

**REPUBLIC OF TURKEY
ÇUKUROVA UNIVERSITY
THE INSTITUTE OF SOCIAL SCIENCES
DEPARTMENT OF ENGLISH LANGUAGE TEACHING**

**RESOLUTION OF STRUCTURAL AMBIGUITIES DURING REAL-TIME L2
SENTENCE PROCESSING: EVIDENCE FROM ONLINE AND OFFLINE
MEASURES**

Onur ULUDAĞ

A PhD DISSERTATION

ADANA / 2018

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A PhD DISSERTATION

ADANA / 2018

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Onur ULUDAĞ

ÖZET

İKİNCİ DİLİN GERÇEK ZAMANLI OLARAK İŞLEMLENMESİ SIRASINDA YAPISAL BELİRSİZLİKLERİN ÇÖZÜMLENMESİ: ÇEVİRİMİÇİ VE ÇEVİRİMDIŞI YÖNTEMLERDEN EDİNİLEN BULGULAR

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İkinci dil öğrenenlerin ikinci dil girdisini işlemlemede kullandığı yöntemlerin araştırılması insan zihnini anlama ve daha iyi ikinci dil öğrenimine sebep olacak teknik yaklaşımlar geliştirilmesinde kıymetli bilgiler sağlamıştır. Bu bağlamda, ikinci dil öğrenenlerin dilsel veriyi işlemlemede kullandığı mekanizmaların incelenmesi ikinci dil ediniminin henüz çözüme kavuşturulmamış yönlerini araştırma imkanı vermektedir. Son yıllarda araştırmacılar ikinci dil öğrenenlerin gerçek zamanlı olarak yapısal belirsizlikleri çözümü yöntemlerini ele alarak, ikinci dilde işlemleme mekanizmasının incelenmesine odaklanmışlardır. Bu tez, ana dili İngilizce olan katılımcılar ve İngilizce öğrenen ve farklı seviye gruplarında olan Türk katılımcıların, iki farklı yapısal belirsizliği işlemlemeleri sırasında kullandıkları farklı bilgi kaynaklarını kıyaslanarak ve ana dilden ikinci dile işlemleme eğilimi aktarımının etkilerini ele alarak ikinci dilde işlemleme mekanizmasının daha net bir resmini çizebilmeyi amaçlamaktadır. Sıfat cümlecığı (SC) ve ilgeç öbeği (İÖ) yapılarının işlemlenmesi hem çevrimdışı hem de çevrimiçi testlerle incelenmiştir. Bu yapılardan kaynaklanan belirsizliklerin araştırılmasında çevrimdışı testler hem İngilizceyi ikinci dil olarak öğrenen hem de ana dili İngilizce olan katılımcıların işlemleme eğilimlerini basılı formatta okuduğunu anlama soru listesiyle incelemiştir. Çevrimiçi testler ise göz izleme tekniği kullanarak hedef sözdizimsel belirsizliklerin gerçek zamanlı olarak işlemlenmesini incelemeye imkan sağlamıştır. Çevrimdışı testlerin sonuçları göstermiştir ki, Türkçe ve İngilizcedeki SC yapılarını bağlama tercihleri farklılık göstermektedir. Ana dili İngilizce olan katılımcılar isim tamlamaları için SC yapılarını kendine yakın olan isme bağlamayı tercih ederken, İngilizceyi ikinci dil olarak öğrenen

katılımcılar aynı yapıları daha uzak olan isme bağlamayı tercih etmiştir. Benzer bir çevrimdışı test, İngilizceyi ikinci dil olarak öğrenen katılımcıların hedef dil İngilizcede SC yapılarını bağlama tercihlerini teşhis etmede başarılı olamasa da, daha hassas ölçüm imkanı veren çevrimiçi göz izleme tekniğinden elde edilen bulgular göstermiştir ki, İngilizceyi ikinci dil olarak öğrenen katılımcılar İngilizce yapısal belirsizlikleri işleme yaparken Türkçede kullandıkları işleme eğilimini göstermektedirler. İÖ yapılarını incelemadaki amaç ise ikinci dil öğrenenlerin ana dillerinden işleme eğilimlerini aktarma yapamayacakları durumlarda nasıl işleme yapacaklarını görmek olmuştur. Araştırmada kullanılan İÖ yapılarının Türkçe karşılıklarında hedef dil İngilizcede olduğu gibi sözdizimsel belirsizlik bulunmaması bu amaca hizmet etmektedir. Bu şekilde işlememeyi direkt olarak etkilediği bulunan birinci dilden ikinci dile işleme eğiliminin aktarılması durumunun etkisi ortadan kaldırılıp araştırma gerçekleştirilmiştir. Bu kapsamda yapılan çevrimdışı ve çevrimiçi araştırma sonuçları göstermiştir ki, hem anadili İngilizce olan hem de İngilizceyi ikinci dili olarak öğrenen katılımcıların benzer şekilde İÖ yapılarını rast gele eşleştirme yapmak yerine, bu yapıları kendisine daha yakın olan eylem öbeğiyle eşleştirme eğiliminde olmuşlardır. Bu sonuç, hem birinci dilde hem de ikinci dilde işleme süreçlerinin yapı odaklı işleme stratejileri tarafından yönlendirildiğini ve işleme kararlarının hiyerarşik olarak derinliğe sahip yapısal bilgiye dayanarak gerçekleştiğini ortaya çıkarmıştır. Bütün bu bulgular, ikinci dilde yapısal işlemenin nasıl gerçekleştiği, birinci dildeki işleme süreçlerinin ikinci dilde gerçek zamanlı olarak cümlelerin işlenmesini etkileyip etkilemediğini, ana dili konuşanlar gibi yetkin işleme becerilerine ikinci dil öğrenenlerin sahip olup olamayacağı ve işleme mekanizmasının gelişen dil yeterliliğiyle değişiminin söz konusu olup olmadığı gibi birçok tartışmalı mevzunun yorumlanmasında kullanılmıştır.

Anahtar kelimeler: İşleme, yapısal belirsizlikler, aktarım, göz izleme tekniği.

ABSTRACT**RESOLUTION OF STRUCTURAL AMBIGUITIES DURING REAL-TIME L2
SENTENCE PROCESSING: EVIDENCE FROM ONLINE AND OFFLINE
MEASURES****Onur ULUDAĞ****Ph.D. Dissertation, English Language Teaching Department****Supervisor: Prof. Dr. Hatice SOFU****June 2018, 136 pages**

The investigation of the ways second language (L2) learners process the L2 input has provided valuable insights into the understanding of human cognition and developing instructional interventions that would bring about better L2 learning. In this respect, the exploration of the mechanisms L2 learners employ to process linguistic data has allowed researchers to examine the aspects of L2 acquisition that still remain unresolved. Over the past few decades, researchers have addressed the investigation of L2 processing mechanism by referring to the way L2 learners resolve structural ambiguities real time. This dissertation also aims to draw a clear picture of the L2 sentence processing mechanism by comparing native English speakers and Turkish learners of L2 English at different proficiency levels in terms of their use of various information sources and effects of transfer during the processing of two different structural ambiguities, namely, the processing of relative clause (RC) attachment ambiguities and prepositional phrase (PP) attachment ambiguities, through a series of offline and online experiments. For each type of ambiguity, the offline experiments tested the attachment preferences of L2 English learners and native English speakers via the use of pencil-and-paper comprehension questionnaires, whereas the online experiments investigated real-time processing of the target syntactic structures through the use of eye-tracking methodology. The offline experiment on the resolution of RC attachment ambiguities revealed that Turkish and English RC attachment preferences differed in that native English speakers preferred to attach the RC to the local noun phrase (low attachment preference), whereas the Turkish participants preferred the nonlocal NP to attach the RC (high attachment preference). Even though the same

offline task fell short of detecting an attachment bias for the Turkish participants in the target language, English, the findings from a more sensitive online measure, the eye tracking task, indicated that the Turkish learners of L2 English tended to transfer the Turkish high attachment preference when processing English RC attachment ambiguities. As for the PP attachment ambiguities, the rationale was to investigate L2 learners' attachment preferences in situations when direct transfer effects from the learners' L1 are not probable as the equivalents of the PP attachment test items used in the offline task are not ambiguous in learners' L1, Turkish. This would render the opportunity to exclude the confounding factor of L1 transfer, which indeed substantially influenced L2 learners' processing decisions in RC ambiguity resolution. The results from both offline and online tasks indicated a clear low attachment bias for the native speakers and L2 learners groups, which suggests that L1 and L2 processing are both guided by structure-based processing strategies/biases in the computation of abstract relationships among syntactic constituents and that processing decisions can be made basing on the hierarchically deep structural information. The findings in general were interpreted to offer insights into several issues including how L2 grammatical processing could take place, whether and to what extent the transfer of L1 processing routines could influence real-time L2 sentence comprehension, whether it is possible for L2 learners to achieve native-like processing in the L2 and whether L2 processing mechanism is subject to a change with the increasing proficiency.

Keywords: Processing, structural ambiguities, transfer, eye tracking methodology.

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ABBREVIATIONS

DP: Determiner Phrase

ERP: Event-related Potentials

L1: First Language

L2: Second Language

NP: Noun Phrase

PP: Prepositional Phrase

RC: Relative Clause

RT: Reading Time

SLA: Second Language Acquisition

SPR: Self-paced Reading

SSH: Shallow Structure Hypothesis



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CHAPTER I

INTRODUCTION

1.1. Introduction

The ability to acquire a second language and to be able to use it offer important implications for the working of human mind and for the purposes of more practical concerns. Therefore, this issue has been a major concern not only for empirical grounds such as the pedagogical interests to help people learn a new language but also for more theoretical grounds such as scientific interests to better understand the nature of the human mind. In this respect, second language (L2) acquisition research has provided significant evidence for our perception of the underlying factors that facilitate or constrain the learning of an L2. A great many researchers studying L2 acquisitions have shown continuous interest in investigating what learners come to know about the mental representation of the grammar to the target language (i.e., the abstract linguistic knowledge of L2 learners) and several models have been proposed to explain how this knowledge is attained and put to use (see VanPatten & Williams, 2007 for a survey of the theoretical models). More recently a growing body of research has investigated how L2 learners make use of this knowledge to comprehend and process L2 in real-time. During the process of real-time sentence comprehension L2 learners meet each word in a reading or listening context and then they attempt to integrate these words into the analysis that has been constructed up until that moment. This rapid and automatic process that proceeds in an incremental fashion entails that in order to comprehend a sentence, L2 learners must parse the sentence, namely, refer to a syntactic analysis which allows identification of the grammatical role of words within each sentence, and also they must incorporate semantic, pragmatic and discourse knowledge to test how appropriate or plausible their interpretation is. Investigations within this respect are driven by basic inquiries from the field and L2 acquisition research such as how L2 learners process the target language in comparison to native speakers, whether the first language (L1) influence L2 learners' moment-by-moment processing decisions, and finally what role the individual differences (e.g., the level of proficiency, the type of immersion and the onset of exposure) have to play (Felser & Roberts, 2007).

In an attempt to address these fundamental questions, researchers have centered their investigations on identification and explanation of the differences and similarities

between L1 and L2 sentence processing. While possible convergence seems to exist in at least some domains of L1 and L2 sentence comprehension, serious accounts have been put forward to explain some of the L1 and L2 processing differences, which by and large include the most commonly cited issues slower and less accurate performance of L2 learners and also different levels of sensitivity to lexical, morphological and syntactic cues (MacWhinney, 2002). These differences have been described with reference to inadequate L2 competency of learners including those at higher proficiency level) and the differences between the L1 and L2 processing mechanisms (Frenck-Mestre, 2002). Such accounts suggest that the language processing of L2 learners will always be “nonconvergent” with that of L1 speakers of a given language, due to various factors such as less efficient learning mechanisms (attributable to the age-related issues), limited working memory resources resulting from morphosyntactic, pragmatic and discourse-related differences between the L1 and L2, and shallower and less detailed syntactic representations computed by L2 speakers during sentence processing (Clahsen & Felser, 2006a).

1.2. Background of the Study

It is essential to evaluate the accuracy of the assumptions stated above concerning the nature of L2 processing system in general and in particular whether L2 learners can process hierarchically deep and detailed syntactic constructions during sentence comprehension in real time. One popular approach to address this issue is to investigate the L2 processing of sentences including syntactic ambiguities which allow to draw more than one structural interpretation. Ambiguity resolution in sentence processing has been studied extensively and different varieties of ambiguous structures (e.g., relative clause attachment ambiguities, main verb vs. reduced relative clause ambiguities, prepositional phrase attachment ambiguities, subject vs. object ambiguities, to name a few) have been focal to these investigations (see Papadopoulou, 2006 for a review). Relative clause (RC) attachment ambiguity resolution has attracted much attention as these constructions are conducive to investigate parametric variations in sentence processing. The RC attachment ambiguities, as it is illustrated in (1) below, have been particularly interesting because of the way these constructions are processed differently by speakers of different languages.

(1) Somebody hit the father of the author who was at the café.

In this example, the RC, *who was at the cafe* could modify either noun phrase (NP), *the father* or *the author*. In order to arrive at a conclusion, the processing mechanism must perform to a particular structural analysis of the sentence. Examples of this sort illustrate that when faced with a local ambiguity, the human processor tends to pursue just one analysis, even if that particular analysis turns out to be incorrect. The evidence that there exists a consistency regarding processing decisions across different kinds of examples and across different groups of people implies that the preferences as to which analysis to pursue is not arbitrary and therefore examining such examples has the potential to present us implications about the architecture of human sentence processing mechanism.

The resolution of RC ambiguity shows significant cross-linguistic variation and has been a subject matter to a great number of investigations in L1 processing research. For instance, English native speakers (Cuetos, Mitchell & Corley, 1996) and similarly native speakers of Norwegian, Romanian and Swedish (Ehrlich, Fernandez, Fodor, Stenshoel & Vinereanu, 1999) were found to prefer to attach the RC to the second noun (*the author*) in (1) above. On the other hand, native speakers of German (Hemforth, Konieczny, Scheepers & Strube, 1998), Dutch (Brybaert & Mitchell, 1996), Russian, (Sekerina, 1997), Spanish (Cuetos & Mitchell, 1988), and Japanese (Kamide & Mitchell, 1997) showed a tendency to attach the RC to the first noun (*the father*). These cross-linguistic variations are essential for L2 sentence processing research as the differences in processing tendencies suggest whether L2 learners could transfer the processing strategies from their L1 to L2 acquisition. Additionally, this strand of research can offer insights to bring an explanation to the observed cross-linguistic variations, which in turn help obtain a better grasp of general sentence processing mechanisms.

Another example of a construction that involves syntactic ambiguity is the resolution of Prepositional Phrase (PP) ambiguities, an illustrative example of which is given in (2). In the following statement, the PP “*from her brother*” could be either attached to the verb *hid* or to the verb *borrowed*.

(2) Laura hid the money that she had borrowed from her brother.

Although this type of constructions are not targeted as commonly as the RC ambiguity resolution in the relevant literature (see Frenck-Mestre & Pynte, 1997), they are particularly of significant value as PP attachment ambiguities do not stem from cross-linguistic variation and they simply indicate a general verb phrase attachment preference. As the resolution of PP attachment ambiguities render the exclusion some of the influencing factors that are inherent in the RC attachment preferences of L2 learners (i.e., the L1 equivalents of the PP attachment constructions in L2 are not ambiguous), they could help to have a better understanding of sentence processing mechanisms, more specifically, whether L2 learners employ learner-specific processing strategies or not. Thus, the resolution of PP attachment ambiguities is also investigated to contribute further to the discussion.

1.3. Statement of the Problem

From the perspective of L2 acquisition, the investigation of these ambiguities is even more interesting in that they can draw a picture of L2 grammatical processing, just as they have explained how sentence comprehension is achieved in L1. Possible cross-linguistic variation can also provide information about the role of transfer and the possibility of native-like processing in the L2. To tap into these issues, Clahsen and Felser (2006a, 2006b, 2006c) formulated a rather popular proposal known as Shallow Structure Hypothesis (SSH). SSH suggests that the syntactic representations that learners formulate for the interpretation of L2 are shallower and less detailed than those of native speakers. However, L2 learners can make use of lexical, semantic and pragmatic information comparatively well to construct a semantic representation of the sentence (Clahsen & Felser, 2006a, p.32). Put it differently, L2 learners do not rely on phrase-structure-based parsing strategies to the same extent as native speakers while processing target language, whereas they can use lexical, semantic and pragmatic information conveyed by the content words in a native-like manner. As for the approach of 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 they do to native speakers of the target language. The studies conducted by Clahsen, Felser and their colleagues on ambiguity resolution tasks (Felser, Roberts and Marinis and Gross, 2003; Papadopoulou and Clahsen, 2003; Clahsen and Felser, 2006a) back up the claims that

L2 sentence processing is not solely governed structural accounts and that transfer of L1 processing strategies to L2 is not an issue that influences the processing decisions of learners (see Chapter 3 for the detailed review of the studies).

Of interest to the present study is a new strand of research that has failed to find support for the claims of SSH. In a recent study, Witzel, Witzel and Nicol (2012) set out to investigate the abilities of Chinese speakers of L2 English to process three types of temporarily ambiguous English sentences including RC attachment ambiguity resolution. Using an eye-tracking methodology, which appears to be more sensitive to reveal consistent results regarding L2 processing decisions of learners than a self-paced, phrase-by-phrase, moving-window reading methodology, the researchers noted that their findings presented a challenge to the assertions of SSH. Specifically, the results of Witzel et al. (2012) disputed the proposition that L2 sentence comprehension is featured with shallow structural processing as the experimental group showed syntactic interpretive biases towards specific structural configurations. This suggests that L2 learners are capable of performing structure-based processing that is sufficiently deep and detailed enough to be functioning during online L2 sentence comprehension.

The difference in the outcomes between the studies that have lend support to the SSH and Witzel et al. (2012) renders generalizability of the basic tenets of SSH problematic and therefore creates the need for further investigations to see whether or not the new results will pattern like SSH-supporting studies or whether they will pattern like those of Witzel et al. (2012), or whether they will show a pattern in some different way.

1.4. Significance of the Study

The significance of the present investigation is threefold: First, admittedly few studies, to the authors knowledge, examined sentence processing decisions of Turkish participants either in their L1 using offline measures (Kirkici, 2004) or in English as a second language using online self-paced, moving-window reading methodology combined with offline measures (Dinctopal-Deniz, 2010). These studies generated somewhat inconclusive results making it impossible to confirm the external validity and generalizability of the findings (see Chapter 2 for a detailed review of the studies). Thus, data from Turkish as a non-configurational language allowing for relatively free word order can shed further light on the issues regarding the role of transfer and native-

like processing by contributing to the understanding of the processes that are part of the sentence comprehension in L2. Also, the comparison of results to those of L2 English processing preferences can provide a new perspective on the likelihood of native-like processing. Secondly, it is important to note that the studies that have been unable to detect any consistent sentence processing patterns have employed either offline comprehension questionnaires (Kirkici, 2004, Rodriguez, 2004 among many others) or online self-paced reading methodology (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 (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 uses the eye-tracking methodology, which has been demonstrated to reveal more consistent reading time patterns than self-paced reading. To test whether Turkish learners display a bias for a certain processing pattern in their L1 and English L2, it is imperative to adopt a methodology that has the potential to detect differences in the processing of the target sentence types. Last but not least, it is important to note that this research paradigm could possibly have some suggestions for general SLA theories in that the ability regarding the real-time processing of linguistic input is a prerequisite for successful acquisition. Equally importantly, the failure to process the incoming linguistic data in real time could help learners notice the specifics of linguistic features and in this way facilitate the learning of the relevant constructions. These factors suggest that L2 learners' processing of the linguistic input predetermines the way they acquire and access linguistic representations (Truscott & Sharwood-Smith, 2004). Within this context, the question becomes whether it is the nonnative-like processing to be blamed for less-than-optimal acquisition. Therefore, having a deeper grasp of how learners at a variety of proficiency levels incorporate the strings of words into sentences and how they ascribe a syntactic and semantic framework to the incoming input can add to the formulation of an SLA theory which can account for how the underlying L2 mechanisms develop.

1.5. Research Questions

The present study conducts a series of online and offline experiments that are designed to compare L1 and L2 processing of two different types of syntactic ambiguities, namely, the processing of RC attachment ambiguities and PP attachment ambiguities as described above. For each type of ambiguity while the offline experiments test the L1 and L2 attachment preferences of Turkish learners of English through the use of pencil-and-paper comprehension questionnaires, the online experiments investigate real-time processing of the target syntactic structures through the use of eye-tracking methodology. The research questions that guide the present study are listed in four sections below in accordance with the purpose of each experiment:

1.5.1. Research Questions for Offline RC Attachment Ambiguity Resolution

1. How do native English speaker control group process RC attachment ambiguities in English offline?
2. How do Turkish learners of L2 English process RC attachment ambiguities in Turkish and English offline?
3. Are the preferences of L2 learners influenced by proficiency effects?
4. Are Turkish learners of L2 English influenced by their L1 processing strategies or by a strategy specific to L2 when comprehending RC attachment ambiguities offline?

1.5.2. Research Questions for Online RC Attachment Ambiguity Resolution

1. How do Turkish learners of L2 English process RC attachment ambiguities online in comparison to the native English speakers in the control group?
2. Do Turkish learners of L2 English make use of syntactic information in their online resolution of temporarily ambiguous statements including English relative clause (RC) constructions?
3. Are the processing preferences of L2 learners influenced by their proficiency levels?
4. Do lexically driven interpretive biases take precedence over structure-based parsing biases in RC ambiguity resolution as suggested by previous research?

1.5.3. Research Questions for Offline PP Attachment Ambiguity Resolution

1. How do Turkish learners of L2 English process PP attachment ambiguities offline in comparison to the native English speakers in the control group?
2. Are the processing preferences of L2 learners on PP attachment ambiguities influenced by their proficiency levels?
3. Do the L2 learners make use of L2-specific strategies when processing PP attachment ambiguities?

