| | The designer | of the building | that comprised of luxurious suites | had | the syle |
| | ***High Attachment*** | | | | |
| | The building | of the designer | that comprised of luxurious suites | had | the style |
| Gaze Duration | | | | | |
| Low Attachment | 319 (68) | 429 (91) | 718 (132) | 459 (115) | 651 (177) |
| High Attachment | 317 (71) | 435 (94) | 731 (144) | 488 (129) | 693 (182) |
| Go-past Time | | | | | |
| Low Attachment | | 441 (99) | **833** (174) | 572 (151) | 549 (134) |
| High Attachment | | 460 (105) | **921** (233) | 646 (168) | 551 (137) |
| Total Time in Region | | | | | |
| Low Attachment | 471 (119) | **685** (207) | **1033** (291) | 667 (227) | 718 (160) |
| High Attachment | 501 (136) | **762** (241) | **1211** (388) | 729 (175) | 744 (177) |

Note: Boldface type indicates statistically significant difference between the two measures.

Table 5. Mean fixation durations (standard deviations) of L2 learners in the individual regions

| | **Regions** | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| | ***Low Attachment*** | | | | |
| | The designer | of the building | that comprised of luxurious suites | had | the style |
| | ***High Attachment*** | | | | |
| | The building | of the designer | that comprised of luxurious suites | had | the style |
| Gaze Duration | | | | | |
| Low Attachment | 327 (88) | 533 (145) | 1201 (251) | 644 (111) | 879 (171) |
| High Attachment | 318 (79) | 541 (163) | 1112 (210) | 658 (107) | 899 (214) |
| Go-past Time | | | | | |
| Low Attachment | | 588 (197) | **1421** (379) | 845 (188) | 811 (161) |
| High Attachment | | 542 (169) | **1276** (347) | 782 (165) | 794 (149) |
| Total Time in Region | | | | | |
| Low Attachment | **548** (169) | 831 (256) | **1783** (299) | 984 (218) | 1008 (211) |
| High Attachment | **455** (154) | 798 (239) | **1699** (269) | 975 (180) | 1021 (224) |

Note: Boldface type indicates statistically significant difference between the two measures.

For the native speaker group, total time in critical region (i.e., Region 3) was statistically higher for high attachment-forced conditions than those for low attachment-forced conditions: $F1\ (1, 22) = 6.071$, $p < .01$, $F2\ (1, 22) = 7.219$, $p < .01$. This finding shows that when the RC modifier forcing attachment to the high NP ($NP_1$) was encountered, it might have challenged the default processing tendency of native English speakers and caused them to reconsider their initial interpretation. This reconsideration might have required to alter the attachment of the RC from the preferred $NP_2$ to the dispreferred $NP_1$, which was reflected in the elevated fixation

durations in the region. Another statistically significant difference was observed in Region 3 for go-past time measure with high attachment sentences read more slowly: $F1$ (1, 22) = 7.905, $p < .05$, $F2$ (1, 22) = 8.974, $p < .05$. This particular finding also suggests that when there is a mismatch between the default processing preference and their interpretation, as seen in the high attachment-forced condition, they might have felt the need to go back and check again to see if there is a problem. Overall, the statistically longer fixation durations in the aforementioned regions in the native English speaker data complement the findings from total sentence time measure and suggest a clear processing preference for low RC attachment.

In line with the results of total sentence time measure, which was the first indicative of a preference for high attachment for the L2 learner group, the findings of per region analyses illustrated in Table 5 above revealed an attachment preference which is the opposite direction of what native English speakers showed. In Region 3, the critical region, total time measures were significantly longer for low attachment sentences than for high attachment sentences: $F1$ (1, 22) = 9.381, $p < .05$, $F2$ (1, 22) = 11.021, $p < .05$. Again, this might have been accounted for the reconsideration of L2 learners initial processing preferences when their default processing preference was challenged by the low attachment-forcing test items. Another interesting finding to note is that the sentences forcing low attachment had longer total time measure in Region 1. This finding suggests that when there is an incompatibility with the high RC attachment, the L2 leaners took longer to go back and check the head of the complex genitive NP: $F1$(1, 22) = 6.583, $p < .05$, $F2$ (1, 22) = 5.162, $p < .05$. The data from the go-past time measures also support L2 learners' tendency to show regressive eye-movement patterns as there were statistically longer go-past time measures in Region 3 for low attachment sentences than high attachment-forced conditions: $F1$(1, 22) = 6.203, $p < .05$, $F2$ (1, 22) = 5.014, $p < .05$. This suggests that when there is a mismatch between L2 learners' default processing preference and the interpretation that the sentence offers, which data suggests, they might have felt the need to go back and reread the components contradicting with their expectations. Overall, one can conclude from this data set that the L2 learners participating in this particular experiment showed a statistically significant high attachment preference while processing the experimental sentences that include RC constructions in disambiguating structural positions.