1.5.4. Research Questions for Online PP Attachment Ambiguity Resolution

1. Do the online attachment preferences of L2 learners for PPs show a different pattern from those of native English speakers?
2. Do the processing preferences of L2 learners differ for offline and online tasks?
3. Do the L2 learners make use of learner-specific processing strategies when comprehending PP attachment ambiguities?

1.6. Definitions

The following definitions are provided in order to avoid any confusion and make sure that the concepts used in the present study are understood accurately.

Agent: Thematic role assigned to the constituent initiating the action.

Ambiguity Resolution: Basing on the available syntactic or semantic information, making processing decisions on structures that would allow for inference of at least two distinct interpretations.

Bias: Tendency to interpret linguistic data in a certain way.

Globally Ambiguous: Target sentences that are constructed in a way that would allow for inference of at least two distinct interpretations

Lexical cues: Content words that help comprehending meaning.

Patient: Thematic roles assigned to the element of the sentence on which the action is performed.

Parsing: Syntactic processing that takes place to comprehend sentences.

Processing: Moment-by-moment comprehension of linguistic input.

Semantic cues: Hints based on meaning that help decipher and comprehend input.

Syntactic cues: Hints based on structural features to decipher and understand input.

Temporarily Ambiguous: Target sentences which include lexical or structural information that would help resolve the ambiguity.

Transfer: Use of first language parsing strategies during second language sentence processing.



CHAPTER II

REVIEW OF LITERATURE

2.1. Introduction

As the L2 processing research has drawn upon the outcomes of the investigations to the L1 processing, it renders the necessity of discussing the theoretical background for processing in the first language. Therefore, the present chapter introduces the fundamental concepts to sentence processing models. This chapter begins with an outlook to more general issues concerning the characteristics of processing mechanisms. Then, different models proposed to account for sentence processing through the available empirical data on syntactic ambiguity resolution are discussed. These models are evaluated with regard to their assumptions about the universality of parsing principles and other working mechanisms. The models are categorized as follows: Models based on universal parsing principles, models based on language-specific principles, models based on prosodic factors and models based on experiential factors. The remainder of the chapter then addresses sentence processing in L2 with a specific emphasis on the investigation of syntactic ambiguity resolution strategies that are employed to examine the processing of L2 input. The chapter concludes with the section that elaborates on the motivation for the present study.

2.2. The Nature of the Human Processing Mechanism

The investigation of the true nature of human language processing mechanisms is fairly challenging as the current technological means allow us to only indirectly examine the human brain and therefore fall short of directly identifying the components determining how the concept of language is represented in the human mind and how that concept is put into practice. It is through behavioral data that we gain insights into the nature of this processing mechanism. Researchers make use of the processing of syntactic ambiguities, which offer empirical data to reveal the issue. The common procedure is that subjects are presented with syntactically ambiguous items that have at least two possible interpretations. When prompted to analyze these items, the language processor opts for an initial analysis by overlooking all the other available information. This process might bring about misanalyses known as “garden path” effects (Clifton &

Frazier, 1989). It is possible to measure these effects through the use of psycholinguistic methodologies such as moving window self-paced reading and eye-tracking tasks. For instance, in self-paced reading tasks, subjects read target items word-by-word or phrase-by-phrase fashion and push a button to see the following constituents after encountering the first one. The reaction times spent from the appearance of target constituent to the pushing of the button is recorded in the sense that longer reaction times reflect processing difficulties. In eye-tracking tasks, which are of interest to the present study, the movements of eye pupil are recorded by a high-resolution camera as subjects read test items. The processing difficulty is reflected respectively in increased reading times and longer fixations at the region of disambiguation. Figure 1 below illustrates how data collection is achieved through eye tracking paradigm.

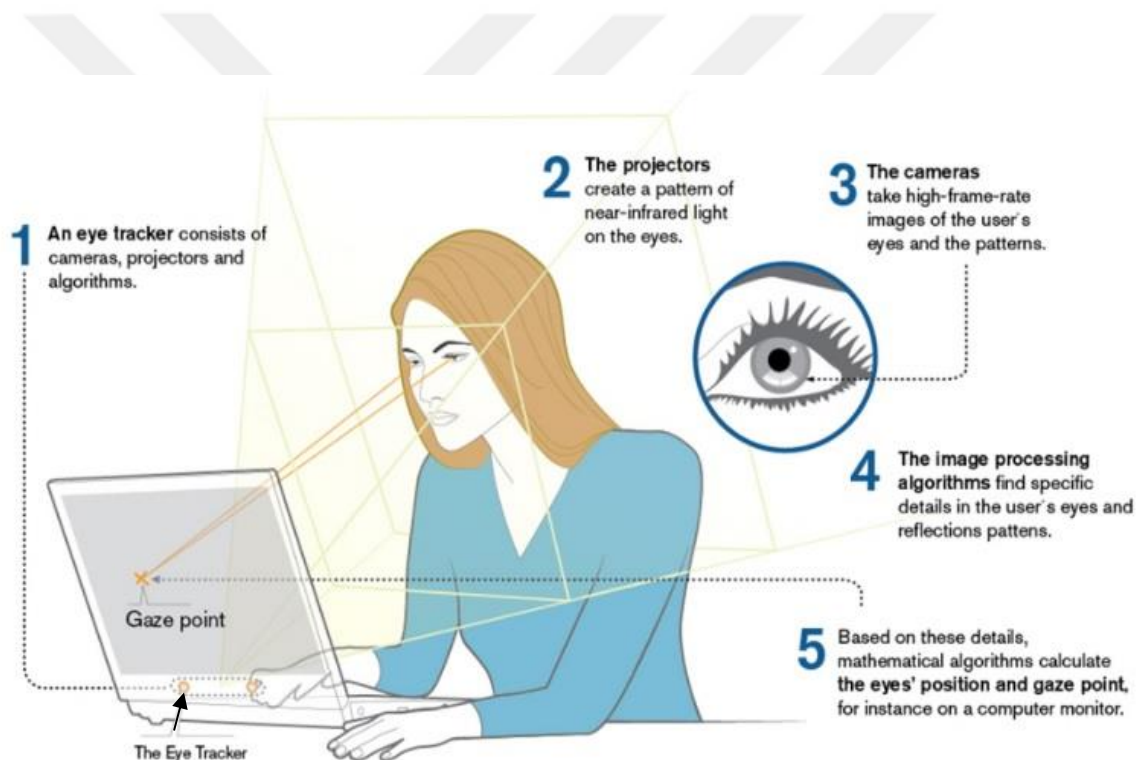


Figure 1. The diagram of the data collection procedure through eye tracking

The human language processing mechanism performs a series of cognitive actions which involve transformation of a string of words in a sentence into a systematic mental representation and then discovery of the intended meaning of the sentence as it is conveyed in real time. In this regard, a central question regarding the nature of human language processor has to do with the mental representation of grammar and processing as both concepts inextricably interrelated. While grammatical knowledge influence

processing, the construction of grammar is essentially dependent on the way whereby we process the linguistic structures. In contrast to the prominent interest in the knowledge of grammar in generative linguistic theory, the scientific interest in processing emerged comparatively late. The firm distinction between these two strands of research was first coined as competence and performance by Chomsky (1965, 3-15). While competence refers to the abstract knowledge of language possessed by a speaker/listener, performance refers to the concrete use of that language knowledge.

The prominence of competence in linguistics caused many researchers to closely associate grammaticality of a sentence with the processability (see Fodor, Bever and Garrett, 1974), which in fact contradicts with the evidence that sentences that seem ungrammatical could be perfectly processed because they could be assigned syntactic structures. Ambiguous sentences offer evidence for the disparity between grammaticality and processability. A sentence is considered to have a syntactic ambiguity when the string of words is compatible with more than one structural interpretation. Ambiguity could be global in that a whole sentence can be associated with more than one interpretation (e.g., *Somebody hit the father of the author who was at the café.*) or it could be local or temporary in that a sequence of words can be associated with more than one interpretation until additional information is encountered (e.g., *The village won during the battle suffered great damage.*). Even though it is grammatically correct, the locally ambiguous statement above poses difficulty for the reader/hearer because the verb *won* tends to be initially interpreted as the main verb. This assumption then turns out to be incompatible with the addition of verb phrase *suffered great damage*, which indeed includes the main verb *suffered*. The possible processing difficulty on the main verb demonstrated in the previous research suggests that processing of a sentence is not solely influenced by the knowledge of grammar. It is reasonable to think that the processing mechanism could be relatively influenced by the syntactic structure of sentences as the parser tends to initially interpret the simplest structure (Long and Prat, 2008). Chomsky (2000) comments on the independent but interrelated relationship between the processing mechanism and grammar as follows:

The faculty of language is embedded within the broader architecture of the mind/brain. It interacts with other systems, which impose conditions that language must satisfy if it is to be usable at all. We might think of these as legibility conditions, in the sense that other systems must be able to read the

expressions of the language and use them as instructions for thought and action (Chomsky, 2000, p. 9).

The majority of psycholinguistic models draws a distinction between the underlying linguistic knowledge and the mechanisms of understanding and producing sentences. While the former is assumed to use a collection of resources ranging from working memory, general world knowledge, personal experiences, the latter is evinced to be influenced by specific processing principles or ambiguity resolution strategies (Pereplyotchik, 2017).

Additionally, human sentence processing is shown almost uncontestedly to be incremental, with newly incoming input (e.g., strings of words) immediately interpreted and integrated in connection with the previous (Just and Carpenter, 1980). However, the question arises whether the processing mechanism creates probable interpretations serially or considers several interpretations of an ambiguity in parallel (see Gibson and Pearlmutter, 2000).

Another essential issue regarding the nature of the processing mechanism that could potentially offer implications for L2 sentence processing is whether the processing mechanism is universal or language specific. Even though there were models claiming that the processing mechanism is language universal (Frazier, 1978, Frazier and Fodor, 1978, cited in Papadoupoulou, 2006), Cuetos and Mitchell (1988) critically disputed this assumption in their study on relative clause attachment preferences of English and Spanish speakers through the use of both online and offline measures. They found that English speakers preferred to attach the RC to the closer NP showing low attachment preference whereas the Spanish speakers indicated high attachment preference by attaching the RC to further NP. Following this seminal study, various investigations were conducted with native speakers of different languages employing a variety of materials and measures both online and offline and a similar cross-linguistic variation was observed. For instance, the speakers of the following languages were reported to prefer low attachment in their resolution of RC ambiguity: English, Italian, Japanese, Arabic, Norwegian, Swedish and Romanian. On the other hand, the speakers of the following languages were found to have a preference for high attachment: Spanish, French, German, Dutch, Russian and Greek (see Papadopoulou, 2006 for an overview of the studies).

It is also possible to find studies in the relevant literature that present incompatible RC attachment tendencies to those languages reported above. For example, even though English speakers were reported to have a low attachment preference, Carreiras and Clifton (1993) indicated no specific attachment tendency for English. Similarly, German was first classified as high attaching language, but Augurtzky (2006) reported a low attachment preference. Further investigations on Spanish (Fernández, 2003), Italian (Frenck-Mestre and Pynte, 2000) and Japanese (Kamide and Mitchell, 1997) suggest that factors such as the experimental methods, disambiguating region of the target items, the type of information used to disambiguate, etc. might account for conflicting findings on the RC attachment tendencies. An overview of the previous studies also indicate that gender, number, case agreement or general world knowledge were used as disambiguating information (Papadopoulou, 2006), which might have an effect on the attachment preferences. It is also often noted that RC attachment preferences are based on relatively weak statistical effects. Last but not the least, in addition to the reported inter- and intra-language variations, individual differences were also reported as a confounding factor. For instance, in Swets, Desmet, Hambrick, and Ferreira (2007), working memory capacity of English speakers were measured by using a reading span task, a measure that counts the number of words a participant can remember in different sentence contexts. The participants were then divided into low reading span and high reading span groups. The results indicated that participants with low reading span tended to attach the RC high while the participants with high reading span displayed a low attachment preference.

The variations in RC attachment preferences illustrated above clearly makes it challenging to account for the differences through a single extensive processing model particularly because some of the findings contradict standard processing models. While it is possible to bring an explanation to the conflicting data by attributing to the confounding factors in the experimental designs such as differences in methodology, materials, data collection tools or participant groups, the parsing models that were proposed regarding some universal principles and other factors offered their own specific accounts. For instance, the models that were based on universal parsing principles suggest that the observed cross-linguistic differences result from pragmatic considerations rather than syntactic factors. The models based on language-specific principles, on the other hand, maintain that in tandem with universal parsing principles there are also parameterized principles varying across languages, which could be taken

to explain the variation in the observed findings. In addition to these models, models based on exposure-based factors assume that processing decisions depends on frequency data within a specific language rather than universal principles. Finally, there are those models which depend on the primacy of prosodic factors suggesting that processing relies on cross-linguistic prosodic patterns that apply even during silent reading. These models that bring different perspectives to language processing are detailed in the next section.

2.3. Sentence Processing Models

The details of the sentence processing models are documented in the following four sections respectively: universal parsing models, language-specific (parameterized) models, exposure-based models and prosody-based models.

2.3.1. Models Based on Universal Parsing Principles

The assumption that dominated the investigations on sentence processing concerns the universality of the human processing mechanism. Universal models of sentence processing maintain that the nature of the human sentence processor is the same across different languages and the parsing routines are determined by a set of constraints guided by phrase-structure information (Frazier, 1978, 1987; Frazier and Fodor, 1978) by the knowledge of grammar (see Crocker, 1996; Pritchett, 1988, 1992; Weinberg, 2001) as well as by working memory limitations. These considerations led to the bold assumption that as long as grammar give direct access to language-specific characteristics for the human language processor, the same processing theory suffices to account for parsing in all language (Frazier, 1985).

One of the most prominent universal theories of sentence processing, the Garden Path model (Frazier, 1978, 1987; Frazier and Fodor, 1978; Frazier and Rayner, 1982), suggests that sentence comprehension includes two distinct stages, namely the parsing stage and the interpretation stage. The parser runs an initial structural analysis on the input based on phrase structure rules in the parsing stage, which is solely syntactic as the parser refers to only syntactic information to reach the initially preferred analysis. The analysis, in this respect, is realized through an independent syntactic routine that is not affected by non-syntactic information sources such as semantic, pragmatic, discourse information as well as general world knowledge. In the interpretation stage,

lexical information is employed to create the final interpretation of the sentence (Frazier, 1987). When the processing mechanism comes across an ambiguous material which forces the parser to decide between alternative choices, it tends to prefer one analysis rather than pursuing several syntactic analyses or delaying the analyses of input. If the initial analysis turns out to be incorrect, the processor is directed towards garden path and the reanalysis of the sentence takes place. This process of reanalysis leads to processing complexity which is reflected in elevated reading times and more frequent errors in final comprehension after the failure of reanalysis.

The first analysis of the sentence is determined by two strategies, Late Closure and Minimal Attachment (Frazier, 1987). According to Late Closure, the new incoming elements are supposed to be attached to the phrase that is processed at the time being. On the other hand, Minimal attachment requires the fewest applications of grammatical rules to attach each incoming word into the structure being built (i.e. the parser initially attempts to interpret sentences in terms of the simplest syntactic structure compatible with the input that is known at the moment).

These principles aim to increase the speed and efficacy so that the new elements can be integrated into the continuing analysis. As the principles are bound by the capacity of the working memory, they help avoid overwhelming processing loads. According to this model, no cross-linguistic transfer effects are expected because these principles are considered universal. However, the cross-linguistic variation in the RC attachment ambiguity illustrated above in the previous research seriously challenged the Garden Path model. Therefore, the advocates of this model proposed the Late Closure Theory. This account claims that the initial parsing is guided by the Late Closure principle, while the final interpretation is determined by pragmatic factors which might bring about the differences cross-linguistically. However, the same tendency for high attachment was observed even when the studies used exact translated equivalents of target items in different languages (Fernandez, 2003).

Another universal processing account, Construal theory, was developed by Frazier and Clifton (1996, 1997) in their attempts to radically amend the Garden Path model. The fundamental difference between the Construal theory and Garden Path model is that the former claims the use of different processing mechanisms for different constructions. Syntactic constructions are classified by two categories named as primary and non-primary phrases. Primary phrases depend on the subject and the main predicate of any finite clauses including the complements and obligatory constituents (Frazier and

Clifton, 1996). All other phrases are optional and hence termed non-primary. These non-primary phrases are linked to the other constituents through semantic and pragmatic principles. The integration of non-primary phrases does not take place in the initial processing. In its attempt to rapidly construct an analysis, the parser can initially ignore the non-primary relations. Construal theory asserts that only primary phrases are processed in a specific way as determined by the Garden Path model and along with Late Closure and Minimal Attachment. Non-primary phrases, instead of being processed by the use of the universal parsing principles, are processed in a non-specific way and they rely on Construal principle, which includes thematic relations and discourse principles. The application of these principles may differ cross-linguistically, which is the case for RCs. According to Construal, RCs belong to non-primary phrases, as they are nominal modifiers. This means that unlike what Late Closure would require, the RCs are not immediately attached to the most recent NP (i.e., “*the author*” as in (1) below) when it can be attached to two NPs in globally ambiguous sentences.

(1) Somebody hit the father of the author who was at the café.

For the RC attachment preferences, Construal assumes association to the current thematic processing domain, i.e. the extended maximal projection of the last theta-assigner (the first NP, “*the father*”) and hence both NPs should be equally available targets for the RC to be attached (Frazier and Clifton, 1996). It should be noted that to explain processing routines observed in various languages, the Garden Path model and its amended versions make use of thematic information. Nevertheless, the difference between Garden Path and Construal is that the latter assumes these effects to appear even in initial processing routines for non-primary phrases.

Construal theory falls short of explaining some issues even though it is possible to account for many findings on RC attachment preferences. For instance, English has an alternative to the complex Norman genitive construction known as the Saxon genitive (*the author’s father* rather than *the father of the author* as in (1) above), which unambiguously requires attachment to *the father*. Considering the Grice’s (1975) maxim of manner (i.e. avoid obscurity and ambiguity), the use of the Norman genitive would imply that the RC is attached to *the author* if possible. Even though languages like German, Dutch and Croatian have alternatives to the genitive construction, the speakers of these languages showed high attachment preferences. Moreover, speakers of

Romanian and Portuguese showed evidence of a low attachment preference although these languages have a pre-nominal genitive construction like the one in English (Papadopoulou, 2006 for a review of the studies).

Another issue with the Construal theory is that it is rather challenging to make a distinction between primary and non-primary phrases as it is in the case of prepositional phrases because the determination of role of prepositional phrases appears to be influenced by the context of the sentence. It is not clear whether the same prepositional phrase can be primary in certain contexts and non-primary in others. Therefore, further explanation is needed for the classification between primary and non-primary phrases so as to investigate the relevant predictions empirically.

The cross-linguistic variation seen in a variety of studies that have been cited above has proliferated models which argue in favor of language-specific processing mechanisms. The predictions of such models are discussed in the following section.

2.3.2. Models Based on Language-specific Principles

Most early research on sentence processing has been conducted on English and therefore the processing principles associated with English have been thought to apply cross-linguistically. Yet, studies on other languages have not consistently yielded similar findings, which has made it difficult to derive a conclusive universal processing model. Instead, results from a variety of languages have indicated that upon processing sentences on-line, native speakers might rely on different processing routines. This consideration has been delineated by models such as The Modifier-straddling strategy (Cuetos and Mitchell, 1988) Anaphor Binding (Hemforth et al., 1998) or Recency and Predicate Proximity (Gibson et al., 1996). Even though these models argue in favor of the presence of language universal processing principles, they assert that the strength of these principles show different levels of variation in different languages.

The Modifier-straddling strategy was developed by Cuetos and Mitchell (1988) to address the distinct processing routines used by the speakers of English and Spanish to process RC attachment ambiguities in sentences like (1) above. Cuetos and Mitchell argued that the tendency of Spanish speakers to attach the RCs to the first NP could be justified by the application of another processing principle favoring high-attachment of incoming elements and competing with Late Closure. This argumentative processing strategy was termed Modifier-straddling and its operation was claimed to vary cross-

linguistically. “Parameter-based linguistic properties of the languages under analysis” was given as the reason for this variation by Cuetos and Mitchell (1988). That is to say, when a modifier is to be attached to a set of potential preceding nouns in post-modifying languages, the Modifier-straddling becomes operational. This strategy does not work in pre-modifying languages because only post-modifying languages use post-nominal adjectives and thus the RC can be attached to the noun unambiguously in NP-Adjective-RC sequences. It is argued that when an adjective intervenes between the noun and the RC as in the sequence of NP-Adjective-RC, a processing routine which provides the connection between them becomes operational. Similarly, the same processing routine works in a broader variety of constructions such as NP1-NP2-RC, which accounts for the preference of high attachment in Spanish.

Although this assumption seemed like a tenable proposition for the findings at that time, subsequent research did not yield supporting data. For instance, the type of preposition that connects the two NPs of the RC (i.e. the use of the equivalent of preposition *with* in Spanish in the complex NP) has been shown to influence the attachment of the RC, indicating low attachment even in Spanish and thus undermining the claims of the Modifier-straddling. (De Vincenzi and Job, 1993). Moreover, the predictions of this model were not supported by the findings from post-modifying languages such as Spanish and Italian, which indicated a low-attachment preference (De Vincenzi and Job, 1993; 1995). On the other hand, Dutch (Brysbaert and Mitchell, 1996) and German (Hemforth, Konieczny, Scheeper & Strube, 1998) exhibited a high-attachment preference although these languages have post-modifying structures. Thus, considering the available set of the data, it is difficult to consider the Modifier-straddling strategy as a plausible account. Nevertheless, it succeeded to attract the attention of researchers to the idea that processing principles could result from language-specific properties.