*3.2.5. Discussion*

Experiment 2 investigated the resolution of the RC attachment ambiguities to see whether and to what extent the transfer of L1 processing routines could influence real-time L2 sentence comprehension in conditions where the RC modifier was forced to either attachment site in the test sentences. The results indicated that both the Turkish learners of L2 English and native English speakers displayed a processing tendency during the comprehension of test sentence in real time. Yet, the direction of the processing tendency was different for native English speakers and the L2 learner

group, thus providing an affirmative answer for the first research question of Experiment 2.

The native English speaker group showed a low attachment preference in line with the results obtained in Experiment 1 and the other examinations of RC attachment in L1 English (Carreiras & Clifton, 1999; Frazier & Clifton, 1996). On the other hand, Turkish learners of L2 English displayed a high attachment preference which was congruent with their L1 Turkish processing decisions as it was revealed by Experiment 1. The difference in the attachment preferences of both groups could be explained with reference to the relative weighting of the structure-based processing principles of Predicate Proximity and Recency (Gibson et al., 1996). It is argued that Predicate Proximity guides the processing mechanism to attach modifiers to argument positions and the average distance between the predicate heads (i.e., verbs) and their arguments determines the strength of this principle. In languages, such as Turkish, which have relatively free word order, this distance is fairly higher and greater initial activation of the predicate is necessary to facilitate attachment over greater distances. Thus, in these languages Predicate Proximity outweighs. On the contrary, the average distance between the heads of the predicate and their arguments are rather shorter in languages that have a rigid word order formulation such as English and Predicate Proximity is weaker. From this viewpoint, it is conceivable to argue that in Turkish Predicate Proximity is assigned greater weight and that the potential transfer of this processing tendency from the parsing of Turkish sentences to L2 English could have resulted in the high attachment preference observed in the findings from Turkish learners of L2 English.

Another explanation for the potential transfer effects could be based on the Tuning Hypothesis (Mitchell & Cuetos, 1991). Essentially, the Tuning Hypothesis argues that the structural ambiguities are resolved in terms of the relative frequencies of previously encountered alternative disambiguations. More specifically, the low attachment bias observed in the native English speakers could result from being exposed to more low attachment resolutions in sentences including RCs. The high attachment preference for Turkish learners of L2 English could stem from being exposed to more high attachment resolutions in L1 Turkish. That is, the L2 learners participated in this study might not have overcome their L1 tuning regarding this particular RC sentence structure. Given all the above considerations based on the findings of Experiment 2, the answer for the second research question is that the Turkish learners of L2 English seemed to have transferred their L1 processing preferences during the real-time interpretation of temporarily ambiguous statements including English RC constructions.

When the individual measures of the on-line data are analyzed in detail (i.e. per region analysis), the most important finding appears to be that at the critical region that hosts the RC native English speakers and Turkish learners of L2 English showed differences in total time measures. This was the main indicator of a low attachment preference for native speakers and a high attachment for the L2 learners. Especially the difference in the go-past time measure in the critical region clearly reveals the