Anaphor Binding is another language-specific processing account which proposes that it is not only the structural principles but also the lexical heads and their properties in the syntactic constructions that guide the initial attachment preferences (Hemforth et al., 1998). It is assumed that anaphors tend to be attached to the most salient discourse entities. In the case of RC attachments, the relative pronouns are anaphors and thus have to be linked to an antecedent. The most salient discourse entity in the case of RC attachment is the first NP, as the first NP is the internal argument of the verb. The model describes the observed cross-linguistic differences with the way relative clauses

are constructed in different languages. More specifically, languages such as German in which RCs are headed by a relative pronoun are sensitive to anaphoric binding and thus demands the RC to be attached the most salient host, which is the first NP, the result of which is the high attachment preference in German. Conversely, languages such as English which allow for the RC to be constructed through a complementizer (that) or the omission of relativized element in grammatically acceptable situations, are insensitive to the process of anaphoric binding. The conditions of anaphoric binding in these languages are not strong enough, which causes the RC to be processed in connection with structural considerations only. Similar to the Late Closure, this requires the RC to be attached to the most recent host, the second NP, and thus accounts for the low-attachment preference in English.

The proposals of Anaphoric Binding regarding the RC attachment preferences have been supported by studies in many languages including English, German, Dutch, Swedish, Norwegian and Russian (Papadopoulou, 2006 for a review). More precisely, the low attachment preferences observed in English Swedish and Norwegian has been explained with the idea that RCs are not necessarily constructed by the presence of a relative pronoun in all these languages. Likewise, the high attachment preferences revealed in studies on German, Dutch and Russian has been explained with reference to the obligatory use of a relative pronoun in the RCs constructions. Moreover, the predictions of Anaphoric Binding were supported by other types of ambiguities such as PP attachment. Hemforth et al. (1996) investigated the attachment of PPs in German claiming that anaphoric binding would not work given the way PPs are introduced and thus the low-attachment preference should be observed. In fact, the results showed a low-attachment preference for PPs in German in both offline and online measures.

Although Anaphoric Binding process has been supported by the data from the languages mentioned above, there has been some evidence against this account as well. For instance, even though the presence of a relative pronoun is obligatory in Romanian (Ehrlich et al., 1999), the RCs was found to be attached to the most recent NP and not to the most salient one, which is the first NP, as it is required by Anaphoric Binding process. Similarly, Arabic and Romanian displayed a low attachment preference though requiring obligatory relative pronouns (Abdelghany and Fodor, 1999 & Ehrlich et al., 1999 cited in Rah, 2009). Conversely, Greek uses a relative complementizer as in English, however, Papadopoulou and Clahsen (2003) indicated a high attachment preference, which is not in line with the predictions of Anaphoric Binding. Conflicting

data has been obtained from Spanish, Italian, and Brazilian Portuguese as well. To illustrate, while Spanish participants showed a high attachment preference, a low attachment preference was observed in Italian and Brazilian Portuguese, contrary to the fact that these languages use similar relative complementizers (*que* -that for Spanish and Brazilian Portuguese and *che* -that for Italian) (Kashiwagi, 2011 for a review).

In addition to the conflicting data from the aforementioned studies, Anaphor Binding has not been considered as a conclusive sentence processing account from a theoretical perspective. First, it is argued that even if a pronoun is not overtly realized, there is still a necessity for pronoun binding, in which case an empty operator is thought to hold the structural position of the relative pronoun (Papadopoulou, 2006). Therefore, there is supposed to be no difference between empty and overt anaphors given that the empty element is bound by the requirements of binding. Lastly, there is no sufficient explanation for the way that the exact strength of Anaphor Binding is determined for a given language.

Gibson and colleagues (Gibson, et al., 1996) devised another parameterized sentence processing account suggesting that processing decisions are determined as the result of the competition between two syntactic principles, namely, recency preference and predicate proximity. Recency preference demands new constituents to be attached to the most recently constructed structures. In this sense, it is similar to locality principles suggested by the previously discussed processing models. Recency is considered to be the consequence of the general makeup of the human language processor and therefore this principle is unlikely to vary cross-linguistically. On the other hand, Predicate Proximity, which requires to attach the constituents to the head of the predicate phrase as close as possible, is language-specific (parameterized) implying that depending on the average distance between a verb and its arguments in a sentence, the relative strength of predicate proximity strategy varies cross-linguistically. According to Gibson et al. (1996) unlike recency, which is thought to be the outcome of the limitations of working memory predicate proximity potentially show variation across languages. To be more precise, it is the relative weight of the predicate proximity that differs across languages and, thus, the effects of this strategy on processing is assumed to be stronger, which rules out the effect of recency. Word order is considered to be the parameter that plays a key role in defining the weight of Predicate Proximity in different languages. To illustrate, languages with a strict word order are expected to be guided by a low attachment preference as the arguments are closer to the verb. On the

other hand, in languages that allow arguments to be far away from the verb, a high attachment preference is anticipated. Considering this argument, the model accurately brings an explanation to the attachment of RCs to the low NP in English Norwegian, Swedish, and Brazilian Portuguese and a high attachment preference for Spanish, French and Russian German due to their relatively free word order patterns. The latter languages allow adjuncts to be positioned between the head of a predicate phrase and its complements. Thus, predicate proximity is stronger than in the former languages which require a strict word order and do not allow for adverbs to intervene between verb and object.

The problem with the predicate proximity that is often expressed in the relevant literature is that the interaction between the strength of predicate proximity and word order is not clearly spelled out. It is not straightforward whether more general word order constraints have an influence on this particular parameterization. Papadopoulou (2006) takes German as an example and argues that although it has strict word order constraints such as the verb second position in finite clauses and final position in embedded clauses, adjuncts are allowed to intervene between the verb and its complements. On the other hand, this does not work for languages like Spanish. While it is possible to make the argument that Predicate Proximity is stronger in the former type of languages than in the latter type, such issues need further support and clarification.

Considering how grammatical information influences processing, Gibson et al. (1996) suggest three probable considerations given the relationship between the grammar and the processing mechanism. First, the grammar of a particular language might directly regulate the processing preferences; therefore, the observed variation in different languages may be determined by the setting of a particular linguistic parameter. However, it should be noted that there is no clear explanation to the question of how the distance between the verb and its arguments constitutes a linguistic parameter. Secondly, Gibson et al. argue that the processor depends on the frequency information that helps resolve certain ambiguities in particular languages. Regarding this proposition, Gibson et al. (1996, p. 47) states that setting parameters of the grammar does not set processing parameters, which can be taken to mean that the grammar approves or disapproves a particular ambiguity resolution and have a direct influence on the frequency of this resolution type. However, in order to resolve ambiguities, the processing mechanism cannot be directly linked with the grammar (see the discussion

above regarding grammaticality and processibility in Section 2.1). Instead, the processor is claimed to be sensitive to the statistical patterns in ambiguities in a given language (Gibson et al., 1996). Finally, it is argued that there is no close relationship between processing and grammatical parameterization. Instead, the processor is parameterized independently of the grammar and depends on a statistical pattern to resolve particular ambiguities. This final explanation is the central consideration underlying experience-based models for sentence processing, which is discussed in the following section.

2.3.3. Models Based on Language Exposure

Exposure-based models favor a statistically guided human processing mechanism that keeps the records of how different ambiguities are resolved in a certain language. They do not assume that the processing decisions are based on the frequency data coming from exposure to the language rather than *de facto* processing principles. Therefore, it is argued that upon confronting a particular ambiguity, the parser resolves it by using the records that are kept from the previously encountered data and prefers the analysis that has been seen most frequently. The fundamental difference between these models and the ones presented so far comes from the supposed interaction between the processing mechanism and grammar. Exposure-based models maintain that the processing mechanism functions independently of the grammar by making its choices basing on solely exposure facts and therefore the two does not have a close relationship.

The models under this category are classified with regard to the way the parser supposedly encodes and uses the frequency information. (MacDonald, 1997). While models such as Tuning theory use coarser measures (coarse-grained models; non-lexicalist models), implying that the frequency information is sort out at a syntactic level (Mitchell et al., 1995; Brysbaert & Mitchell, 1996), others use detailed records of frequency information at lexical or contextual level (fine-grained models; lexicalist models; constraint-based processing models (MacDonald, 1993; MacDonald, Pearlmutter & Seidenberg 1994).

A well-documented example of coarse-grained model, The Tuning Theory, (Mitchell et al., 1995; Brysbaert & Mirtchell, 1996) argues that the processing mechanism stores a statistical registry regarding the most frequent way of the resolution of structural ambiguities in a given language and then build up the initial analysis of the

sentence on frequency information at a structural level. At this initial level lexical, pragmatic or discourse information is overlooked and only the records of syntactic information are used. In the later stages of processing the former set of information could be employed if need be. Tuning is considered to be a further adaptation of Garden Path model because both assume a processing mechanism that runs an initial analysis exclusively built upon structural accounts. The difference is that while the structural decision are based on universal processing principles in Garden Path, the same process is realized through the statistical records of the most frequent way whereby a structural ambiguity is resolved in the relevant language (Brysbaert & Mirtchell, 1996). As for the resolution of RC attachment ambiguities, the proponents of Tuning assert that the different RC attachment preferences that have been observed in various languages can be featured with the frequency of alternative disambiguations that has been confronted in different languages. To be more precise, if low attachment preference is more frequent in the resolution of RC ambiguities, then the speakers of these languages are affected by this exposure and show a low attachment preference in the RC disambiguation and vice versa. To address the question of what makes up the exact nature of information that the processing mechanism stores, Mitchell et al., (1995, p.479-480) argue that the processor makes use of the accumulated statistics for all encounters with NP-*of*-NP-RC structures and resolves these ambiguities by addressing to the same central record. This central statistical record includes neither the specific lexical properties of the two NPs nor their tendency of taking modifiers.

Researchers evaluate the predictions of Tuning and other exposure-based models by comparing the available corpus data on the ambiguity resolution patterns with data from experiments tapping into this issue. A convergence between the patterns of corpus data and experiments renders evidence that would consolidate the predictions of Tuning. In this respect, the analysis of the corpus data for RC attachment preferences in English Spanish and French has supported the Tuning theory (Traxler, 2011). More specifically, corpus data shows that the RCs are attached to the second NP in English more frequently resulting in a low attachment preference whereas it is more frequently attached to the first NP in French and Spanish suggesting a preference for high attachment. Previous research on these languages displays findings corresponding with the corpus data, thus supporting the predictions of the Tuning theory.

A divergence between corpora and the experimental findings was also observed, which would essentially undermine the predictions of Tuning. To name a few, Mitchell

and Brysbaert (1998) reported evidence from Dutch indicating that while high attachment preference was observed in their online data, in corpus data low attachment of RCs was more frequent. Similarly, Gibson et al., (1996) reported evidence against Tuning from conjoined DP-three-site ambiguities. The analysis of the corpora indicated that the most preferred host for the conjoined DP was the third DP and the least preferred one was the first DP, but the online and offline measures in English showed that the most preferred host was actually the lowest DP, whereas the middle DP was the least preferred one instead of the the highest one, as it would be expected from the analysis of the corpora. The relevant data argues against the statistically-driven nature of the processing mechanism and maintains that initial processing decisions could be determined by some other factors that are independent of statistical records of exposure. Finally, inconclusive results were also obtained from Cuetos et al. (1996). A pre- and post-test design study was conducted with Spanish children to see whether exposure to a particular type of disambiguation could influence the RC attachment preferences, as it would be predicted by Tuning. After the pre-test which was designed to identify the attachment preferences of participants, one of the groups was exposed to RC constructions that force disambiguation towards high attachment while the other were given materials forcing disambiguation towards low attachment. The results for the the latter group did not demonstrate a significant change in the initial high attachment preference, whereas the initial high attachment preference became even stronger in the former group. Although the participants' initial preferences were confirmed by the exposure effect, their preferences did not change when they were exposed to materials that did not match their initial preference. The results were interpreted in the way that when exposure to a specific kind of disambiguation reinforced an already existing preference in the language, as in the case of high-attachment forced group, attachment choices could be influenced. Conversely, exposure to a disambiguation type that is not supported by the language like the low-attachment forced sentences in Spanish could not change the initial choice.

As in the case of Tuning, constraint-based processing models attribute great importance to exposure-based factors (MacDonald, 1993; MacDonald, Pearlmuter & Seidenberg 1994). These models claim that not only the frequencies of structures but also the frequency of individual lexical items have a say in processing decisions. Contrary to what Tuning suggests, though, non-syntactic information is believed to predominantly guide the processing mechanism to decide on the preferred analysis. In

this sense, three wide-ranging categories of constraints are classified: lexical information, structural information and pragmatic/discourse information (MacDonald, Pearlmutter and Seidenberg, 1994). Information from these sources is activated in parallel and interacts with each other to reach the final analysis. Satisfaction of these constraints is assumed to be necessary for sentence processing, however, some constraints might take precedence over others. The dominance of a constraint is attributable to locality and frequency of a form and to the nature of the activation and competition mechanisms.

With respect to the disambiguation of RC attachment, MacDonald et al (1994) argued that ambiguities of modifier attachment are influenced by the lexical frequency preferences of the preceding attachment sites that need to be modified. Therefore, if the first noun has a stronger lexical bias of appearing with a modifier than the second, the modifier will be attached to the first noun rather than to the second and vice versa. In this regard, observed cross-linguistic variation is attributable to the probable lexical biases of the two NPs. Nevertheless, this proposition was not validated by Corley and Corley (1995), a study which manipulated the position of the nouns. The results indicated an overall low attachment preference in English irrespective of the positions of the two NPs. Moreover, Gibson, Pearlmutter and Torrens (1998) compared Spanish sentences including two and three possible attachment NPs. Even though the same NP had the lowest position in both conditions, a low attachment preference was observed when there were three attachment sites and a high attachment preference was observed when there were two possible attachment sites.

Thornton, Gil and MacDonald (1998) and Thornton, MacDonald and Gil (1999) offered further explanation to the cross-linguistic variation in RC attachment ambiguity by addressing to the degree that nouns are available to be modified. This suggests that if a NP is already modified or received comparatively more prior modification, the other NP should be the target for available modification. Thornton et al. (1999) coined the term “modifiability” to identify this sort of pragmatic information and assumed it as a universal constraint affecting attachment preferences. They provided evidence favoring modifiability in their study that employed self-paced reading tasks in Spanish and English to test RC attachment preferences. The researchers explained the cross-linguistic low attachment preference by referring to the idea that the first NP is always modified by the second NP in NP-NP-RC constructions, therefore it is natural to expect the RC to modify the second NP as the constituent that did not receive prior

modification. The high attachment preference could be attributed to the availability of alternative structures such as the two genitive forms (Norman and Saxon) in English.

2.3.4. Models Based on Prosodic Factors

Different models and theories of sentence processing, as well as empirical findings from various investigations, which examined the validity of the theoretic assumptions, were presented up to this point. Prosodic information was not included in these studies because the aim of the relevant research paradigm was to mainly focus on syntactic, semantic and lexical cues employed by the processing mechanism. However, Fodor (2002) argues that prosodic factors were overlooked in sentence processing research and this might have led studies to artificial results as prosody exists even in environments where it seems that it is not involved, such as the silent reading. Therefore, investigating prosodic factors in sentence processing could be of great importance.

Fodor (2002) postulated Implicit Prosody Hypothesis, a parameterized sentence processing account on a prosodic level, and suggested that cross-linguistic differences in processing strategies and structural preferences result from the strength of several syntactic and prosodic constraints that apply each language. In the resolution of RC attachment ambiguities the constituent of the sentence that has a greater prosodic intensity is assumed to display high attachment preferences whereas a low attachment preference is expected for elements that have prosodically lighter intensity. Prosodic breaks also have the potential to affect attachment decisions in the way that when a break comes before the RC, it is assumed to cause high attachment preference. Similarly, when there is a lack of break preceding the RC, it is expected to be attached to the second NP, leading to a low attachment preference.

The propositions of the Implicit Prosody Hypothesis have found support from the research paradigm that focused on the effects of prosodic manipulations on attachment preferences. It is assumed that when RC structures are long, a prosodic phrase boundary tends to separate from the preceding constituents, thus resulting in a high attachment preference. As for shorter RC constructions, they are primarily incorporated into the preceding phrase, which would instigate a low attachment preference. An illustration of this condition is offered by Augurtzky (2006, p.67) as follows:

1. (NP1 of NP2) (long relative clause)

2. (NP1 of NP2 short relative clause) or (NP1) (of NP2 short relative clause)

Gilboy and Sopena (1996) manipulated materials by putting a comma between NP2 and the RC to test the effects of a prosodic break and presented supporting results for the effects of length manipulations on RC attachment preferences.

Although findings from such studies that test the effects of length manipulations can account for certain results on the resolution of syntactic ambiguities, a comprehensive account that could offer an explanation to the cross-linguistic differences observed in the previous research is needed. Quinn, Abdelghani and Fodor (2000, cited in Papadopoulou, 2006) tapped into this issue through a different research paradigm that focused on the effects of specific prosodic characteristics of a given language. They set out to research whether the languages that displayed an overall low attachment preference such as English and Arabic have different default prosodic configurations than languages such as French which seemingly indicated an overall high attachment preference. Native speakers to these languages were assigned to read items that include RCs which force both low and high attachment disambiguations. While the researchers found no cross-linguistic differences for short RCs, RCs with longer constructions demonstrated distinct prosodic patterns in the tested languages. More specifically, while the RC appears to be salient only in high-attachment forced condition, the first stress-bearing unit in the RC is salient in French but not in Arabic for both low and high-attachment forced conditions. Although there were slight differences of patterns between the two low attaching languages, the stress patterns were compatible with the observed attachment preferences for the respective languages. Therefore, the findings lend support to the predictions of the Implicit Prosody Hypothesis as they argue that prosodically salient constituents are more likely to be attached high than less salient constituents. Investigations on other languages such as Jun (2003) indicate converging results, however, further research is needed to determine whether the relevant prosodic patterns revealed through reading aloud would also tally with silent reading. Even though Implicit Prosody Hypothesis can partially offer explanation for some of the observed attachment preferences, it should be noted that these preferences might very well be influenced by the underlying structural or discourse factors rather than prosody. Therefore, the propositions of this account do not go any further than offering explanations on a descriptive level. Further studies on this particular research paradigm are required to acquire more comprehensive results.

2.3.5. Summary of the L1 Sentence Processing Models

In this section the summary of the sentence processing models discussed and evaluated until this point are presented. As can be understood from the above discussion, the models identify and highlight different aspects of sentence processing, they provide a rich theoretical background whereby we can compare sentence processing in L1 and L2. Although some of the predictions successfully offer explanations to specific observations, the evidence from empirical research is not conclusive enough to fully accept or deny any particular account. Furthermore, divergence in materials and tasks that are used in the data collection procedure renders comparability across the studies problematic. This further makes the task of coming up with a compelling model even more challenging. Nevertheless, the reported findings allow us to draw some conclusions with regard to certain aspects of processing. Firstly, the processing tendencies concerning attachment preferences have been reported to differ not only from one language to another but also from one investigation in a particular language to another. More specifically, methodological factors such as the use of different test items, requirements of different tasks, the means of disambiguation, the length of attached constituents and others have been shown to affect processing decision and attachment preferences of participants. Secondly, the findings have revealed that syntactic factors are not the only parameter that influences initial attachment preferences as several discourse factors such as the influence of an animate or inanimate NP or the theta-assigning properties of the linking preposition on RC attachment preferences are likely to have a role in initial processing decisions. These inconclusive results clearly address the need for further research which meticulously control for the confounding factors so as to offer a better understanding to the processing mechanism guiding attachment preferences.

Investigations on L2 sentence processing becomes even more intriguing because, in addition to the methodological issues discussed above, the probable influence of the L1 or other additional L2s and individual differences such as age, sex, aptitude, motivation, learning styles and strategies and affective factors might have a role in the processing decisions of L2 learners. No matter how complicated it may seem, research on L2 processing has the potential to provide insights into the nature of L2 grammatical knowledge and how it is accessed by learners. This strand of research can also cast light

upon L1 processing through the evaluation of the predictions of aforementioned models. In the following sections, these issues are to be addressed by reviewing previous research on the processing of syntactic ambiguities in L2.

2.4. Sentence Processing in a Second Language

The question of how L2 learners perform the real-time processing of L2 input has attracted the attention of researchers for the prospect it holds in investigating the aspects of L2 acquisition that are yet to be revealed and in evaluating the validity of the existing sentence processing models discussed in the previous chapter. Since the development of the abstract linguistic knowledge is assumed to be input-driven, the investigation of the processing of sentences in real time becomes fairly important to fully understand the construction of L2 grammar in the target language. In this respect, there has been research (for example Bley-Vroman, 1991) arguing that L2 learners depend on processing strategies to perform the analysis of L2 input rather than relying on the syntactic constraints demanded by the Universal Grammar. Some L2 researchers (Klein, 1999; Harrington, 2001; Juffs, 2001) have even brought up the question of whether the deficient L2 competence results from the less-than-optimal processing mechanisms used by the L2 learners. Hence, investigations with an ever-increasing use of online experimental techniques such as eye-tracking methodology, the self-paced reading technique, etc. have proliferated to see whether or not the processing strategies of L2 learners reflect their abstract linguistic knowledge. The findings revealed through these studies are far from being conclusive and further research is needed to unveil the details of the way L2 learners process sentences in the target language. The following research questions are frequently addressed in the relevant literature to serve this purpose:

1. Is L2 processing fundamentally different from L1 processing?
2. Do L2 learners transfer processing mechanisms from their first language to the second language?
3. Is it possible for L2 learners to acquire the processing mechanisms used by native speakers of the target language?
4. How do processing mechanisms develop with the improving overall language proficiency?

The possible answers that could be provided to these overarching questions can even shed light on the issue of why it is comparatively difficult to achieve native-like performance in an L2.

As it has been detailed in the previous chapter, most of the research in the domain of psycholinguistics and more precisely of sentence processing has been conducted on native speakers regarding how they process syntactic ambiguities in their native language; therefore, the proposed processing models do not make direct propositions concerning the L2 processing mechanisms and its procedures. Nevertheless, processing of syntactic ambiguities in L2 has caught the attention of researchers in relation to the role of L1 transfer, specifically the transfer of L1 processing strategies to L2, and the potential for native-like processing in the L2 (Dussias, 2001; 2003; Felser et al., 2003, Fernandez, 2002; Papadopoulou & Clahsen, 2003). In the following section, the studies that have examined the processing mechanisms employed by L2 learners to process structurally ambiguous sentences are outlined. These studies are categorized in accordance with the target constructions that have been employed to investigate the ambiguity resolution in L2.

2.5. Ambiguity Resolution in L2

To the knowledge of the author, research in the relevant literature has focused on four different types of ambiguous constructions to explore the mechanisms involved in L2 sentence processing. These constructions are as follows: the subject vs. object ambiguity, main verb vs. reduced relative clause ambiguity, prepositional phrase attachment ambiguity and relative clause attachment ambiguity.

2.5.1. Subject-Object Ambiguity Resolution

An illustration of the subject-object ambiguity appears below in the following example:

- (3) After the referee stopped the footballer scored a fantastic goal.

In the sample sentence above, the verb in the the adverbial clause is optionally transitive, which induces two possible analyses of the noun phrase (NP) *the footballer*, either as the direct object of the verb *stopped* or as the subject of the following main

verb *scored*. The investigation of the processing of similar sentences as (3) with native speakers showed that NP *the footballer* was initially analyzed as the object of the verb in the adverbial clause (Frazier and Fodor, 1978). The observed attachment preference was justified with regard to the Late Closure strategy (see the discussion in Chapter 2), which suggests that newly incoming input is supposed to be attached to the phrase that is currently being processed, namely, the verb phrase (VP) including the verb *stopped* in (3).

In their attempt to investigate how L2 learners would process similar subject-object ambiguities as in (3), Juffs and Harrington (1996) carried out a study with native speakers of English and advanced Chinese learners employing an online grammaticality judgement task using the following sentence types below:

- (4) Optionally transitive verbs

After Mary ate the pie proved to be mouldy.

- (5) Solely intransitive verbs

After John came the kids started to cry and scream.

- (6) Verb subcategorizing for two arguments

Tom watched the lady cried in the office.

- (7) Verb subcategorizing for one argument

Mary believed her father loved Jack.

Using self-paced reading the moving window methodology, the researcher displayed the sentences word-by-word. After presenting the target items, the participants were instructed to judge the grammaticality of the sentences they read, which provided an additional offline data collection measure. The results indicated that both native speakers and L2 learners are more likely to reject sentences like (4) and (6) than sentences like (5) and (7). Equally importantly, it was revealed that when participants saw sentences like (4) and (6), they initially attached the NPs *the pie* and *the lady* to verbs *ate* and *watched* respectively, instead of the following verbs. The authors accounted for the findings by referring to Late Closure strategy (see the discussion in Chapter 2), which argues that the new constituent should be attached to the phrase currently being processed. This finding is important as it shows that the L2 learners and native speakers displayed similar processing strategies. Nonetheless, different patterns of results were observed for sentences like (5) and (7) in that the L2

learners showed longer reading times (RTs) than native speakers when they saw the NPs *the kids* and *her father* and the verbs *started* and *loved*.

In a follow-up study, Juffs (1998) conducted a similar online grammaticality judgement task employing advanced Chinese, Japanese, Korean learners of English with sentences like (2) and (3). The learner group were found to display longer RTs for the NPs that follow the intransitive verbs in sentences like (3) than the native speakers. However, the grammaticality judgements of the native speakers and those of L2 learners were not different. Based on the findings, the author argued that the development of the processing mechanisms and grammatical knowledge might not overlap (Juffs, 1998, p. 421).

Frenck-Mestre and Pynte (1997) examined the subject-object ambiguity with a participant group of French learners of English and English learners of French through the use of eye-tracking methodology. The researchers set out to investigate whether the L2 learners transferred lexical properties from their first language when processing L2 input. To this end, they employed verbs that had different argument structures in the two languages such as the following:

- (8a) Every time the dog obeyed the pretty little girl showed her approval.
- (8b) Chaque fois que le chien obéissait la jolie petite fille montrait sa joie.
- (9a) Every time the dog barked the pretty little girl showed her approval.
- (9b) Chaque fois que le chien aboyait la jolie petite fille montrait sa joie

In sentence (8a), the verb, *obey*, is optionally transitive and thus the NP, *the pretty little girl*, could be attached either to the verb *obeyed* as the direct object or to the verb *showed* as the subject of the subsequent main clause. The resolution of the ambiguity is achieved by the subject-interpretation with the following main verb, *showed*. In sentence (9a), the verb, *bark*, is intransitive, so the direct object-interpretation of the NP, *the pretty little girl*, becomes impossible, and therefore it renders the sentence unambiguous. On the other hand, in the French counterparts of the sentences, the verbs of *obey* and *bark* are *obéir* and *aboyer* respectively and both verbs are intransitive in French. This implies that the direct object-interpretation of the NP, *la jolie petite fille* (*the pretty little girl*) with the verb *obéir* (*obey*) in sentence (8b) does not seem plausible. Hence, while native speakers of English are expected to display processing difficulties with sentence (8a) but not with sentence (9a), native speakers of French are

expected to show the same tendency in processing both sentences (8b) and (9b). As for the L2 learners, if they transfer L1 processing information from their first language to the target one, French learners of English are expected to show no processing difficulties with both sentences (8a) and (9a), as both verbs are intransitive in French, the participants' first language. On the other hand, English learners of French, are expected to consider sentence (8b) more difficult to process than (9b), as the verb *obey* in English is optionally transitive. Both groups of participants were tested in both the target language and their first language. The findings of the study indicated that as far as the target items in English are concerned, both French learners of English and native French speakers showed difficulties of processing sentences like (8a) at the disambiguation region. This suggests that both groups initially processed the NP, *the pretty little girl*, as the direct object of the verb *obey*. Additionally, French learners of English spent longer time to read the subordinate verb in sentences like (8a) than in sentences like (9a), which implies that L2 processing was temporarily influenced by the lexical information from the native language. As far as the French sentences are concerned, English learners of French took longer time to read the subordinate verb in sentences such as (8b) than in sentences such as (9b), which yielded the same results for L2 learners with the English sentences. Transfer effects could only be observed at the region of the verb that held different argument structures in the two languages. In the other regions, however, there was no significant difference between the patterns displayed by native speakers and L2 learners. The authors suggested that there was no qualitative difference between L1 processing and L2 processing and that information of argument structure in the first language could be transferred to L2 only temporarily. An important point to note regarding the procedure of the experiment is that the participants were tested for their first and second language in the same trial, so both languages were active when the experiment was in progress. Therefore, this could have induced transfer effects. Another interesting issue to note is that the French verbs that were used in the test items were not purely intransitive and could take an indirect object. Therefore, the longer RTs displayed by the English learners of French when reading sentences like (8b) could better explained by the fact that some of the verbs that were supposed to be purely intransitive are also used with an indirect object rather than by the transfer effects.

Felser and Roberts (2004) conducted a similar study investigating the subject-object ambiguity resolution preferences of native speakers of English and advanced

Greek learners of English in a SPR task. They developed sentences similar to (4) above and manipulated the plausibility of the NPs following the embedded verbs. The results showed that the plausibility cues employed in the study influenced L2 learners more than the native speakers and L2 learners experienced difficulties to recover from initial misanalyses of such sentences.

Finally, in a more recent study Jegerski (2012) investigated subject object ambiguity resolution with a group of participants including native Spanish speakers and English learners of Spanish in a self-paced reading task. The researcher initially set out to test the prediction that the garden path effect previously observed during the processing of subject–object ambiguities in native English would not hold in a null subject language like Spanish and further explored that whether the same effect would be observed among English learner of L2 Spanish whose native language was a non-null subject language. The test items consisted of sentences like the following: “*Cuando el escultor acabó/volvió la obra tenía tres metros de altura* - *When the sculptor finished/came back the piece was three meters in height*”. The results suggested that native speakers of Spanish had significantly increased reading times on postverbal NPs when they occurred after intransitive rather than transitive verbs. This finding contradicted the data from English. As for L2 learners, they behaved similarly as the native speaker group showing slower RTs on postverbal NPs. The researcher concluded that L1 and L2 processing could be governed by mostly similar principles, at least where lexical information like verb transitivity is concerned.

2.5.2. Main vs. Reduced RC Ambiguity Resolution

Another type of construction that has been examined in the relevant literature has been the main clause vs. reduced RC ambiguity. The ambiguity in these constructions emerges from the tendency to misinterpret the the past participle form of the verbs as the simple past tense in English. To put it differently, in a sentence like (10) below, readers usually analyze the word *proposed* as the main verb initially and seeing the following verb *started* causes disruption in processing and helps the reader realize that his/her initial analysis was wrong. This realization, known as garden-path effect (see the discussion in Chapter 2 regarding the universal parsing models), requires the reanalysis of *proposed* as a past participle.

(10) The plan proposed at the meeting started a heated debate.

Juffs (1998) explored the main clause vs. reduced RC ambiguity with L2 English learners to see if learners' L1 (Japanese, Chinese, Korean, Romance languages) could possibly influence L2 parsing strategies. Juffs manipulated causative (e.g., Sally broke the window) and inchoative (e.g., The window broke) constructions by claiming that these constructions would be difficult for learners to process as their L1 demands extra morphological marking for the causative or inchoative constructions unlike the case in English, which does not mark the difference in syntactic position between the target constructions. Using a self-paced reading moving methodology, the researcher found out that although they demonstrated advanced level of proficiency in L2 English, all learners from different L1 backgrounds differed from the monolingual English native speakers significantly while processing the target constructions. The findings were interpreted to mean that L2 learners could have an advanced level of competence in the domain of grammar, however, the ability to use the grammatical knowledge online could be affected by the resources available for processing mechanism and the L1 influence.

Rah and Adone (2010) also addressed the similar issue with German L1-English L2 learners to see the effects of level of proficiency. The researchers note that unlike the full RCs, English reduced RCs does not have a direct equivalent in German and the direct translation of the English RC looks ungrammatical in German. Taking this difference into consideration, the researchers prepared experimental items like (11) below, in which the ambiguous verbs are paired with good and bad cues to the nature of reduced RC.

- (11) a. The brown sparrow seen by the hungry cat pecked at an insect.
 b. The brown sparrow noticed on an upper branch pecked at an insect.
 c. The brown sparrow / noticed / almost every day / pecked / at an insect.

The test items were presented in the self-paced moving window paradigm in chunks as in (11c) and additionally the participants were promoted to complete an offline task. The findings for the offline task indicated that there was no significant difference among the learners and the native speaker control group, but there was an effect for ambiguity with the ambiguous bad cue sentences as in (11c), which were

regarded as ungrammatical more often compared to other types of sentences. The results from the online task indicated that the learners had greater difficulty than the native speakers while processing reduced RCs. It is demonstrated that learners in the intermediate level of proficiency group tended to mistakenly take the reduced RC as the main verbs and spend more time to recover from the misanalysis after initial reading. Nonetheless, the advanced learners were found to perform significantly better than the intermediate learners, which suggests that higher proficiency levels could improve learners' performance in recovering from the initial misanalyses.

More recently, Yang and Shih (2012, cited in Juffs & Rodriguez, 2015, p.174) examined the processing of main verb/reduced RC ambiguities and similar to the findings of Rah and Adone (2010) claimed that proficiency may have an effect on learners' ability to process the sentences targeted in the relevant literature. They developed test items by manipulating animacy information (using animate or inanimate as subjects/agents, the type of RC (full or reduced RC) and ambiguity (unambiguous or ambiguous constructions). The sample test items fulfilling each category are listed below.

- (12) a. The boy kissed by the girl was cute (animate, reduced RC, ambiguous)
- b. The boy who was kissed by the girl was cute (animate, full RC, unambiguous)
- c. The apple kissed by the girl was cute (inanimate, reduced RC, ambiguous)
- d. The apple that was kissed by the girl was cute (inanimate, full RC, unambiguous)
- e. The apple seen by the girl was cute (inanimate, reduced RC, unambiguous)
- f. The apple that was seen by the girl was cute (inanimate, full RC, unambiguous)

The participants were divided into three groups, namely elementary, intermediate and advanced, in accordance with their level of proficiency. The target test items were presented through self-paced moving window pattern. The results from the online task indicated a main effect for animacy condition with reduced RCs, but with the full RCs. This finding suggests that inanimate reduced RCs were read more slowly than the full

RCs. The intermediate learners performed similarly to the native speakers showing an effect of animacy in the reduced RCs but not in the full RCs. As for advanced learners, they showed no effect of animacy. The authors suggested that the performance of elementary learners, immediately assuming subject + main verb sequencing, were indicative of shallow processing, which is shown by the higher reading times during the processing of reduced RCs. In contrast, the intermediate learners performed like native speakers, showing signs of deeper level processing.

2.5.3. PP Attachment Ambiguity Resolution

Another example of a construction that has been extensively researched is the resolution of Prepositional Phrase (PP) ambiguities, which is also within the scope of research conducted for the purposes of the present study. Fenck-Mestre and Pynte (1999) carried out an eye-tracking study with advanced L1 French-L2 English and advanced L1 English-L2 French learners on the resolution of PP attachment ambiguities. The test materials involved temporarily ambiguous constructions that prompted the participants to attach the PP either to a VP or to a NP. The researchers used the lexical information of verbs preceding the PP to manipulate argument status (transitive vs. ditransitive) and the resulting attachment (attaching PP to VP or attaching PP to NP). The test items included materials with transitive and ditransitive verbs as in (13) below:

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

The researchers wanted to address the question of whether the processing strategies of L2 learners are different from those used by native speakers even when the target construction under investigation has a direct equivalent in L1 and L2. They also want to examine whether L2 learners are affected by the lexical information conveyed by the verb when resolving the PP attachment ambiguities.

The results indicated that the participants from both language groups resolved the PP attachment ambiguity by relying on the type of the verb employed in the test items.

This suggests that when the verb is transitive the participants intended to attach the PP to the closet NP rather than the VP (NP-attachment). In fact, L2 learners showed a stronger preference for NP-attachment than did the native speakers. On the other hand, the participants preferred to attach the PP to the VP in the sentences with ditransitive verbs. The researchers claimed that this particular finding could offer suggestions regarding the nature of the processing mechanism in that the parser could be lexically-driven because the lexical information held by the verb was evinced to influence the initial processing preferences. Although the overall results showed that L2 learners used similar processing strategies to those of native speakers, the two groups of participants were found to differ in the processing of sentences. More precisely, data on the first fixations showed that L2 learners took longer to read sentences forced to disambiguate towards VP than the sentences were disambiguated towards NP as in (13c) and (13d) respectively when the verb is transitive. In addition, the data from the L2 learners on the first-pass regressions also indicated that regardless of type of the verb used in the sentences (transitive or ditransitive) L2 learners were inclined to regress more often when the sentences forced disambiguation towards VP than towards NP attachment, a finding which was not observed in the data from the native speakers. Based on these findings, the researchers implied that L2 learners prefer to do the attachment of the incoming linguistic input locally depending on an L2-specific recency strategy, which suggests that learners attach new constituents of the sentence to the most recently processed elements (NP) unless lexical information specifically dictates that the attachment should be modified to VP. To put it differently, although learners use the recency strategy that requires low or local attachment, this particular strategy could be affected by the lexical information given by the verb.

In a more recent study, Rah and Adone (2010) conducted a similar examination on PP attachment preferences with German learners of L2 English. The researchers investigated similar issues to those stated in Frenck-Mestre and Pynte (1999), namely, whether the online PP attachment preferences of L2 learners are different from those of native speakers and whether L2 learners used learner-specific strategies such as recency. Additionally, they designed their study in a way that would allow them to test the effects of learners' level of proficiency on their processing decisions by sampling two participant groups in intermediate and advanced levels. The results indicated no qualitative differences between the processing preferences of learners and native speakers in that the two learner groups displayed same level of sensitivity to the same

factors that seemed to guide the VP attachment preference of native speaker group. Contrary to what French-Mestre and Pynte (1997) found, Rah and Adone suggested that their data did not offer evidence for the use of learner-specific recency strategy. They stated that intermediate and advanced learners' online processing of PP attachment ambiguities showed a pattern that is quite similar to native-like processing preferences. More specifically, intermediate learners showed a stronger preference for VP attachment than did the advanced learner group. The researchers claimed that the difficulty intermediate learners experienced in recovering from the initial misanalysis could be the reason this result. Alternatively, they also asserted advanced learners' seemingly decreased sensitivity to lexical information could be attributed for the weaker VP attachment preference.

Overall, the results from these studies suggest that learners with a higher level of proficiency in the target language demonstrate a nativelike processing pattern at a greater extent. However, their processing appears to be less automatic compared to the processing of native speakers. Furthermore, unlike native speakers, L2 learners appear to experience more difficulties in recovering from initial misanalyses.

2.5.4. RC Attachment Ambiguity Resolution

RC attachment ambiguity resolution, which is of interest to the present study, has been the construction that has attracted the most attention in sentence processing research. The resolution of this sort of ambiguity has been particularly interesting as research on both L1 and L2 sentence processing displayed significant cross-linguistic variation in the attachment preferences of RCs, which in turn makes it a great tool to investigate parametric variations in sentence processing. These cross-linguistic variations are relevant for L2 sentence processing research as the differences suggest whether L2 learners transfer L1 processing strategies to their acquisition of L2. From a broader perspective, the probable accounts that could be suggested regarding the observed cross-linguistic variations can help acquire a better grasp of general sentence processing mechanisms, as well. A review of the offline and online studies regarding L2 learners RC attachment preferences is presented in the following.

Fernandez (2002) investigated online and offline RC attachment preferences of adult bilingual speakers of Spanish and English and compared them to those of monolingual native speakers of Spanish and English. She examined ambiguous

sentences including RCs preceded by complex genitive NPs which were linked with the preposition *with* or the preposition *of* as illustrated by (14) below:

(14) a. Roxanne read the review *of* the play that was written by Diane's friend.

NP1 NP2

b. The crowd cheered for the singer *with* the guitarist that was awarded a medal.

NP1 NP2

As can be seen, both (14a) and (14b) have two possible interpretations as the RC can be attached either NP2 of the complex genitive NP (ex. *play* as in 14a or *guitarist* as in 14b) resulting in low attachment preference or NP1 (ex. *review* as in 14a or *singer* as in 14b) resulting in high attachment preference as it is commonly referred in the relevant literature. In the offline task, the participants were instructed to read each ambiguous sentence and answer a follow-up question after each sentence, asking which of the two NPs they would be more likely to attach the RC. The online experimentation included a self-paced reading task. Overall, the results indicated that the processing of RC attachment ambiguities was affected by the dominant language of the bilingual speakers participated in the study. The effect of the dominant language is displayed in different ways in online and offline tasks.

As far as the offline task is concerned, while monolingual English speakers attached the RC to the NP2 showing a low attachment preference, monolingual Spanish speakers attached it to the NP1 displaying a high attachment preference. Regarding the attachment preferences of bilingual speakers of English and Spanish, the researcher suggested that their attachment preferences were influenced by their dominant language because they preferred the attachment site which was in line with the attachment preferences of the monolinguals of the respective languages. Put it differently, while the English dominant group favored the NP2 showing a low attachment preference, the Spanish dominant group tended to attach the RC to the NP1, which resulted in a high attachment preference.

Interestingly enough, the findings of the online task did not coincide with the data from the offline task as both groups of monolingual speakers demonstrated similar attachment preferences by preferring to attach the RC to the NP2, which resulted in low attachment preference. The researcher argued that this finding was in parallel with the consideration that the initial processing decisions for the attachment of RCs were guided

by the available syntactic information. As for the processing decisions of bilingual speakers, they did not show any significant tendency to attach the RC to either of the NPs displaying no clear attachment preference. Fernandez concluded that the lexical semantic factors could play a role on the final processing decisions of learners as it is shown in the results of the offline study, however, the initial processing choices were guided by syntactic information, which appears in the findings of the online investigation.

Papadopoulou (2006) cited French-Mestre (1997; 2002; 2005) to present data from L2 learners on RC attachment choices. She stated that French-Mestre conducted an eye-tracking experiment with a group of participants including native speakers of French, beginning English and Spanish learners of French as well as advanced English learners of French. The test items consisted of sentences in French which were constructed in a way that would allow the resolution of the RC ambiguity by making use of the number information. An English equivalent of the test items appear in (15) below:

- (15) Aline calls the daughters of the nanny who are/is returning from Paris.
- NP1 NP2

The results indicated that French monolingual control group displayed a high attachment preference by preferring NP1 to attach RC. Similarly, beginning Spanish learners of French also showed a high attachment preference. On the other hand, the beginning English learners of French preferred to attach the RC to NP2 and showed a low attachment preference, whereas the findings for the advanced English learners patterned with the native speakers of French as they preferred to attach the RC to NP1. Based on the data presenting that beginning L2 learners had similar RC attachment preferences to those reported for their L1, French-Mestre argues that the processing routines in the first language could be directly transferred into the target language. Additionally, she asserts that linguistic experience in the target language plays a primary role in the acquisition of L2-specific processing routines.