need for the participants to go back and check the head of the complex subject NP when there is an incompatibility with their preferred attachment tendency and the target test item forcing the attachment to the opposite direction. Compared to the inconclusive findings for RC attachment in the literature of the L2 sentence processing, especially those taken to support the SSH by not being able to get comparable differences (e.g. Dussias, 2003; Felser et al., 2003; Fernandez, 2002; Papadopolou & Clahsen, 2003) these findings from the present experiment is particularly intriguing. In this respect, it can be said that task sensitivity might have played a role in the difference. It is noteworthy that all of the studies that did not report any attachment preferences for L2 learners have employed a self-paced reading methodology (Dinctopal-Deniz, 2010; Dussias, 2003; Felser et al., 2003; Fernandez, 2003; Papadopoulou & Clahsen, 2003), while comparably few studies that have demonstrated attachment preferences have employed eye tracking methodology (Frenck-Mestre, 1997, 2002; Witzel et al., 2012). As it is argued previously, it might be necessary to use a conducive methodology that has the potential to unravel this often subtle difference in the RC attachment preferences. This methodological issue can also be used as a solid ground to can account for the lack of a statistically significant attachment preference in the findings of L2 learner data from the Experiment 1.

A further explanation for the present results is that the position of the complex NP in the present experiment might have affected the attachment preferences. The sentences often used in the previous studies tended to have a structural sequence as the following: *The dean liked the secretary of the professors who was/were reading* (Felser et al., 2003). In these sentences, the complex NP preceding the RC is the object of the main verb, whereas in the present study the complex NP is located as the subject of the sentence. When the complex NP is used in object position, it is very likely that contextual information that could be cofounding in nature can influence the processing decisions readers after seeing the RC modifier. More specifically, based on the context, readers can possibly establish certain anticipations concerning the noun to be modified and these anticipations can interact with default RC attachment preference. Alternatively, previous real-time reading studies have found wrap-up effects, namely, longer fixation durations on the last constituents of the sentence (Rayner, Kambe & Duffy, 2000), therefore, eliminating this confounding variable by not placing the disambiguating RC as the last element of the sentence could have contributed to the present findings. Taking all into consideration, it can be suggested that the test sentences of the present experiment could have warranted a more practical investigation.

## 4. Discussion and Conclusion

The aim of the two experiments reported in the present study was to acquire a better understanding of the nature of L2 off-line and on-line processing by comparing the RC attachment preferences of Turkish learners of L2 English and native English speakers. The studies were designed to identify potential variations between L1 and L2 processing and each experiment purported to address the same broad research

agenda with a somewhat divergent viewpoint. As it is outlined above, some interesting findings were obtained regarding the role of L1 transfer in L2 processing strategies. The results from the present study did not pattern like Dinctopal-Deniz (2010) concerning the processing tendencies of Turkish participants. The researcher reported that both L1 Turkish and L1 English groups showed a low attachment preference by attaching the RC to the $NP_2$ in the off-line and on-line tasks. When it comes to the findings for Turkish learners of L2 English, the results offered an inconsistent pattern in the off-line and on-line tasks. While Turkish learners of L2 English displayed a high attachment preference in the off-line task, they showed a low attachment preference with inanimate NPs and a high attachment preference with animate NPs. The results from the present study indicated a different pattern of findings compared to Dinctopal-Deniz (2010). In fact, off-line Experiment 1 revealed that there were cross-linguistic variations in the resolution of RC attachment ambiguities between L1 Turkish and L1 English sentence processing strategies, with a high attachment preference for L1 Turkish and a low attachment preference for L1 English. Even though a statistically significant RC attachment bias was not detected in the L2 English data for the off-line task, the findings from a more sensitive on-line measure, the eye tracking task, indicated that the Turkish learners of L2 English indeed tended to transfer the Turkish high attachment preference when processing English RC attachment ambiguities in real time. In this respect, our results patterned more like those of Witzel et al. (2012), which indicated a high attachment preference for Chinese learners of English. As it is argued above, task sensitivity could be claimed to have played a role (see the discussion for Experiment 2 above).