Dussias (2003) also examined the effects of L1 on L2 processing of RC attachment ambiguity resolution with English-Spanish bilinguals through the use of offline and online tasks. Two groups of bilinguals, namely L1 Spanish-L2 English and L1 English-L2 Spanish were employed and their processing decisions were compared to monolingual speakers of English and Spanish. The offline task included a pen-and-

paper questionnaire in both Spanish and English and an online self-paced reading task was administered. The results for the offline task showed that while monolingual Spanish speakers had a high attachment preference, English monolinguals had a high attachment preference, which is parallel with what previous research has suggested (see the discussion in previous sections on L1 sentence processing). As for the data from the bilingual groups, both bilingual groups (L1 Spanish-L2 English and L1 English-L2 Spanish) showed a low attachment preference in the offline task. This result was in line with that of monolingual English speakers. In the Spanish offline task, both bilingual groups similarly had a low attachment preference contrary to the results from monolingual Spanish speakers. The results for the Spanish online task demonstrated that monolingual Spanish speakers preferred to attach the RC high, which again coincided with the previous research. The online results for bilinguals were particularly interesting in that the L1 Spanish-L2 English bilingual group displayed a low attachment preference in Spanish whereas the L1 English-L2 Spanish bilingual group did not show any significant preference for low or high attachment sites. Dussias (2003) argued that the low attachment preference displayed by both bilingual groups might be accounted for the additional cognitive burden on the bilingual mind which accommodates two linguistic systems. It could be suggested that the tendency to attach the incoming linguistic input to the most recently processed material might be the result of bilingual mind's attempt to use working memory limits parsimoniously and whereby eliminating the likelihood of exceeding the working memory capacity. This tendency is also evidenced by the elevated reading times for bilingual groups compared to the monolingual participants. Dussias also interpreted these findings in terms of language exposure by reporting that at the time of the study both bilingual groups were residing in an environment where English was the dominant language, which could have influenced the processing decisions in both English and Spanish.

The studies cited thus far have examined the RC attachment preferences with reference to the effects of the dominant language in bilingual processing. There are also those studies that approach the issue from the perspective of whether it is syntactic or lexico-semantic information that guides sentence processing in L2. It has been claimed that L2 learners who have learnt their L2 after fully acquiring their L1 process the L2 differently from native speakers. This difference is argued to come from the consideration that while processing L2, learners do not depend on syntactic information to the same extent as native speakers do. However, they can make use of lexical or

semantic information in a native-like fashion. Such assertions backed by empirical findings have led to development of Shallow Structure Hypothesis by Clahsen and Felser (2006a, 2006b, 2006c, 2017).

The Shallow Structure Hypothesis (SSH) was originally suggested to account for the differences between L1 and L2 in real-time sentence processing. The central assertion of the SSH was that irrespective of their proficiency level, L2 learners tend to have problems in making abstract syntactic representations in real time and compared to native speakers, L2 learners are guided more strongly by semantic, pragmatic, plausibility or surface level information. Clahsen and Felser (2006a) argued that L2 learners could make use of lexical, pragmatic and world knowledge in a native-like manner to construct a semantic or conceptual representation of the sentence, but that the syntactic representations L2 learners construct for comprehension are shallower and less detailed than those of native speakers. Put it differently, while processing target language L2 learners do not rely on phrase-structure-based parsing strategies to the same extent as native speakers although they can use lexical-semantic information in a native-like manner. The researchers tried to clarify these broad and general considerations by stating that L2 learners try to make up for their potentially reduced ability to utilize syntactic or grammatical information during real time processing by making use of nongrammatical information more effectively. However, that does not necessarily mean that lexical, semantic, pragmatic information are the only source of processing strategies at the disposal of L2 learners.

The studies conducted by Clahsen, Felser and their colleagues on RC ambiguity resolution tasks set the ground for the claim that L2 sentence processing is not guided by purely structural considerations. For instance, in their study, Felser, Roberts, Marinis and Gross (2003) employed sentences as in (16) below.

(16) The dean liked the secretary of the professors who **was/were** reading.

As can be seen in the example, the RC *who was/were reading* is in a structural position that allows it to modify either high NP (the secretary) or the low NP (the professors). The RC attachment ambiguity is resolved (or disambiguated) in this case by subject-verb agreement, with *was* forcing high attachment, and *were* forcing low attachment.

In addition to these phrase-structure based parsing strategies, RC attachment also appears to be influenced by availability of semantic information. Therefore, Felser et al. (2003) additionally investigated RC attachment preferences with two types of sentences as indicated in (17) below:

- (17) a. The dean liked the secretary *of* the professor who was reading a letter.
 b. The dean liked the professor *with* the secretary who was reading a letter.

In sentences such as (17a) the parser is considered to be guided by syntactic cues. On the other hand, in sentences such as (17b) the preposition *with* is assumed to provide lexical-semantic cues to the parser. The researchers tested proficient Greek L1 – English L2 and German L1 – English L2 learners on sentence types similar to (17). Both groups of learners showed a clear low RC attachment preferences when the component elements of the complex NP were linked with the preposition *with* (*the professor with the secretary*). However, they showed no attachment preference when the component NPs were linked with the preposition *of* (*the secretary of the professor*). These results were taken to show that although both learner groups were able to make use of lexical information in processing of RC ambiguities, neither group was influenced by predicate proximity which is the structure-based principle that appears to be operative in processing of these structures in L1 Greek and L1 German. Furthermore, both groups were not able to converge on the nativelike processing of these structures (low attachment preference in English) according to the recency principle.

Before reporting the studies that were conducted with Turkish participants, it is necessary to give information regarding the sentence structure in Turkish and how RC structures are constructed. Although the basic word order is SOV in Turkish, it is a non-configurational language which allows for relatively free word order. Its grammar necessitates the placement of the heads in all phrase structures into phrase-final position as it is a predominantly head-final language. Therefore, RC constructions appear in front of the NP that they modify. The Turkish equivalent of the construction in (1) looks as follows:

- (1) Birisi cafede duran yazarın babasına vurdu
[Somebody Café-LOC stay-REL yazar-GEN father-POS-ACC hit-PAST]

The English complex genitive NPs are structured as genitive possessive constructions in Turkish. These are marked with genitive and possessive suffixes on the first and second NP, respectively. Although the structure is similar to the Saxon genitive in English (e.g. *the author's father*), it is still ambiguous in Turkish. In the first off-line study to be conducted on the resolution of ambiguous RCs with complex genitive antecedents, Kırkıcı (2004) found that native speakers of Turkish did not show a certain attachment preference in sentences when an ambiguous RC has two potential animate NPs in the genitive construction. However, with the inanimate NPs the subjects preferred to attach the ambiguous RC to the low NP.

Dinctopal-Deniz (2010) conducted another study with Turkish participants that could be claimed to lend support to the assumptions of SSH. The researcher set out to investigate the processing of RC attachment preferences of monolingual Turkish speakers, highly proficient Turkish speakers of English as a second language and native English speakers in on-line self-paced reading tasks and offline pen-and-paper questionnaires. The researcher aimed to test whether native and non-native speakers use syntactic and lexical information to the same extent during real-time processing. Therefore, the test sentences included both globally ambiguous RC constructions and temporarily ambiguous ones that were manipulated using animacy information in the complex genitive NP and in the disambiguating region, as illustrated in (18) and (19).

(18) Animacy-Forced Condition

- a. The author of the play that was killed last month was famous
- b. The play of the author that was killed last month was famous

(19) Inanimacy-Forced Condition

- a. The ship of the captain that was painted blue looks gorgeous
- b. The captain of the ship that was painted blue looks gorgeous.

The results demonstrated that in both online and offline tasks Turkish L1 and English L1 speakers preferred to attach the RC to the low NP in their native languages. However, Turkish speakers of L2 English did not behave like either L1 Turkish speakers or L1 English speakers in their online and offline attachment preferences. In

the online task, they were claimed to be influenced by lexical information that NPs carried. While they preferred to attach the RC to the high NP when the NP was animate, they did not seem to present statistically significant attachment preference when the NP is inanimate. On the other hand, the offline questionnaire results showed a high attachment preference regardless of the animacy information that the NP carried. In her discussion of the results, Dinctopal-Deniz (2010) maintained that the data from the L1 Turkish-L2 English indicating no attachment preference in the absence of lexical information during online processing could be taken to interpret that initial analysis of L2 English learners did not seem to be guided by syntactic information, rather; it seems that they relied more heavily on lexical information while processing L2, which is congruent with the predictions of SSH.

Of interest to the present study, Witzel, Witzel and Nicol (2012) investigated processing patterns of L1 English speakers and Chinese speakers of L2 English on three sentence types including temporarily ambiguous RC constructions. The researchers employed an eye-tracking methodology in order to increase the possibility of detecting an attachment preference (bias) and indicated that all of the studies that failed to find online attachment preference for L2 learners used a self-paced, word by word or phrase by phrase, moving window reading methodology (Dussias, 2003; Felser et al., 2003; Fernandez, 2003; Papadopoulou & Clahsen, 2003) while two of the admittedly few studies that showed attachment preferences for RC constructions used eye-tracking (Frenck-Mestre, 1997, 2002).

In their study, the sentences of particular interest were as follows:

(20) Low Attachment Forced

- a. The son of the actress who shot **herself** on the set was under investigation.

High Attachment Forced

- b. The son of the actress who shot **himself** on the set was under investigation.

With the use of this type of RC ambiguity resolution sentences, the researchers wanted to investigate the assumptions of SSH and maintained that L2 English group in their study should not preferentially attach the structurally ambiguous RC to either the high NP (*the son*) or low NP (*the actress*) because as predicted by SSH, in the absence

of biasing lexical information, which is the case in the test items, processing of the sentences L2 sentences should not be guided by structure-based locality principles (i.e., by either recency or predicate proximity). This probable finding would be in line with the central SSH tenet that L2 learners do not compute structural representations of sufficient depth and detail in order for structure-based parsing strategies to be operative during online L2 sentence comprehension (Witzel et al., 2012).

The results showed that when processing sentences containing RCs in structurally ambiguous positions, both Chinese L1 speakers of English L2 and L1 English speakers indicated a preference for a particular NP. More specifically, unlike L1 English speakers who showed a low attachment preference, L2 English participants preferred to attach the RC to high NP. The researchers indicated that this set of results suggested that L2 sentence processing is guided (at least in part) by phrase-structure-based parsing strategies, thus presenting a challenge to the SSH.

The difference in the outcomes between the studies that have been claimed to favor SSH and Witzel et al. (2012) suggests that another investigation needs to be done to see whether or not the new results will pattern like SSH-supporting studies or whether they will pattern like those of Witzel et al. (2012), or whether they pattern in some different way.

2.6. Motivation for the Present Study

The motivation for this particular study comes from the findings of Witzel et al., (2012) and those investigating the predictions of the SSH, particularly, Dinctopal-Deniz (2010). As described above, Dinctopal-Deniz suggested that L2 English learners in her study relied more on lexical or semantic parsing biases and in the absence of this lexical information, their processing preference did not appear to be guided by syntactic parsing biases. Witzel et al., (2012), however, did not replicate her results and found out that L2 English learners' attachment preference is guided in accordance with structure-based parsing principles. This suggests that L2 sentence processing involves the computation of rich syntactic structure, which casts doubt on the specific assertion of SSH that L2 sentence comprehension is characterized by shallow structural processing. However, further research seems to be necessary to test the validity of this claim comprehensively.

An important matter that creates the necessity for further investigation is that, as discussed above, admittedly few studies examining the RC attachment preferences of Turkish participants both in their first language and in English as second language used offline measures (Kirkici, 2004) or a self-paced, moving-window reading methodology combined with offline measures (Dinctopal-Deniz, 2010). However, even for the studies examining L1 RC attachment preferences in the relevant literature, differences of reading time between low versus high RC attachment sentences are often subtle and eye-tracking methodology appear to reveal those differences more consistently than self-paced reading (Carreiras & Clifton, 1999). In order to test whether Turkish learners display a bias for high or low RC attachment both in their L1 and English L2, it is essential to conduct another study using a method which is at least capable of revealing differences in the processing of these sentence types.

Furthermore, a close examination of Dinctopal-Deniz's study indicates that the findings of her study, which are claimed to support the predictions of SSH, may not be interpreted to do so. She used temporarily ambiguous RC constructions using animacy as the disambiguating cue, as illustrated in (18) and (19) above. She explained the reason for using animacy as a disambiguating cue in terms of the agreement paradigm in Turkish. Since Turkish does not show gender agreement and the marking of plurality on the verb is relatively optional (largely determined by contextual factors), she maintained that using animacy information as a disambiguating cue would allow for equivalent testing conditions across Turkish and English. However, since the test sentences do not present any structural cues to attend to, as the RC constructions did in Witzel et al. (illustrated in (20) above), the disambiguation of RC attachment could only take place by using the animacy information, namely, lexicosemantic and pragmatic considerations. In other words, the participants can be claimed to have resolved the RC attachment ambiguity simply by applying lexical semantics or event probabilities rather than attending to a syntactic or morphological cue. Therefore, the finding suggesting that L1 Turkish-L2 English learners did not show any attachment preferences in the inanimacy-forced condition cannot be taken to indicate that L2 learners do not exploit structure-based parsing strategies, which therefore cannot lend support to the predictions of SSH. On the contrary, one can claim that the findings of the study contradict with the claims of SSH which indicates that when the nonstructural cues are absent, RC attachment preferences are made randomly. Even though the test items used in animacy and inanimacy forced conditions included nonstructural cues, the

participants of the study were found to have made their RC attachment preferences randomly. A research design that could actually incorporate how lexical and structural cues can influence the RC attachment preferences of L2 learners seem to be necessary for the continuing debate. To this end, the present study will use sets of RC ambiguity resolution sentences that are similar to those used in Dinctopal-Deniz (2010) and Witzel et al. (2012) to test out whether the RC attachment preferences of L2 English participants can make use of structural and lexical information to the same extend. Additionally, the study will also offer insights into the discussion that lexically driven interpretive biases take precedence over structure-based parsing biases in RC ambiguity resolution, which is suggested by the research paradigm on SSH.

To contribute to a better understanding of processes involved in L2 sentence comprehension, the present study will examine whether L2 learners show attachment biases during the online and offline processing of syntactically ambiguous sentences. The eye movements of proficient Turkish learners of English and native English speakers will be analyzed through RC and PP ambiguity resolution tasks. First of all, while determining the RC attachment preferences of participants in Turkish can provide information about the role of transfer and native-like processing, the comparison of those results to that of L2 English RC attachment preferences will also provide a new perspective on the possibility of native-like processing. Furthermore, the present study will also contribute to the discussion on the role of syntactic and lexical information in L1 and L2. According to the Shallow Structure Hypothesis, both syntactic and lexical information are available to native speakers, whereas L2 speakers are influenced by the lexical information during online processing. If there is evidence that L2 English learners can use the syntactic information available in their online resolution of the ambiguity, this will provide evidence against Shallow Structure Hypothesis. On the other hand, if they fail to use the syntactic information and their processing decisions are influenced by the lexical information, this will confirm the predictions of SSH.

CHAPTER III

METHOD

3.1. Introduction

This chapter presents a report of the series of experiments that were conducted to compare L1 and L2 offline and online processing of two different types of syntactic ambiguities described in the previous chapters. The main body of the present chapter is divided into four sections. The first section describes the offline experiment, which tested RC attachment ambiguity resolution preferences of L1 Turkish speakers and native English speakers through the use of pen-and-paper comprehension tests. The second section gives the details of the second experiment, which tested online RC attachment ambiguity resolution preferences of native English speakers and Turkish learners of English at different proficiency level using eye-tracking methodology. The third experiment included the offline analysis of another type of syntactic ambiguity called PP attachment ambiguities, which are of significant value as these constructions do not show cross-linguistically different resolution patterns and allow to exclude some of the confounding factors inherent in the RC attachment preferences. Using the same eye tracking methodology of online RC attachment ambiguity experiment, the final experiment examined online PP attachment ambiguity resolution preferences of Turkish learners of English and native English speakers. The details of these experiment are reported in the following sections.

3.2. Offline RC Attachment Ambiguity Resolution Preferences

This experiment examined offline processing of globally ambiguous Turkish and English sentences including a complex genitive NP of the type of *NP1 of NP2* followed by a RC construction. Turkish learners of L2 English at two different proficiency levels indicated their RC attachment preferences for globally ambiguous sentences both in Turkish and English on pencil-and-paper comprehension questionnaire. In order to find a common ground to make direct comparison, native English speakers were also tested to express their RC attachment preferences for globally ambiguous English sentences in the present study. The research questions addressed in this experiment are as follows:

1. How do native English speaker control group process RC attachment ambiguities in English offline?
2. How do Turkish learners of L2 English process RC attachment ambiguities in Turkish and English offline?
3. Are the preferences of L2 learners influenced by proficiency effects?
4. Are Turkish learners of L2 English influenced by their L1 processing strategies or by a strategy specific to L2 when comprehending RC attachment ambiguities offline?

3.2.1. Participants

The participants employed for the present study were Turkish learners of English, who ranged in age from 19 to 22. They were all students from various departments at a public university in Turkey. Before the study was conducted, all students received formal instruction by attending a preparatory program and studied English for a year. The participants' level of proficiency in English had been determined by a non-standardized proficiency test administered at the end of the preparatory program. Having successfully passed the proficiency test, they were enrolled in an English class during the first semester of their disciplinary education in their own departments. All subjects participated in the experiments on a voluntary basis.

In order to test the influence of proficiency in the present experiments, the subjects were divided into two groups, namely, intermediate and advanced proficiency groups. This was achieved through the use of a paper and pencil-based proficiency test, which was administered before the study. The participants who gave about 75% correct answers on average were placed into the intermediate proficiency group and those giving an average of about 90% correct answers were placed in the advanced proficiency group. This measure was taken to ensure that subjects within the same group were approximately on the same level.

The control group consisted of native speakers of English 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.

The final number of participants was 76, distributed as follows: control (n=24), intermediate (n=26), advanced (n=26). They all had normal or corrected-to-normal vision and reported to use computers on a daily basis.

3.2.2. Materials

Two different sets of materials were developed for the purposes of the present study and all items in the materials were developed by the author of the study by basing on the guidelines and specifications in the previous research. The first set of materials was 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 in a way that would allow inference of at least two distinct interpretations. Unlike the temporarily ambiguous sentences which include lexical or structural information later in the sentence that would help resolve the ambiguity, in the globally ambiguous sentences, one of the alternative interpretations is preferred over the others usually without the reader being unaware of the presence of the ambiguity after the entire sentence is processed.

Each set of sentences consisted of twenty-four globally ambiguous experimental items and twenty-five unambiguous fillers. The fillers were used to distract 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 experimental sentences directly followed one another. Both nouns in the complex genitive NP held the same lexical information regarding the animacy of the noun. Namely, in half of the experimental sentences (n=12) the complex genitive NPs were constructed using animate nouns, as in (21) and (23) and in the other half (n=12), they were constructed by using inanimate nouns, as in (22) and (24) below.

(21) 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]*

(22) 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] *[part-PLU-POS]*

(23) 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

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

- What amazed the guests?
 a. the room b. the furniture

All test items were followed by a comprehension question inquiring which noun the relative clause (RC) modified. The answer choices given in (a) and (b) were counterbalanced in a way that the first and the second NP appeared equally as option (a) and (b) as illustrated above.

Common nouns (with the article *the* in the English set) were used in the NPs forming the complex NP genitive constructions. The verbs for English test items included regular and irregular verbs and they were all in the past tense. The target items were designed so that the participants would not be lexically biased to attach the RC to either NP host. Vocabulary items were selected from everyday language which are thought to be familiar to the participants. Additionally, in order to control for the length effect, the number of the words that appeared in each sentence were balanced.

3.2.3. Procedure

The offline task was administered as a pencil-and-paper comprehension questionnaire a week after the online task with the same participant group. The participants were instructed to read each ambiguous sentence and decide which of the two possible interpretations they opt for. They were also asked to 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. The experiment for Turkish participants took place after regular class hours. At no time did the participants perform any work related to the experiment outside of class. They were first given the questionnaire that tested their RC attachment preferences for globally ambiguous Turkish sentences and then the questionnaire with the English items was delivered. 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 researcher himself carried out the experiment and the nature of the experiment were not discussed with the participants to avoid answering possible questions about the target structure during all phases of the study.

3.3. Online RC Attachment Ambiguity Resolution Preferences

The present experiment aims to investigate real-time processing of temporarily ambiguous structural configurations including RCs by two groups of Turkish learners of English at different proficiency levels as well as a control group consisting of native English speakers. The research questions subject to this experiment were as follows:

1. How do Turkish learners of L2 English process RC attachment ambiguities online in comparison to the native English speakers in the control group?
2. Do Turkish learners of L2 English make use of syntactic information in their online resolution of temporarily ambiguous statements including English relative clause (RC) constructions?
3. Are the processing preferences of L2 learners influenced by their proficiency levels?

4. Do lexically driven interpretive biases take precedence over structure-based parsing biases in RC ambiguity resolution as suggested by previous research?

3.3.1. Participants

The same sampling group participating in the previous offline experiment, i.e. two groups of Turkish learners of English at intermediate and advanced proficiency levels and a control group consisting of native English speakers took part in this online experiment. Both intermediate and advanced groups consisted of 26 participants and the control group included 24 native English speakers.

3.3.2. Materials

Since the present study aims to investigate the role of structure-based parsing biases and lexically driven interpretive biases in the resolution of temporarily ambiguous statements including RC structures, two RC ambiguity resolution conditions were designed, namely Condition 1: RC ambiguity resolution through structural information and Condition 2: RC ambiguity resolution through lexical-semantic information. Twenty-four experimental items were developed for each of condition. For Condition 1, reflexive pronouns with gender information (himself/herself) were used as a disambiguating cue to resolve the temporary RC attachment ambiguity. The sentences of particular interest in this respect were as follows (with boldface type showing the direction of disambiguation):

(25) High Attachment Forced (syntactic disambiguation)

- a. The **brother** of the girl who introduced **himself** at the party was very popular.

Low Attachment Forced (syntactic disambiguation)

- b. The brother of the **girl** who introduced **herself** at the party was very popular.

The RC *who introduced himself/herself* in these sentences were placed in a structural position that would allow it to modify either NP (*the brother* or *the girl*) in the complex genitive NP (i.e. NP-*of*-NP-RC constructions). Common nouns (with the

article *the*) were used in all NPs forming the complex genitive NP constructions and the constituent noun were connected with the preposition *of*. The proper attachment site for the RC was signaled by antecedent-reflexive gender agreement. To illustrate, while *herself* indicates low attachment to the gender-compatible NP *the girl*, *himself* indicates high attachment to the gender-compatible NP *the brother*. Twenty-four of the experimental items developed for Condition 1 were balanced in a way that *himself/herself* were equally associated with each attachment type (twelve experimental items for high attachment as illustrated in (25a) above and twelve experimental items for low attachment preference as illustrated in (25b) above).

The rationale for designing the test items in this condition was that if the processing mechanism tends to systematically attach the RC to high NP (i.e., *the brother* in 25b above), it will be forced to reanalyze when the fragment including the disambiguating information (i.e. *who introduced herself*;) is processed. As the reflexive pronoun *herself* refers to the female antecedent *the girl*, the reanalysis will require to change the attachment of the RC from the preferred NP1 (i.e., *the brother*) to the dispreferred NP2 (i.e., *the girl*). Since the reanalysis is thought to demand additional processing, the forced processing of the dispreferred attachment site (i.e., *the girl*) should take longer to read than a comparable sentence containing an ambiguity resolved in favor of high attachment (e.g., see 25a above).

Similarly, twenty-four experimental items were developed for Condition 2: RC ambiguity resolution through lexical-semantic information. In this condition animacy information was used as a disambiguating cue instead of reflexive pronouns. The lexical information (i.e. animate vs. inanimate) that the NPs held was manipulated to determine the direction of the disambiguation (i.e. high vs. low) of the RC constructions as illustrated in (26) below:

(26) High Attachment Forced (lexical disambiguation through animacy)

- a. The author of the novel that was killed last week was very funny.

Low Attachment Forced (lexical disambiguation through inanimacy)

- b. The author of the novel that was made into movie was very funny.

Both examples are only temporarily ambiguous as the RC held the disambiguating information. The RC was used in a structural position that could allow it to modify

either of the component NPs in the complex NP, *The author of the novel*. For instance, in the high attachment-forced condition in (26a) above, the RC *that was killed last week* included lexical information that would only make it possible to attach it to an animate noun, thus forcing disambiguation towards the NP *the author*. Conversely, in the low attachment-forced condition in (26b) above, the RC *that was made into movie* could be only attached to the low NP *the novel* because the information the RC carries makes it necessary to disambiguate towards the low NP. Thus, the same rationale detailed above for the Condition 1 was applied to identify the attachment tendency for the test items in Condition 2.

Similar to the previous condition, twenty-four of the experimental items developed for Condition 2 were balanced in a way that twelve of the experimental items were disambiguated towards the animate noun and the other twelve disambiguated towards the inanimate nouns. Common nouns were used in all NPs constituting the complex NP genitive constructions and the constituents of the complex NP were connected with the preposition *of*. In order to force learners to attend to only the lexical information in the RC, the relative pronoun *that* was used to control for the confounding role of *who/which*.

For the experimental items in each condition, five regions were identified as indicated in the table below. As can be seen in the table, the items were disambiguated using syntactic and lexical information that was available in the third region where the RC was placed and for this reason, the third region was assigned as the critical region. If the participants had low attachment preferences, they would be expected to display longer reading times (RTs) in the third region in sentences, where high attachment was forced. On the other hand, if they had high attachment preferences, they would be expected to show longer RTs in the third region in sentences, where low attachment was forced. The length of the experimental sentences and the words that appeared in each region were balanced for length across all experimental items. Table 1 below illustrates the regions in the target experimental items for each condition.

Table 1

Identified Regions of the Target Experimental Items for RC Attachment

Regions for Condition 1 (syntactic disambiguation)				
1	2	3	4	5
<i>Low Attachment Forced</i>				
The husband	of the woman	that blamed herself	for the breakup	wanted a divorce
<i>High Attachment Forced</i>				
The son	of the queen	that devoted himself	to the kingdom	died very young
Regions for Condition 2 (lexical disambiguation)				
1	2	3	4	5
<i>Low Attachment Forced</i>				
The architect	of the house	that cost millions	in the auction	looked very impressive
<i>High Attachment Forced</i>				
The manager	of the company	that gave speeches	on the television	became very famous

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 seventy-two (72) sentences in the experiment. Half of these items were followed by simple YES / NO comprehension questions. Experimental and filler items were presented in a way that no more than two experimental items appeared successively.

3.3.3. Procedure

All target sentences appeared on the monitor as single lines of text (with standard capitalization and punctuation). The eye tracking device setup during the data collection was illustrated in Figure 1 below. The participants were asked to read each sentence silently at their natural reading pace, making sure to comprehend well enough to accurately answer occasional YES/NO questions. Eye movements were recorded using an eye tracking equipment with binocular sampling at 60 Hz. The data was processed by using a software (ClearView) and exported from the device. Variables in the later

analyses were calculated with Visual Basic for Applications which ran on Microsoft Office Excel 2010.

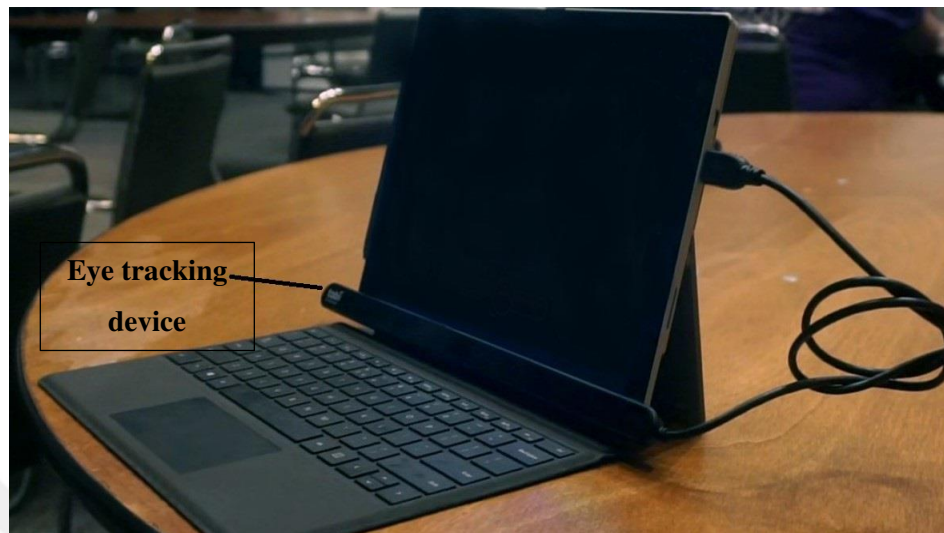


Figure 2. Eye tracking device setup during data collection

The participants were seated about 60 cm away from the screen. In order to calibrate the eye-tracking device for the experimentation, participants were instructed to follow a fixation mark (an asterisk) 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. Each trial began with a fixation sign (an asterisk) near the left edge of the computer screen. On the same region then the test items appeared. After participants finished reading the target sentence, they pressed the space key as instructed before and then the target sentence disappeared from the screen. When the target sentence was 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 when ready by pressing the space key again. If the item is followed by a comprehension-check question, the participants answered YES with the left arrow key or NO with the right arrow on the keyboard and the next trial began automatically. Figure 3 below illustrates the layout of the computer screen from the different stages of the eye tracking task. (The screen shots illustrating individual stages of the online task are presented in Appendix 8, Appendix 9 and Appendix 10.)

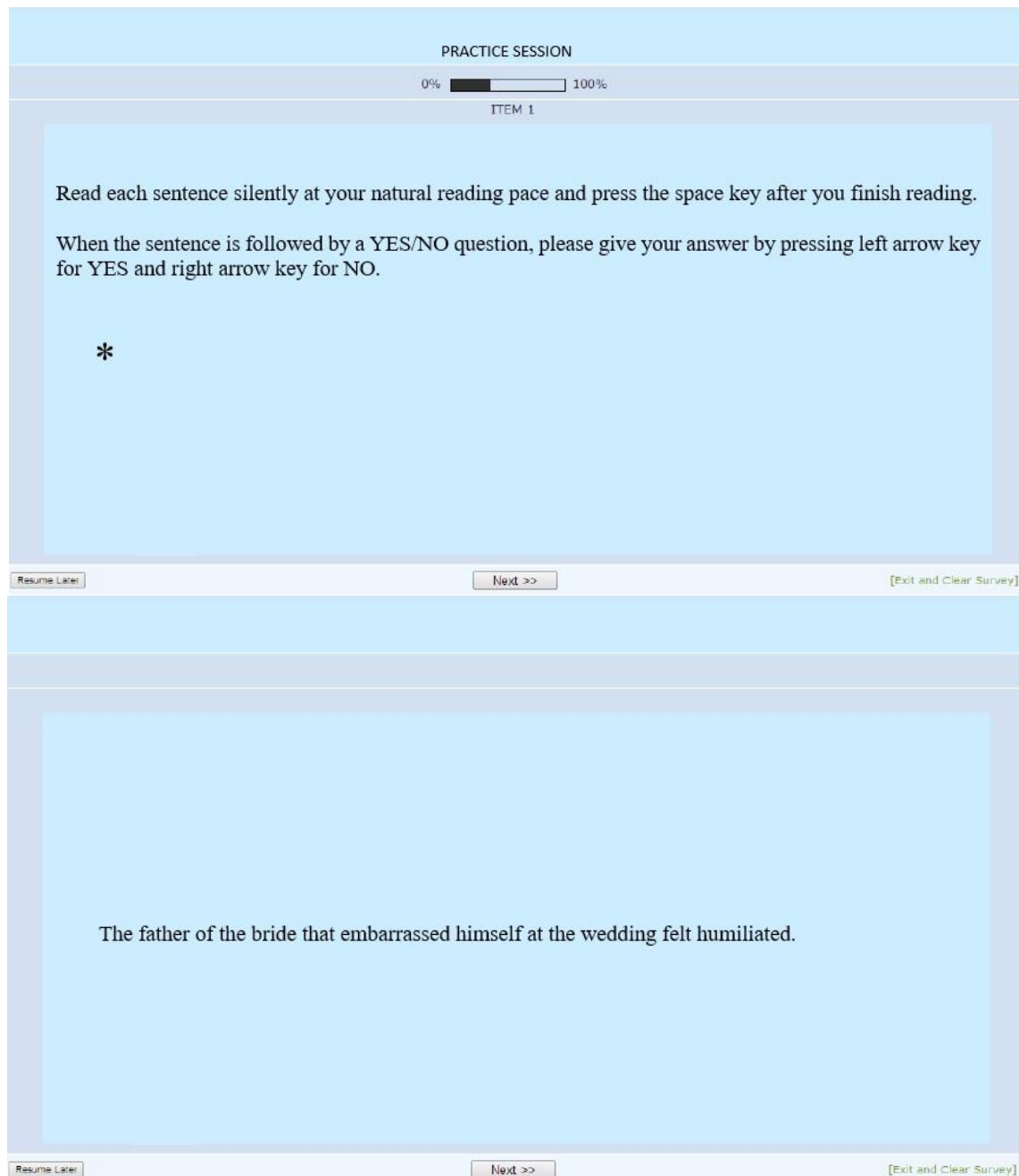


Figure 3. Layout of the computer screen during the practice session and each trial.

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

- 1) First-pass Reading Time (RT): the total of the fixation durations in a region after first entering that region until leaving it.
- 2) Go-past RT: 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.

- 3) Total RT: the total of all fixation durations per region.
- 4) Total sentence RT: the total of all of the fixation durations for the whole sentence.

3.4. Offline PP Attachment Ambiguity Resolution Preferences

Even though maximum care was taken to reduce the effects of confounding variables in the development of experimental items, it could be difficult to interpret the results of the investigations on the RC attachment preferences of L2 learners because various factors including transfer effects can play a role in L2 learners' processing. Therefore, it is necessary to control for some of the variables so as to reveal more about the processing strategies of L2 learners. To this end, PP attachment ambiguities, which do not indicate cross-linguistic variation as opposed to RC attachment ambiguities and rather display a general verb phrase attachment preference, were manipulated to test if similar insights could be acquired from PP attachment preferences. In the example (26) below, the two interpretations as in (a) and (b) are possible because the PP *from her brother* can be attached to either VP1 *hid* or VP2 *borrow*.

- (26) Laura hid the money that she had borrowed from her brother.
- a. Laura hid the money from her brother
 - b. Laura borrowed the money from her brother.

The resolution of PP ambiguities, an illustrative example of which is given in (26) above, does not involve direct transfer of attachment preference from the participants' L1 as the direct Turkish counterpart of the target constructions have two distinct interpretations in Turkish as in (27) and (28), which does not bring about any ambiguity.

- (27) Laura erkek kardeşinden ödünç aldığı parayı sakladı.
 [Laura her brother-ABL borrow-RC money-ACC hide-PAST]

- (28) Laura ödünç aldığı parayı erkek kardeşinden sakladı.
 [Laura borrow-RC money-ACC her brother-ABL hide-PAST]

As can be seen in the examples, relatively free word order of Turkish can influence the way sentences are interpreted. Even though the basic order is SOV, this might vary considerably depending on the focused element. When an element of a given sentence is wanted to be highlighted, the highlighted element is placed preverbally as it is seen in the above examples. Therefore, it is improbable to assume that transfer from L1 affects learners' processing of PP attachment ambiguities.

The present study investigates the offline processing of PP attachment ambiguities by Turkish learners to see how their processing decisions are influenced when no transfer effects are expected. Research questions addressed in this experiment are as follows:

1. How do Turkish learners of L2 English process PP attachment ambiguities offline in comparison to the native English speakers in the control group?
2. Are the processing preferences of L2 learners on PP attachment ambiguities influenced by their proficiency levels?
3. Do the L2 learners make use of L2-specific strategies when processing PP attachment ambiguities?

3.4.1. Participants

The same sampling group participating in the previous RC attachment ambiguity experiment, i.e. two groups of Turkish learners of English at intermediate and advanced proficiency levels and a control group consisting of native English speakers took part in this experiment. Both intermediate and advanced group consisted of 26 participants and the control group included 24 native English speakers.

3.4.2. Materials

Twelve (12) globally ambiguous experimental sentences and fourteen (14) unambiguous fillers were developed for the offline task. The fillers were used to distract 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 experimental sentences directly followed one another.

The experimental sentences were constructed in the following nature: NP1 – VP1 – NP1 – that – NP2 – VP2 – PP as it is illustrated in (26) below and two possible interpretations, as in (a) and (b), followed the items. Both VP1 and VP2 were ditransitive in the way that they met at least one of the criteria for ditransitive verbs suggested by Schütze & Gibson (1999). The preposition in the PP was manipulated so that the PP could disambiguate towards both VP1 and to VP2.

- (26) Laura hid the money that she had borrowed from her brother.
- a. Laura hid the money from her brother
 - b. Laura borrowed the money from her brother.

Participants' task was to choose the interpretation (a or b) which is easier for them to understand or which sounds more natural to them. Proper nouns were used in the subject position. The verbs included regular and irregular items and they were all in the past tense. Vocabulary items were selected from everyday language which were thought to be familiar to the participants. The experimental sentences were designed so that the participants would not be biased to prefer one attachment site over another.

3.4.3. Procedure

Similar procedures to the offline experiment for the RC attachment preferences were followed in the present experiment. The offline task was administered as a pencil-and-paper comprehension questionnaire a week after the online task. The participants were told to read each ambiguous sentence and decide which of the two possible interpretations they preferred. They were also instructed to choose the option 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. However, in order 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 them correctly could be excluded from the analysis. The treatment took place after regular class hours of Turkish participants. At no time did the participants perform any work related to the experiment outside of class. The researcher himself carried out the experiment and the nature of the experiment was not discussed with the participants to

avoid answering possible questions about the target structure during all phases of the study.

3.5. Online PP Attachment Ambiguity Resolution Preferences

The present experiment can be considered as the online adaptation of the previous PP attachment experiment and therefore taps into similar issues brought into consideration. However, the present study was designed in a way that allow for a direct comparison between globally ambiguous sentences and temporarily ambiguous sentences which are disambiguated using the preposition information in the PP. The research questions addressed in this particular experiment are as follows:

1. Do the online attachment preferences of L2 learners for PPs show a different pattern from those of native English speakers?
2. Do the processing preferences of L2 learners differ for offline and online tasks?
3. Do the L2 learners make use of learner-specific processing strategies when comprehending PP attachment ambiguities?

3.5.1. Participants

The same groups of participants from the previous experiments took part in the present study: two groups of Turkish learners of English at intermediate and advanced proficiency levels and a control group consisting of native English speakers. Both intermediate and advanced groups consisted of 26 participants and the control group included 24 native English speakers.

3.5.2. Materials

The materials were of the same construction to the ones used in the offline task in the previous, offline PP attachment ambiguity: NP1 – VP1 – NP1 – that – NP2 – VP2 – PP. However, the experimental items of the present study were designed to have temporarily ambiguous structures so that the sentences were disambiguated through the compatibility of the preposition in the PP to either VP1 or VP2. Namely, the prepositions were used as a disambiguating cue to resolve the temporary PP attachment ambiguity. The sentences of particular interest in the present experiment are illustrated as follows (with boldface type showing the direction of disambiguation):

(27) High Attachment Forced

- a. John **told** the secret that he had heard **to his friend** yesterday.

Low Attachment Forced

- b. John told the secret that he had **heard from his friend** yesterday.

The PPs *to his friend*/*from his friend* in these sentences were placed in a structural region that would allow it to modify either VP1 (*told*) or VP2 (*had heard*). The proper attachment site for the PP is signaled by compatibility of the preposition to the VPs. To illustrate, while *to* indicates high attachment to the compatible VP *told*, *from* requires low attachment to the compatible VP *had heard*. Twenty-four experimental items were balanced in a way that prepositions were associated with each attachment type equally (twelve experimental items for high attachment as illustrated in (27a) above and twelve experimental items for low attachment preference as illustrated in (27b) above).

Proper nouns were used in the subject positions. The verbs included regular and irregular items and they were all in the past tense. Vocabulary items were selected from everyday language which were thought to be familiar to the participants. The experimental sentences were designed so that the participants would not be semantically biased to opt for any attachment site.

Five regions were identified as indicated in the table below for the experimental items in each condition. As can be seen in the table, the items were disambiguated using preposition information that was available in the fourth region where the PP appeared. For this reason the fourth region was taken as the critical region. If participants had low attachment preferences, they would be expected to have longer reading times (RTs) in the fourth region in sentences, where high attachment was forced through the meaning of preposition in the PP. On the other hand, if they had high attachment preferences, they would be expected to show longer RTs in the fourth region in sentences, where low attachment was forced through the meaning of preposition in the PP. Additionally, total RTs per region and go-past RTs were the measures which would lend support to identify the direction of the attachment.

The length of the experimental sentences and the words that appeared in each region were balanced for length across all experimental items. Table 2 below illustrates the regions for the target experimental items.

Table 2

Identified Regions of the Target Experimental Items for PP Attachment

Regions for PP Attachment Ambiguities				
1	2	3	4	5
<i>Low Attachment Forced</i>				
Mary	passed the papers	that she had received	from her boss	yesterday
<i>High Attachment Forced</i>				
Martin	told the secret	that he had heard	to his friend	yesterday

In addition to the experimental sentences, twelve (12) unambiguous fillers were created to distract participants from the purposes of the experiment. In total, there were thirty-six (36) sentences in the experiment. Half of these sentences were followed by YES / NO comprehension questions. The presentation of the experimental and filler items was done randomly throughout the experiment. The only restriction took into consideration was that no more than two experimental items appeared successively.

3.5.3. Procedure

The same procedures followed for the online RC attachment experiment were employed in the present experiment. Participants were asked to read each sentence silently at their natural reading pace, making sure to comprehend well enough to accurately answer occasional YES/NO questions. Eye movements were recorded using the eye tracking equipment.

The same eye-tracking measures used in the online RC attachment experiment were reported in the present study. More specifically; first-pass reading time (RT), go-past RT; total RT were measured by the eye tracking equipment and the data was processed in the way that was specified for the second experiment.

CHAPTER IV

FINDINGS

4.1. Introduction

The present chapter details the results of the four experiments described in Chapter 3. The organization of the chapter is as follows: The first experiment reports on the findings from offline processing of globally ambiguous Turkish and English sentences including RC constructions by Turkish learners of L2 and native English speakers. The RC attachment preferences were analyzed by means of participants' answers to comprehension questions. In the following experiment, online RC attachment preferences of the same participant groups were examined through an eye tracking device on the basis of reading times at critical regions. The third experiment reports on offline processing of PP attachment preferences through the use of globally ambiguous sentences. The offline PP attachment decisions of participants were determined through a pencil-and-paper comprehension questionnaire. The chapter ends with the presentation of the results regarding the online processing of PP attachment ambiguities, the investigation of which was realized through the eye tracking task.

4.2. Analysis of the Findings

For the findings of each experiment, the SPSS statistics software was used to run all statistical analyses. A mixed analysis of variance (ANOVA) was conducted with group as a between-subjects variable and the relevant experimental manipulations as within-subjects variables. Separated one-factor repeated measures ANOVAs was run on the findings of the individual groups, provided that the analysis yielded a significant interaction between the factors. These analyses were conducted separately with subjects (*F1*) and with items (*F2*) as a random variable. In order to examine how each group performed independently, a series of paired t-tests were also conducted where necessary. The Scheffe tests were employed as post-hoc tests for between-subjects-variables such as Group. Planned pair-wise contrasts were reported if more than two-level within-subjects variables were obtained. The statistical significance level α was set at 0.05 for all of the analyses.