The theoretical positions regarding L1 transfer to L2 processing offer explanations to account for the issue. For instance, Input Processing Model by VanPatten (2007) suggests that L2 learners embark on their acquisition journey with the parsing procedures of L1, therefore relying on the L1 processing procedures to interpret L2 data appears to be a plausible strategy that L2 learners often resort to. Similarly, Competition Model, which was referred to elsewhere above, proposes that learners are most likely to depend on their L1 for sentence interpretation as "they begin second language acquisition with the form-to-function mappings from the native language" (MacWhinney, 2005). The logical take-away from these accounts in the present investigation is that many researchers presume a certain level of cross-linguistic transfer in L2 learning, which is likely to lessen or disappear with the developing L2 proficiency. In this sense, it would be especially intriguing to compare the processing preferences of less proficient and more proficient L2 learners than those employed in the present study, or to compare early and late bilinguals in the future examinations. Even though the proposed models can account for much of the experimental data from the present study, the cross-linguistic difference in processing decision and the concerning debate on the general architecture and functioning of the processing mechanism is far from being resolved. Thus, further investigations on various languages using a range of methods and materials are needed to offer more comprehensive and credible accounts for this intriguing field.

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**The Research and Publication Ethics Statement**

The data set reported in the study was acquired as part of a PhD dissertation entitled "Resolution of Structural Ambiguities during Real-Time L2 Sentence Processing: Evidence from On-line and Off-line Measures", which was submitted to Çukurova University Institute of Social Sciences in 2018. The author certifies that no ethical considerations were violated in this study and that the study conforms to the formal standards and ethics of research and publication.

**The Conflict of Interest Statement**

In line with the statement of Committee on Publication Ethics (COPE), I hereby declare that I had no conflicting interests regarding any parties of this study. This research study is funded by the researcher himself without any occurrence of conflicting interest in the manner of author.

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## Appendix A. Experimental Items for Off-line RC Attachment Ambiguity Resolution in English

*Read the sentences below and decide which of the alternative answer (A or B) to the questions seem the most appropriate to you:*

1. The secretary of the manager that resigned from the company was very sad.
   - Who resigned from the company?

   a. the secretary b. the manager
2. The terrace of the restaurant that had the Christmas decorations looked really elegant.
   - Where was the decorations?

   a. the restaurant b. the terrace
3. The father of the author that was killed in the robbery was really rich.
   - Who was killed in the robbery?

   a. the father b. the author
4. The gate of the farm that was built last winter looked pretty strange.
   - What was built last winter?

   a. the farm b. the gate
5. The brother of the pilot that used drugs in the office was arrested yesterday.
   - Who used drugs in the office?

   a. the pilot b. the brother
6. The dinner of the trip that upset guests for many reasons was very boring.
   - What upset the guests?

   a. The dinner b. the trip
7. The department of the university that was opened last year became well-known.
   - What was opened last year?

a. the university b. the department

8. The friend of the child that had expensive toys was very naughty.
   - Who had the expensive toys?
   a. the friend b. the child
9. The garden of the church that had high walls looked very pretty mysterious.
   - Which had the high walls?
   a. the church b. the garden
10. The son of the driver that was sent to jail committed serious crimes.
   - What was sent to jail?
   a. the son b. the driver
11. The recording of the film that was made last year was very successful.
   - What was made last year?
   a. the film b. the recording
12. The assistant of the doctor that examined many patients impressed us.
   - Who examined many patients?
   a. the assistant b. the doctor
13. The cafeteria of the school that was closed last year was horrible.
   - Which was closed last year?
   a. the school b. the cafeteria
14. The wife of the gardener that grew organic fruit made a lot of money.
   - Who grew organic fruit?
   a. the wife b. the gardener
15. The branch of the company that was located in the center paid a lot of tax.
   - Which was located in the center?
   a. the company b. the branch
16. The boyfriend of the girl that was sitting at the cafe waited for an hour.
   - Who was sitting at the cafe?
   a. the boyfriend b. the girl
17. The furniture of the room that had bright colors looked quite elegant.
   - Which had the bright colors?
   a. the room b. the furniture
18. The roommate of the student that attended a conference was very smart.
   - Who attended the conference?

a. the roommate b. the student

19. The commercial of the brand that was popular in the media attracted attention.
    - Which was popular in the media?
    a. the brand b. the commercial
20. The model of the designer that lived in Italy had a luxurious life style.
    - Who lived in Italy?
    a. the model b. the designer
21. The bank of the company that had made profit sent customers letters.
    - Which had made profit?
    a. the company b. the bank
22. The sister of the boy that got injured in the accident was in great pain.
    - What got injured in the accident?
    a. the sister b. the boy
23. The seeds of the vegetable that was imported to the country was analyzed carefully.
    - Which was imported to the country?
    a. the vegetable b. the seeds
24. The father of the man that had mental problems went to the hospital.
    - Who had the mental problems?
    a. the father b. the man