4.3. Offline RC Attachment Ambiguity Resolution Preferences

The results indicated that L1 Turkish participants showed a high attachment preference (68%) over low attachment (32%) when they made untimed judgements of the globally ambiguous Turkish sentences including RCs which could possibly modify both NPs in the genitive constructions. The difference in the attachment preference between high and low was statistically significant: $t = 5.128, p < .001$.

In an attempt to see the effect of animacy in the offline attachment preferences of participants, which was observed in the previous research, a further analysis was conducted and the same preference revealed when the RC modified animate NPs (60% high, 40% low): $t = 4.084, p < .005$ and when the RC modified inanimate NPs (69% high, 31% low) $t = 5.541, p < .001$.

A further 2 X 2 ANOVA was conducted with Condition (animate vs. inanimate) and Attachment Preference (high vs. low) to examine whether the attachment preferences differed in animate and inanimate conditions. The results of the ANOVA indicated a main effect for Attachment Preference: $F(1, 50) = 31,214, p < .001$. There was no significant interaction between Condition and Attachment Preference: $F(1,50) = 1,986, p < .821$.

The results of the offline task investigating the RC attachment preferences of L1 Turkish participants indicated that they preferred to attach the RC to the high NP regardless of the animacy information manipulated in the test items.

As for the RC attachment preferences in English, the percentages of the offline RC attachment choices for all three groups are illustrated in the table below:

Table 3

Percentages of Offline Attachment Choices in the RC Attachment Condition for All Groups

	RC Attachment Preference in Ambiguous Sentences	
	% High Attachment	% Low Attachment
Native Speakers	20.8	79.2
Intermediate L2 Learners	59.9	40.1
Advanced L2 Learners	53.5	46.5

The native speakers in the control group showed a statistically significant attachment preference for the low NP (79.2%) instead of the high NP (20.8%) $t = -10.581, p < .0001$. On the other hand, the results for the learner groups (both advanced and intermediate) did not indicate a similar attachment preference. The advanced learners showed a statistically unreliable preference for high attachment (53.5%) over low attachment (46.5%): $t = -7.585, p < .872$. The intermediate learners also performed similarly (55.9% high attachment vs. 40.1% low attachment) and their preferences were not statistically significant either: $t = -5.618, p < .763$. The difference between overall attachment preferences of both learner groups was not statistically significant: $t = -1.744, p < .0995$.

Previous research on the RC attachment preferences of Turkish L1-English L2 learners found that animacy or inanimacy of the NP in the genitive construction could be a confounding variable that affects the outcome of learners' RC attachment preferences. Therefore, in order to see the effect of animacy on the attachment preferences, the results were submitted to a mixed two-factor ANOVA with Group as a between-subjects variable and Condition (animate vs. inanimate) and Attachment preference (high vs. low) as within-subjects variables. The analysis yielded a significant interaction between Group and Attachment Preference: $F(1, 67) = 41.103, p < .005$, which indicates that groups differed in their attachment preferences. There was no main effect between condition and attachment and no interaction between Condition and Group: $p > .05$.

When animate and inanimate conditions were investigated separately, the results indicated that the native speakers showed a low attachment preference regardless of the animacy information displayed in the genitive constructions (animate condition: 79%, $t = -4.783, p < .005$; inanimate condition: 77%, $t = -6.113, p < .001$). The learner groups, however, did not show any attachment preference in both animate and inanimate conditions: $t = -8.308, p < .106$.

Overall, the analysis of the results to the offline task revealed that only the native speakers showed a clear low attachment preference in the globally ambiguous sentences. As for the intermediate and advanced learners, in spite of their tendency to attach the RC to the high NP in globally ambiguous sentences, this difference did not attain statistical significance.

4.4. Online RC Attachment Ambiguity Resolution Preferences

Mean total sentence RTs in milliseconds (ms) and standard deviations for the processing of the globally ambiguous sentences by the control group (native speakers), intermediate learner group and advanced learner group appear in Table 4 below. As can be seen, native speakers of English took the least time in reading globally ambiguous sentences including animate and inanimate NPs. The advanced learners also had shorter total sentence RTs than intermediate learners.

Table 4

Mean (Standard Deviations) Total Sentence RTs on Globally Ambiguous Sentences with Animate and Inanimate NPs

	Total RTs in ms for Globally Ambiguous Sentences	
	Animate	Inanimate
Native Speakers	3782 (643)	3642 (661)
Intermediate Learners	5380 (948)	5358 (899)
Advanced Learners	4841 (745)	4721 (782)

An ANOVA with Group as a between-subjects variable for total sentence RTs of globally ambiguous statements yielded a significant main effect: $F(1, 22) = 4571, p < .01$. The post hoc Scheffe tests found a significant difference between the total sentence RTs of native speakers and advanced learners ($p < .01$) and a significant difference was found between the advanced learners and the intermediate learners ($p < .05$). Another interesting factor that could be observed in the total sentence RTs is that all participants had shorter RTs for the globally ambiguous statements with inanimate NPs than animate NPs, however these differences were not statistically significant ($p < 1$).

As for the temporarily ambiguous items, which offers more revealing data thanks to the per region analyses, a two-factor ANOVA with Attachment (high vs. low) and Disambiguation Type (himself/herself vs. animacy/inanimacy) as within-subjects factors were conducted for all three groups, respectively with subjects and with items as random variables. Table 5 illustrates the mean total sentence RTs for temporarily ambiguous sentences.

Table 5

Mean (Standard Deviations) Total Sentence RTs for Temporarily Ambiguous Sentences

	Total RTs in ms for Temporarily Ambiguous Sentences					
	Native Speakers		Intermediate Learners		Advanced Learners	
	High	Low	High	Low	High	Low
Disambiguation through structure-based features (himself/herself)	3853 (749)	3693 (731)	5240 (878)	5536 (962)	4795 (751)	5144 (919)
Disambiguation through lexical features (animacy/inanimacy)	3948 (723)	3574 (711)	5563 (915)	5529 (884)	4945 (771)	5124 (875)

For native speakers, the analysis for the total sentence RTs yielded a main effect for Attachment ($F(1, 22) = 9.711, p < .004$; $F(1, 22) = 10.103, p < .015$). There was no main effect for Disambiguation Type (himself/herself vs. animacy/inanimacy) ($F(1, 22) < 1$; $F(1, 22) < 1$) and no significant interaction ($F(1, 22) < 1$; $F(1, 22) < 1$). These results suggest that sentences which disambiguated towards high NPs were read slower than low attachment forced conditions, which in turn could be taken to imply a preference for low attachment for native speakers.

The pattern of results for advanced learners demonstrated an attachment preference in the opposite direction. For advanced learners, two-factor ANOVAs with Attachment (high vs. low) and Disambiguation Type (himself/herself vs. animacy/inanimacy) as within-subjects factors and as within-items factors yielded a main effect for Attachment ($F(1, 24) = 11.204, p < .001$; $F(1, 22) = 12.871, p < .0025$). However, there was no main effect for Disambiguation Type (himself/herself vs. animacy/inanimacy) ($F(1, 24) = 1.718, p \leq .229$; $F(1, 22) = 1.616, p \leq .278$) and no significant interaction ($F(1, 24) = 1.325, p \leq .279$; $F(1, 22) = 1.260, p \leq .327$). These results suggest that for advanced learners, total sentence RT was significantly longer for low attachment sentences, which indicates that advanced learners took longer to process sentences that disambiguate towards low NPs regardless of the disambiguation type.

The analysis of the intermediate learners' total sentence RTs yielded a main effect for Attachment ($F(1, 24) = 2.944, p < .299$; $F(1, 22) = 3.128, p < .317$) and there was

a main effect for Disambiguation Type (himself/herself vs. animacy/inanimacy): $F_1(1,24) = 4.153, p < .05$; $F_2(1, 22) = 5.443, p < .05$ and a significant interaction was found between two factors ($F_1(1,24) = 3.2863, p < .005$; $F_2(1, 22) = 2.851, p < .005$). The results showed that there was a statistically reliable trend suggesting longer total sentence RTs under low attachment sentences. It is also important to note that the post hoc Scheffe tests found a significant difference between the total sentence RTs of structure-based disambiguation (himself/herself) and lexical disambiguation (animacy/inanimacy) ($p < .01$) suggesting that intermediate learners took longer time to process sentences that disambiguated through the use of lexical features.

As for the analysis of the individual regions of experimental items, the attachment site (high vs. low) was a repeated measure. For native speakers, the mean first-pass RTs, go-past RTs, total RTs for the experimental items in Condition 1 are presented (condition and region) in Table 6 below.

Table 6

Native Speakers' Means (Standard Deviations) for the Temporarily Ambiguous RC Statements (Disambiguation through Structure-based Features)

	Regions				
	1	2	3	4	5
Low Attachment					
	The husband	of the woman	that blamed herself	for the breakup	wanted a divorce
High Attachment					
	The son	of the queen	that devoted himself	to the kingdom	died very young
First-pass Reading Times					
Low Attachment	321 (77)	433 (104)	729 (148)	466 (115)	660 (189)
High Attachment	319 (81)	449 (99)	749 (128)	495 (120)	682 (175)
Go-past Reading Times					
Low Attachment		458 (106)	*821 (181)	585 (162)	590 (161)
High Attachment		497 (129)	*896 (224)	640 (163)	593 (129)
Total Time in region					
Low Attachment	431 (123)	696 (211)	**1089 (303)	678 (241)	799 (214)
High Attachment	455 (148)	746 (234)	**1180 (375)	703 (174)	759 (199)

The experimental sentences were disambiguated with structure-based features (i.e. himself vs. herself). The third region, which hosts the RC construction, was the critical region because longer RTs in this region would indicate an incompatibility with the NPs preceding this region, which in turn would suggest an attachment bias. For example, if the participants had low attachment preference, they would be expected to show longer RTs in the third region where high attachment is forced through structural information. On the other hand, if participants had high attachment preferences, they would have longer RTs in the third region where low attachment is forced through structural information. Additionally, total RTs per region and go-past RTs were the measures which would lend support to identify the direction of the attachment.

Similarly, the mean first-pass RTs, go-past RTs, total RTs of native speakers for the experimental items in Condition 2 are presented (condition and region) in Table 7 below. In this condition, the experimental sentence were disambiguated with lexical-semantic information (i.e. animacy vs. inanimacy), the rationale of which was explained in the previous chapter. Again the third region was the critical region as elevated RTs in this region would suggest an attachment bias.

Table 7

Native Speakers' Means (Standard Deviations) for the Temporarily Ambiguous RC Statements (Disambiguation through Lexical Features)

	Region				
	1	2	3	4	5
Low Attachment					
	The architect	of the house	that cost millions	in the auction	looked very impressive
High Attachment					
	The manager	of the company	that gave speeches	on the television	became very famous
First-pass Reading Times					
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 Reading Times					
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)

Total RTs in critical region, region 3 for the native speaker group was statistically higher for high attachment-forced conditions than for low attachment-forced conditions: $F1_{\text{himself/herself}}(1, 22) = 5.412, p < .01$, $F2_{\text{himself/herself}}(1, 22) = 6.109, p < .01$; $F1_{\text{animate/inanimate}}(1, 22) = 7.021, p < .001$, $F2_{\text{animate/inanimate}}(1, 22) = 9.117, p < .001$. Another statistically reliable difference was revealed for go-past RT in region 3 with high attachment sentences again read more slowly: $F1_{\text{himself/herself}}(1, 22) = 6.821, p < .05$, $F2_{\text{himself/herself}}(1, 22) = 5.902, p < .05$; $F1_{\text{animate/inanimate}}(1, 22) = 6.715, p < .01$, $F2_{\text{animate/inanimate}}(1, 22) = 9.299, p < .01$. Similarly, total RTs in the second region was statistically longer for high attachment-forced condition in the sentences which used animacy information for disambiguation: $F1_{\text{animate/inanimate}}(1, 22) = 4.985, p < .05$, $F2_{\text{animate/inanimate}}(1, 22) = 7.321, p < .05$. Overall, the statistically longer RTs in the aforementioned regions suggest a bias low RC attachment.

For the intermediate learners, the data reported previously indicated that total sentence RTs differed significantly when the disambiguation was achieved through structural features instead of lexical features. While the sentences that used reflexive pronouns as a disambiguating cue had statistically shorter total sentence RT for high attachment than low attachment, the difference in sentences that used animacy as a disambiguating cue did not attain statistical significance. The same pattern of results was also observed in per region analyses as illustrated in Table 8 below.

Table 8

Intermediate Level Learners' Means (standard deviations) for the Temporarily Ambiguous RC Statements (Disambiguation through Structure-based Features)

Region					
	1	2	3	4	5
Low Attachment					
	The husband	of the woman	that blamed herself	for the breakup	wanted a divorce
High Attachment					
	The son	of the queen	that devoted himself	to the kingdom	died very young
First-pass Reading Times					
Low Attachment	343 (79)	531 (165)	1180 (259)	683 (144)	899 (176)
High Attachment	339 (75)	527 (171)	1125 (236)	664 (138)	941 (186)
Go-past Reading Times					
Low Attachment		577 (180)	*1511 (394)	859 (218)	801 (179)
High Attachment		560 (171)	*1401 (374)	822 (188)	822 (191)
Total Time in region					
Low Attachment	588 (191)	906 (295)	*1844 (299)	977 (205)	1221 (246)
High Attachment	555 (177)	865 (257)	*1638 (271)	912 (179)	1270 (262)

In the critical region, Region 3, total RTs for the sentences that used reflexive pronouns as a disambiguating cue were significantly longer for low attachment sentences than for high attachment sentences: $F1_{\text{himself/herself}}(1, 22) = 12.141, p < .001$, $F2_{\text{himself/herself}}(1, 22) = 9.922, p < .001$. As for the Condition 2, the results of which appear in Table 9 below, a somewhat different pattern was observed.

Table 9

Intermediate Level Learners' Means (Standard Deviations) for the Temporarily Ambiguous RC Statements (Disambiguation through Lexical Features)

	Region				
	1	2	3	4	5
Low Attachment					
	The architect	of the house	that cost millions	in the auction	looked very impressive
High Attachment					
	The manager	of the company	that gave speeches	on the television	became very famous
First-pass Reading Times					
Low Attachment	337 (85)	544 (147)	1177 (268)	689 (154)	871 (185)
High Attachment	335 (81)	554 (162)	1161 (291)	668 (145)	854 (199)
Go-past Reading Times					
Low Attachment		579 (188)	1452 (372)	899 (204)	801 (193)
High Attachment		592 (201)	1428 (357)	865 (185)	788 (177)
Total Time in region					
Low Attachment	582 (182)	933 (265)	1868 (329)	954 (188)	1192 (224)
High Attachment	594 (164)	911 (244)	1841 (291)	986 (198)	1231 (231)

Even though there were slightly longer total RTs in the critical region of animacy condition for low attachment sentences, this difference was not statistically significant: $F_{1_{animate/inanimate}}(1, 22) = 2.483, p > 1$, $F_{2_{animate/inanimate}}(1, 22) = 3.145, p > 1$. A similar statistically reliable difference was also revealed for go-past RTs in Region 3 for disambiguation through reflexive pronoun condition: $F_{1_{himself/herself}}(1, 22) = 13.011, p < .001$, $F_{2_{himself/herself}}(1, 22) = 10.213, p < .001$; but no significant difference was observed for animacy condition: $F_{1_{animate/inanimate}}(1, 22) = 3.775, p > 1$, $F_{2_{animate/inanimate}}(1, 22) = 3.902, p > 1$.

The overall results of intermediate learners indicated a bias for high attachment in sentences which used the structural features (himself/herself) as a disambiguating cue. However, the same attachment bias was not observed for sentences that used animacy information as a disambiguating cue. Even though the RTs per regions appeared to be

longer for low attachment sentences in animacy condition, the trend was not statistically significant.

The results of the processing preferences of the advanced learners revealed an attachment bias in the opposite direction of native speakers. The findings of per region analyses were illustrated in Table 10 and Table 11 below.

Table 10

Advanced Level Learners' Means (Standard Deviations) for the Temporarily Ambiguous RC Statements (Disambiguation through Structure-based Features)

	Region				
	1	2	3	4	5
Low Attachment					
	The husband	of the woman	that blamed herself	for the breakup	wanted a divorce
High Attachment					
	The son	of the queen	that devoted himself	to the kingdom	died very young
First-pass Reading Times					
Low Attachment	326 (91)	526 (157)	*1165 (242)	659 (121)	833 (199)
High Attachment	305 (73)	534 (179)	*1087 (221)	634 (131)	882 (217)
Go-past Reading Times					
Low Attachment		562 (176)	*1439 (381)	834 (205)	829 (205)
High Attachment		558 (187)	*1351 (357)	799 (163)	851 (177)
Total Time in region					
Low Attachment	*539 (183)	883 (271)	*1705 (289)	*985 (228)	1032 (238)
High Attachment	*441 (125)	849 (224)	*1486 (253)	*863 (139)	1156 (234)

Table 11

Advanced Level Learners' Means (Standard Deviations) for the Temporarily Ambiguous RC Statements (Disambiguation through Lexical Features)

	Region				
	1	2	3	4	5
Low Attachment					
	The architect	of the house	that cost millions	in the auction	looked very impressive
High Attachment					
	The manager	of the company	that gave speeches	on the television	became very famous
First-pass Reading Times					
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 Reading Times					
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)

As it was reported previously, the total sentence RTs for low attachment sentences were significantly longer: $F1(1, 24) = 11.204, p \leq .001$; $F2(1, 22) = 12.871, p \leq .0025$, which was the first indicative of a bias towards high attachment. In addition to that finding, in the critical region, Region 3, total RTs were also significantly longer for low attachment sentences than for high attachment sentences: $F1_{\text{himself/herself}}(1, 22) = 10.679, p < .001$, $F2_{\text{himself/herself}}(1, 22) = 8.841, p < .001$; $F1_{\text{animate/inanimate}}(1, 22) = 6.272, p < .05$, $F2_{\text{animate/inanimate}}(1, 22) = 7.039, p < .05$. An interesting finding to note is that the sentences in which low attachment is forced had longer total RTs in Region 1. This finding suggests that when there is an incompatibility with the high RC attachment, the advanced learners took longer time to go back and check the head of the complex subject NP: $F1_{\text{himself/herself}}(1, 22) = 7.774, p < .005$, $F2_{\text{himself/herself}}(1, 22) = 4.319, p < .05$; $F1_{\text{animate/inanimate}}(1, 22) = 5.474, p < .05$, $F2_{\text{animate/inanimate}}(1, 22) = 4.051, p < .05$. The data from the go-past RTs support advanced learners' tendency to show regressive eye-movement patterns as there

were statistically longer go-past RTs in Region 3 for low attachment sentences than high attachment-forced conditions: $F1_{\text{himself/herself}}(1, 22) = 4.311, p < .05$, $F2_{\text{himself/herself}}(1, 22) = 5.245, p < .05$; $F1_{\text{animate/inanimate}}(1, 22) = 5.085, p < .05$, $F2_{\text{animate/inanimate}}(1, 22) = 4.903, p < .05$.

Overall, one can conclude from the aforementioned findings that the advanced learners who participated in this particular experiment showed a statistically reliable high attachment bias in sentences that include RC constructions in disambiguating structural positions.

4.5. Offline PP Attachment Ambiguity Resolution Preferences

The percentages of the offline PP attachment preferences for the three groups are illustrated in Table 12 below:

Table 12

Mean PP Attachment Preferences For Ambiguous Sentences

	VP Attachment Preference in Ambiguous Sentences	
	% High Attachment	% Low Attachment
Native Speakers	22.2	77.8
Intermediate Learners	33.7	66.3
Advanced Learners	36	64

When the native speakers made untimed judgements of the globally ambiguous sentences including PPs which could be possibly attached to either low VP or high VP, they showed a statistically significant trend to attach the PP to the low VP (77.8%) rather than the high VP (22.2%): $t = -15.229, p < .0001$, which is in line with their preference regarding the their tendency to attach the RCs to the low NP in genitive constructions. As for the both learner groups, the advanced learners preferred to attach the PP to the low VP (64%) instead of the high VP (36%) and their preference was statistically significant: $t = -8.548, p < .005$. Similarly, the results of the intermediate learners also indicated a statistically significant trend to attach the PPs to the low VP (66.3%) rather than high VP (33.7%): $t = -10.209, p < .005$.

The results were also submitted to a mixed two-factor ANOVA with Attachment as a within-subjects variable and Group as a between-subjects variable. The analysis

yielded a main effect for Attachment: $F(1, 70) = 76.788, p \leq .0001$, but no main effect for Group ($F \leq 1$) and no significant interaction ($F \leq 1$). The findings suggest that all groups performed similarly in the offline task. When the performance of each group was analyzed more closely, it was revealed that the low attachment preference of native speakers was comparatively persistent as only 2 of 24 the native speakers showed a preference for high attachment while two others had no preference. A similar pattern was also observed for the intermediate learners. Of the 26 intermediate learners only five tended to prefer high attachment and three had no preference. As for the advanced learners, three participants preferred to attach the PP to the high VP whereas six indicated no preference.

The results from individual groups imply that most of the learners had the same low attachment preference similar to native speakers. The factor of proficiency did not appear to be confounding variable in predicting the attachment preferences of participants, at least as it was measured in the present experimentation, as both learner groups performed quite similarly.

4.6. Online PP Attachment Ambiguity Resolution Preferences

The fourth region hosting the PP structure was the critical region as longer RTs in this region would indicate an incompatibility with the VPs preceding this region. This incompatibility would suggest an attachment bias. For example, if the participants had low attachment preference, they would be expected to show longer RTs when high attachment is forced through the meaning of preposition in the PP. On the other hand, if participants had high attachment preferences, they would have longer RTs when low attachment is forced through the meaning of preposition in the PP. Additionally, total RTs per region and go-past RTs are the measures which would lend support to identify the direction of the attachment.