## Appendix B. Experimental Items for Off-line RC Attachment Ambiguity Resolution in Turkish

Aşağıdaki cümleleri okuyunuz ve size en makul gelen seçeneği (A ya da B) işaretleyerek ilgili soruları cevaplayınız:

1. Görevinden istifa eden rektörün danışmanı mutsuz günler geçirdi.
    - Görevinden istifa eden kimdir?
    a. rektör b. danışman
2. Geçen yıl açılan üniversitenin kütüphanesi modern teknolojiyi kullandı.
    - Geçen yıl açılan neresidir?
    a. üniversite b. kütüphane
3. Hastaları muayene eden doktorun asistanı herkese iyi davrandı.
    - Hastaları muayene eden kimdir?
    a. asistan b. doktor

4. Dışarıdan ithal edilen sebzenin tohumları dikkatlice analiz edildi.
   - Dışarıdan ithal edilen nedir?
   a. sebze b. bitki
5. Şirkette işe başlayan müdürün sekreteri herkesin sevgisini kazandı.
   - Şirkette işe başlayan kim?
   a. sekreter b. müdür
6. Herkesi çok ağlatan filmin müziği sosyal medyayı salladı.
   - Herkesi çok ağlatan nedir?
   a. müzik b. film
7. İş kazasında yaralanan ustanın çırağı ambulansın gelmesini bekledi.
   - İş kazasında yaralanan kimdir?
   a. usta b. çırak
8. Modern tasarımı olan evin mobilyaları farklı yorumlar aldı.
   - Modern tasarımı olan nedir?
   a. ev b. mobilyalar
9. Ruhsal problemleri olan kadının kocası sıkıntılı günler geçirdi.
   - Ruhsal problemleri olan kimdir?
   a. kadın b. (kadının) kocası
10. Parlak renkleri olan odanın perdeleri görenleri hayran bıraktı.
   - Parlak renkleri olan nedir?
   a. oda b. perdeler
11. Eleştiriye maruz kalan hakemin yardımcısı emekli olmayı düşündü.
   - Eleştiriye maruz kalan kimdir?
   a. (hakemin) yardımcısı b. hakem
12. Harika manzarası olan restoranın terası müşterileri memnun etti.
   - Harika manzarası olan neresidir?
   a. teras b. restoran
13. Dava sonucunu bekleyen sanığın avukatı kalp krizi geçirdi.
   - Dava sonucunu bekleyen kimdir?
   a. avukat b. sanık
14. Yazın kalabalık olan kasabanın plajı turistleri misafir etti.
   - Yazın kalabalık olan neresidir?
   a. plaj b. kasaba

15. Filmde rol alacak aktörün dublörü senaryoyu dikkatle okudu.
    - Filmde rol alacak kimdir?

    a. dublör b. aktör

16. Yurt dışından getirilen makinanın parçaları testi başarıyla geçti.
    - Yurt dışından getirilen nedir?

    a. (makinenin) parçaları b. makine

17. Üç dil bilen öğrencinin öğretmeni herkesi çok etkiledi.
    - Üç dil bilen kimdir?

    a. öğrenci b. öğretmen

18. Sürekli kar eden şirketin bankası müşterilere mektup gönderdi.
    - Sürekli kar eden neresidir?

    a. şirket b. banka

19. Alkol bağımlısı olan komşunun oğlu hastanede tedavi gördü.
    - Alkol bağımlısı olan kimdir?

    a. komşu b. (komşunun) oğlu

20. Asırlar öncesine dayanan köyün camisi turistlerin ilgisini çekti.
    - Asırlar öncesine dayanan neresidir?

    a. cami b. köy

21. Tarlaya mahsul eken çiftçinin karısı hava durumunu dinledi.
    - Tarlaya mahsul eken kimdir?

    a. (çiftçinin) karısı b. çiftçi

22. Eleştirel dille yazılan kitabın eleştirisi okuyucudan övgü aldı.
    - Eleştirel dille yazılan nedir?

    a. (kitabın) eleştirisi b. kitap

23. Son treni kaçıran adamın arkadaşı istasyondan hızlıca ayrıldı.
    - Son treni kaçıran kimdir?

    a. adam b. (adamın) arkadaşı

24. Medyada çok konuşulan markanın reklamı oldukça dikkat çekti.
    - Medyada çok konuşulan nedir?

    a. marka b. reklam

## Appendix C. Experimental Items for On-line RC Attachment Ambiguity Resolution in English

*C.1. Low Attachment Forced Towards Animate Nouns*

1. The truck of the driver that apologized for reckless driving caused the accident.

2. The company of the manager that spoke about electric cars produced many projects.
3. The plane of the pilot that argued with angry passengers left Ataturk airport.
4. The book of the author of that wrote about human psychology impressed the readers.
5. The project of the assistant that studied at Harvard University deserved a praise.
6. The column of the journalist that interviewed with drug addicts attracted public attention.
7. The hospital of the doctor that shouted at waiting patients caused complete chaos.
8. The house of the lady that inherited huge family fortune hosted expensive parties.
9. The country of the president that learned to speak English welcomed foreign guests.
10. The university of the rector that met with foreign ministers organized successful events.
11. The software of the engineer that suffered from health issues transformed the industry.
12. The seminar of the professor that researched human DNA cells required much reading.

*C.2. Low Attachment Forced Towards Inanimate Nouns*

1. The designer of the building that comprised of luxurious suites had the style.
2. The comedian of the show that aired on Saturday nights entertained the viewers.
3. The singer of the song that climbed on music charts became worldwide famous.
4. The guide of the tour that lasted for fifteen minutes disappointed the tourists.
5. The baker of the cookies that contained of chocolate chips pleased the customers.
6. The newspaper of the journalist that included new job adverts helped the unemployed.
7. The scientist of the study that involved many detailed experiments offered new insights.
8. The farmer of the field that contained organic apple trees served local markets.
9. The director of the movie that starred young talented actors changed film industry.
10. The captain of the ship that carried valuable electronic goods escaped the storm.
11. The chef of the restaurant that had scenic city views satisfied the customers.
12. The artist of the painting that cost millions of dollars looked very impressive.

*C.3. High Attachment Forced Towards Animate Nouns*

1. The driver of the truck that apologized for reckless driving caused the accident.
2. The manager of the company that spoke about electric cars produced many projects.
3. The pilot of the plane that argued with angry passengers left Ataturk airport.
4. The author of the book that wrote about human psychology impressed the readers.

5. The assistant of the project that studied at Harvard University deserved a praise.
6. The journalist of the column that interviewed with drug addicts attracted public attention.
7. The doctor of the hospital that shouted at waiting patients caused complete chaos.
8. The lady of the house that inherited huge family fortune hosted expensive parties.
9. The president of the country that learned to speak English welcomed foreign guests.
10. The rector of the university that met with foreign ministers organized successful events.
11. The engineer of the software that suffered from health issues transformed the industry.
12. The professor of the seminar that researched human DNA cells required much reading.

*C.4. High Attachment Forced Towards Inanimate Nouns*

1. The building of the designer that comprised of luxurious suites had the style.
2. The show of the comedian that aired on Saturday nights entertained the viewers.
3. The song of the singer that climbed on music charts became worldwide famous.
4. The tour of the guide that lasted for fifteen minutes disappointed the tourists.
5. The cookies of the baker that contained of chocolate chips pleased the customers.
6. The journalist of the newspaper that included new job adverts helped the unemployed.
7. The study of the scientist that involved many detailed experiments offered new insights.
8. The field of the farmer that contained organic apple trees served local markets.
9. The movie of the director that starred young talented actors changed film industry.
10. The ship of the captain that carried valuable electronic goods escaped the storm.
11. The restaurant of the chef that had scenic city views satisfied the customers.
12. The painting of the artist that cost millions of dollars looked very impressive.