In the statistical analyses for PP attachment preferences, the attachment site (high vs. low) was a repeated measure again. The mean first-pass RTs, go-past RTs, total RTs for the experimental items are presented in milliseconds (condition and region) in Table 13 for native speakers.

Table 13

Mean RTs (Standard Deviations) of Native Speakers in PP Attachment Preferences

	Region				
	1	2	3	4	5
Low Attachment					
	Mary	passed the papers	that she had received	from her boss	yesterday
High Attachment					
	Martin	told the secret	that he had heard	to his friend	yesterday
First-pass Reading Times					
Low Attachment	273 (44)	401 (110)	814 (132)	479 (105)	379 (54)
High Attachment	269 (41)	403 (101)	855 (155)	501 (113)	405 (63)
Go-past Reading Times					
Low Attachment		433 (145)	*903 (173)	*647 (151)	388 (107)
High Attachment		428 (159)	*1098 (199)	*785 (189)	429 (119)
Total Time in region					
Low Attachment	310 (101)	*701 (184)	*1277 (321)	*899 (259)	433 (156)
High Attachment	329 (108)	*766 (201)	*1359 (339)	*1054 (318)	469 (165)

For native speakers, in the critical region of the experimental sentences, Region 4, there were longer go-past and total RTs for high attachment sentences: go-past RT, $F_1(1, 22) = 14.714, p < .05$, $F_2(1, 22) = 17.384, p < .05$; total RT, $F_1(1, 22) = 19.556, p < .001$, $F_2(1, 22) = 20.201, p < .001$. High attachment sentences also incurred longer total RTs in Regions 2 and 3: Region 2, $F_1(1, 22) = 8.021, p < .05$, $F_2(1, 22) = 8.668, p < .05$; Region 3, $F_1(1, 22) = 11.314, p < .01$, $F_2(1, 22) = 15.458, p < .01$, which indicate longer times spent checking these sections after regressive eye movements. In this case, these longer total RTs possibly reflect the checking of the verbs when the preposition mismatched the meaning of the verb.

For advanced level learners, the mean first-pass RTs, go-past RTs, total RTs in each identified region for experimental sentences are presented in milliseconds (condition and region) in Table 14 below.

Table 14

Mean RTs (Standard Deviations) of Advanced Learners in PP Attachment Preferences

	Region				
	1	2	3	4	5
Low Attachment					
	Mary	passed the papers	that she had received	from her boss	yesterday
High Attachment					
	Martin	told the secret	that he had heard	to his friend	yesterday
First-pass Reading Times					
Low Attachment	283 (45)	441 (121)	837 (158)	*485 (115)	370 (66)
High Attachment	289 (47)	455 (133)	849 (167)	*534 (126)	429 (73)
Go-past Reading Times					
Low Attachment		467 (151)	1069 (173)	*704 (195)	388 (132)
High Attachment		485 (162)	1155 (199)	*817 (249)	429 (139)
Total Time in region					
Low Attachment	433 (179)	*892 (204)	*1452 (334)	*1031 (265)	459 (161)
High Attachment	471 (191)	*1009 (241)	*1687 (355)	*1247 (321)	498 (156)

The overall results for the advanced learners showed similar patterns to that obtained for the native speakers. The critical region, Region 4, indicated higher first-pass, go-past and total RTs for high attachment: first-pass RT, $F(1, 24) = 4.839$, $p < .05$, $F(1, 22) = 5.129$, $p < .05$; go-past RT, $F(1, 22) = 10.106$, $p < .05$, $F(1, 22) = 11.049$, $p < .05$; total RT, $F(1, 22) = 26.228$, $p < .001$, $F(1, 22) = 30.543$, $p < .001$. In Region 2 and Region 3, the regions preceding the prepositional phrase, the advanced learners had longer total RTs for high attachment sentences: Region 3, $F(1, 22) = 19.556$, $p < .001$, $F(1, 22) = 20.201$, $p < .001$; Region 2, $F(1, 22) = 11.393$, $p < .005$, $F(1, 22) = 13.411$, $p < .005$.

As for the intermediate learners, the RTs in each region are illustrated in Table 15 below. It can be seen that the only significant difference that was found in the critical region, Region 4, was for the go-past RTs: $F(1, 24) = 5.355$, $p < .05$, $F(1, 22) = 6.307$, $p < .05$. The results immediately preceding the critical region were comparable to those of the native speakers. Specifically, the intermediate learners had longer go-past

and total RTs for high attachment sentences in Region 3: go-past RT: $F1(1, 22) = 8.965, p < .01, F2(1, 22) = 10.592, p < .01$; total RT, $F1(1, 22) = 25.856, p < .001, F2(1, 22) = 27.549, p < .001$. A final but an unexpected finding was observed in the final region, Region 5, which could be explained through the wrap-up effects, which is frequently addressed in the eye-tracking methodology: $F1(1, 24) = 4.213, p < .05, F2(1, 22) = 5.677, p < .05$.

Table 15

Mean RTs (Standard Deviations) of Intermediate Learners in PP Attachment Preferences

	Region				
	1	2	3	4	5
Low Attachment					
	Mary	passed the papers	that she had received	from her boss	yesterday
High Attachment					
	Martin	told the secret	that he had heard	to his friend	yesterday
First-pass Reading Times					
Low Attachment	285 (33)	463 (139)	879 (144)	495 (131)	382 (79)
High Attachment	287 (30)	466 (145)	875 (151)	529 (125)	413 (88)
Go-past Reading Times					
Low Attachment		566 (174)	*1157 (218)	*818 (207)	403 (119)
High Attachment		591 (182)	*1269 (273)	*904 (221)	469 (128)
Total Time in region					
Low Attachment	459 (165)	1084 (198)	*1561 (359)	1235 (310)	*493 (121)
High Attachment	492 (203)	1127 (264)	*1799 (398)	1278 (377)	*571 (162)

In sum, the results from native speakers and both learner groups suggested a clear low attachment bias on sentences that include prepositional phrase ambiguities. In the following section, these findings are discussed with regard to the specific research questions that guided this study.

CHAPTER V

DISCUSSION

5.1. Introduction

The purpose of the present chapter is to discuss the results of the experiments with a specific emphasis on each research question previously listed. The chapter begins with a section designed to recall the research questions and then each research question guiding the individual experiments is respectively discussed with reference to the findings and their contribution to the relevant considerations in the field.

5.2. Research Questions

As it is mentioned in the first chapter, the present study aimed to compare L1 and L2 processing of two different types of syntactic ambiguities; namely, the processing of RC attachment ambiguities and PP attachment ambiguities, through a series of online and offline experiments. For each type of ambiguity while offline experiments tested the attachment preferences of L1 Turkish speakers at different proficiency levels and native English speakers through the use of pencil-and-paper comprehension questionnaires, online experiments investigated real-time processing of the target syntactic structures through the eye-tracking methodology. The investigation of these ambiguities attracted a great deal of attention in that the findings could offer new insights for the interpretation of several issues including how L2 grammatical processing could take place, whether and to what extent the transfer of L1 processing routines could influence real-time L2 sentence comprehension, whether it is possible for L2 learners to achieve native-like processing in the L2 and whether L2 processing mechanism is subject to a change with the increasing proficiency. In order to tap into these issues, the present study was guided by the following research questions listed in four sections below in accordance with the purpose of each experiment.

5.2.1. Research Questions for Offline RC Attachment Ambiguity Resolution

The research questions guiding this experiment are as follows:

1. How do native English speaker control group process RC attachment ambiguities in English offline?
2. How do Turkish learners of L2 English process RC attachment ambiguities in Turkish and English offline?
3. Are the preferences of L2 learners influenced by proficiency effects?
4. Are Turkish learners of L2 English influenced by their L1 processing strategies or by a strategy specific to L2 when comprehending RC attachment ambiguities offline?

5.2.2. Research Questions for Online RC Attachment Ambiguity Resolution

The research questions addressed in this experiment are as follows:

1. How do Turkish learners of L2 English process RC attachment ambiguities online in comparison to the native English speakers in the control group?
2. Do Turkish learners of L2 English make use of syntactic information in their online resolution of temporarily ambiguous statements including English relative clause (RC) constructions?
3. Are the processing preferences of L2 learners influenced by their proficiency levels?
4. Do lexically driven interpretive biases take precedence over structure-based parsing biases in RC ambiguity resolution as suggested by previous research?

5.2.3. Research Questions for Offline PP Attachment Ambiguity Resolution

The following are the research questions for the present investigation:

1. How do Turkish learners of L2 English process PP attachment ambiguities offline in comparison to the native English speakers in the control group?
2. Are the processing preferences of L2 learners on PP attachment ambiguities influenced by their proficiency levels?
3. Do the L2 learners make use of L2-specific strategies when processing PP attachment ambiguities?

5.2.4. Research Questions for Online PP Attachment Ambiguity Resolution

The research questions for the present experiment are as follows:

1. Do the online attachment preferences of L2 learners for PPs show a different pattern from those of native English speakers?
2. Do the processing preferences of L2 learners differ for offline and online tasks?
3. Do the L2 learners make use of learner-specific processing strategies when comprehending PP attachment ambiguities?

5.3. Discussion

In this section, the findings for each experiment are discussed with reference to the research questions. The first section includes the discussion of the results from the experiment investigating the offline processing of globally ambiguous Turkish and English sentences including RC constructions by Turkish learners of L2 English at two different proficiency levels and a control group consisting of native English speakers. In the second section, the findings of the experiment examining the real-time processing of temporarily ambiguous structural configurations including RCs are addressed. The third section presents the discussion of results from the experiment investigating offline processing of PP attachment ambiguities in English by Turkish learners of English and a control group of native English speakers. Finally, in the fourth section the processing of English PP attachment ambiguities in real time is discussed with regard to the findings acquired from the same participant groups specified above.

5.3.1. Offline RC Attachment Ambiguity Resolution Preferences

The results concerning the first research question that addressed the native English speakers' resolution of RC attachment ambiguities in English sentences containing a complex genitive NP of the type of *NP1 of NP2* followed by a RC indicated that they preferred to attach the RC to the NP2 (i.e. low attachment) in the offline task administered as a pencil-and-paper comprehension questionnaire. With respect to the specific considerations offered for RC attachment ambiguity resolution, it is evident that the data from native English speakers is consistent with the previous findings on RC attachment preferences in English (e.g. Carreires & Clifton, 1999; Frazier & Clifton,

1996). This preference has been interpreted in terms of a structure-based universal processing principles called recency and predicate proximity. Previous research has shown that while recency overrides predicate proximity for ambiguous RCs in two-site contexts in English, predicate proximity takes precedence over recency in languages such as German or Spanish which have a less restricted word order than English (Gibson, et al., 1996). The principle of recency biases the processing mechanism to attach the upcoming information to the most recently processed constituent whenever it is grammatically applicable. In sentences involving RC attachment ambiguity, the application of this principle results in a low attachment preference. Therefore, the findings that are indicative of low attachment preference in English are compatible with previous research and the recency principle.

The results regarding the second research question investigating the Turkish speakers' offline processing of RC attachment ambiguities in Turkish demonstrated that when they made untimed judgements of the globally ambiguous Turkish sentences including RCs, the Turkish participants displayed a certain interpretive bias in their first language, but it was in the opposite direction to that of native English speakers. Turkish speakers preferred to attach the RC to the high NP in the genitive constructions in their L1 and their high attachment preference did not seem to differ in accordance with the animacy information manipulated in the test items. When Turkish data is evaluated from the perspective of L1 processing models, specifically of Construal Hypothesis (Frazier & Clifton, 1996), it is argued that the RC attachment preferences are non-primary decisions and determined by Referentiality Principle, which anticipates a preference for high attachment. Similarly, from the viewpoint of universal processing principle such as predicate proximity (Gibson, et al., 1996), an interplay of universal principles should play a role in the final attachment decisions because both NPs in the genitive construction are available as potential hosts in the entire complex NP, which is indeed the thematic processing domain closest to the ambiguous RC. Taking account of the fact that Turkish bears resemblance to languages such as German and Spanish in the sense that all are nonconfigurational languages that allow for free word order, it should be anticipated that predicate proximity takes precedence over recency. This accounts for the tendency to attach the RC to the NP closest to the main predicate (i.e., high attachment preference-NP1) as evinced by previous research on other nonconfigurational languages. In this respect, compatible with the expectations of Construal Hypothesis and predicate proximity principle, the Turkish subjects displayed

a high attachment preference in Turkish target items by preferring to attach the ambiguous RC to the NP closest to the main predicate (NP1). Thus, basing on the data from the learners' first language processing preferences, it could be stated that they behaved in accordance with the Construal Hypothesis and also applied a structural processing strategy, predicate proximity, to parse the target sentences 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 principle as the weight of the predicate proximity displays stronger effects on parsing and can override recency when the language allows arguments to be far away from the verb (Gibson et al., 1996).

As for the Turkish participants' resolution of RC attachment ambiguities in English, the results demonstrated that both learner groups (both advanced and intermediate) displayed neither low attachment preference like the native English speakers nor high attachment preference as they did in their L1 Turkish. That is to say, Turkish learners of L2 English did not show statistically reliable preference for either NP1 or NP2 disambiguation for complex genitive NPs in English sentences.

This pattern of results from the offline task also suggested that the answer to the third research question inquiring the effects of learners' proficiency on their processing decisions was negative. Although the intermediate learner group displayed a slightly greater tendency to attach the RC to the high NP in globally ambiguous English sentences, this difference did not reach statistical significance. It could be argued that the intermediate learners could be more dependent on their first language to comprehend L2 sentences in comparison to the advanced learners and this could have tipped the processing decisions in favor of high attachment and it could also be said that more proficient learners would be less susceptible to transfer from the L1 and they would be more likely to show nativelike proficiency effects. However, the lack of significant correlations of processing choices with the stated proficiency measures suggests that this relationship is far from being straightforward and thus underlies individual variation. Moreover, the absence of significant correlation might suggest that the effects of L1 transfer which can be interpreted from the statistically unreliable preference for high attachment is strong enough to override the effects of L2 proficiency. All in all, the data set from both learner groups did not yield any fair grounds to offer insights into the gradual development of L2 processing.

Finally, the fourth research question investigated whether L2 learners are influenced by their L1 or by an L2-specific strategy when processing offline RC attachment ambiguities in English. Given that adult L2 learners already hold a fully developed processing mechanism in their first language, it is reasonable to think that the processing strategies from their first language can be transferred to the L2. In spite of their statistically insignificant tendency to attach the RC to the high NP (NP2) in globally ambiguous sentences, the findings did not suggest that Turkish-speaking L2 English learners transferred the NP1 preference from their native language. One possible explanation to account for the results comes from the proponents of the Competition Model through a concept referred to as amalgamation (Hernandez, Bates & Avila, 1994). According to this concept, the L2 learners could have been at a stage in between transferring the high attachment preference from their first language and acquiring the nativelike low attachment preference from the target language. This explanation, however, is called into question when we take into consideration the findings from Papadopoulou and Clahsen (2003). The results of the study argue against an intermediary stage in L2 processing because the participants did not show any attachment preferences even though both the target language (Greek) and the participants' first language (Spanish, German, and Russian) show a bias for low attachment preference.

Another explanation to the present findings also comes from the predictions of Shallow Structure Hypothesis (SSH) (Clahsen & Felser, 2006a, 2006b, 2006c) which suggests that L2 learners differ from both child and adult L1 speakers in their processing of sentences because L2 learners do not rely on structure-based parsing strategies (Recency and Predicate Proximity) when processing L2 (see Chapter 2 for the details). According to SSH (2006c), L2 learners cannot process complex syntactic constructions that include hierarchically deep structures in a nativelike manner, however, they process lexical, semantic and simple syntactic structures as well as native speakers do. The predictions of SSH are based on a number of experimental reports indicating that when processing ambiguous sentences L2 learners make use of lexical, semantic and pragmatic information to guide their RC attachment preferences and they do not seem to use the structure-based recency principle. Therefore, the decisions of RC attachments are randomly made in L2 sentence processing (Clahsen & Felser 2006a, p. 18). Within the case of the present study, SSH predicts that L2 learners employed in this study should not prefer to attach the structurally ambiguous RC to either the low NP

(NP2) or the high NP (NP2). More specifically, when there is a lack of lexical information that creates a bias for either direction, the L2 processing decisions of learners should not be guided by structure-based universal processing principles (i.e., by either predicate proximity or recency) that are detailed above. Consistent with predictions of the SSH, the lack of statistically significant attachment preference in the present findings can be explained with reference to the tenets of SSH. Thus, the participants cannot be said to have transferred the L1-specific high attachment preference, nor did they acquired the use of L2-specific low attachment preference.

It is important to note that until recently most sentence processing studies carried out in the field of SLA have made use of offline methods such as the pencil-and-paper-based comprehension tests used in the present study. In contrast to the online methods which collect data about sentence interpretation as each word or phrase is read or heard in real time, offline methods gather information after participants read or hear a sentence in its entirety. In addition to this, participants make their interpretation decisions without being timed in offline 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 offline measures do not entirely reflect participants' initial processing tendencies. Even though it is possible to explain the reported results of the present experiment by addressing lexicosemantic, plausibility or some other nonsyntactic source of information as suggested by SSH, it would be unreasonable not to attest some role for structure-based processing biases. The offline methodology employed in the present experiment might have fell short of detecting an attachment bias pointing at structure-based processing principles because of the stated flaws inherent in its design. In order to increase the possibility of detecting such biases, making use of online measures such as eye tracking methodology would be more instrumental as it can provide sensitive indications of processing tendencies and thus suit very well to the investigation of structural computations taking place during L2 sentence comprehension.

5.3.2. Online RC Attachment Ambiguity Resolution Preferences

In the present experiment, two groups of L2 English learners' online resolution of the RC attachment ambiguities were investigated in comparison to the native English

speakers, as it is addressed by the first research question. The results indicated that both the L2 learner groups and native English speakers showed interpretive biases on the sentence types created within each condition, yet the direction of the bias was different for native English speakers and the L2 learner groups. In line with the results obtained in the offline RC attachment ambiguity resolution experiment conducted within the scope of this dissertation and the studies of RC attachment in L1 English (Frazier & Clifton, 1996, Carreiras & Clifton, 1999), the native English speakers showed a low attachment bias. As it is argued above, this preference has been accounted for in terms of the structure-based universal parsing principle called recency, which directs the processing mechanism to attach the incoming sentence constituents to the most recently processed elements (Gibson, et al., 1996). The Turkish learners of English, however, displayed a high attachment bias which was consistent with their L1 processing decisions as it was revealed by the offline RC attachment ambiguity study. Similarly, this preference has been explained with regard to the structure-based universal parsing principle called predicate proximity, which guides the processing mechanism to attach modifiers to argument positions (Gibson, et al., 1996). The findings of the present experiment demonstrated that the structure-based parsing principles posited in the processing of structurally ambiguous RCs were operative with native English speakers using recency and L2 learners using predicate proximity. Therefore, the answer is affirmative for the second research question asking whether L2 learners make use of lexical and structural information in their online resolution of temporarily ambiguous statements including English RC constructions.

There are a number of potential explanations as to why the direction of the attachment preferences on the target test items was different. First of all, a popular account that was also reported in the previous section concerns the relative weighting of the structure-based processing principles of recency and predicate proximity by native English speakers and by the L2 learners participated in this experiment. In order to elucidate the L2 learners' weighting of predicate proximity over recency, it is argued that the strength of predicate proximity is determined by the average distance between the predicate heads (verbs) and their arguments. In languages that have relatively free word order like Turkish, this distance is fairly higher and greater initial activation of the predicate is necessary to facilitate attachment over greater distances. In these languages predicate proximity is stronger. On the other hand, in languages that have a rigid word order formulation such as English, the average distance between the heads of the

predicate and their arguments are rather shorter and predicate proximity is weaker. Thus, it is conceivable that predicate proximity is assigned greater weight in Turkish, and that the setting of this parameter affects the processing of RCs by Turkish participants. Secondly, the difference in RC attachment preferences can be described with reference to the tuning hypothesis (Mitchell & Cuetos, 1991), which was explained in detail in Chapter 2. Essentially 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 their exposure to more low attachment resolutions in sentences including RCs. The high attachment preference for Turkish learners of English could stem from their exposure to more high attachment resolutions in L1 Turkish. In other words, the L2 learners participated in this study might not have overcome their L1 tuning regarding this particular sentence type. Another consideration that could be offered to explain the difference in the direction of the RC attachment bias between the native English speakers and L2 English learners has to do with implicit prosody hypothesis (Fodor, 1998, 2002). According to this hypothesis, a default prosodic contour is projected on the stimulus even during silent reading and it may influence syntactic ambiguity resolution in a such way that the processing mechanism opts for the syntactic analysis associated with the most natural (default) prosodic contour for the target structure (Fodor, 2002). Specifically, in RC structures like the ones used in this study, the length of the RC might influence whether the reader will impose a prosodic break between the RC and the complex genitive NP. This, in turn, influences the attachment preference with the assumption that low attachment is preferred if there is no break. Nevertheless, it should be noted that it is rather vague to determine the accuracy of this account without the L2 production data for the relevant sentence types. Finally, the L2 learners' failure to achieve pragmatic processing can be addressed in an attempt to account for the difference in RC attachment preferences. More precisely, the different processing preferences displayed by the L1 English speakers and L2 learners might be explained through the universal processing account, construal hypothesis (Frazier & Clifton, 1997), which proposes to associate RC modifiers to the higher NP. According to construal hypothesis, in languages that employ two forms of genitive constructions (i.e., "*NP of NP*" construction often called Norman genitive and "*'s*" possessive construction called Saxon genitive), low attachment (NP2) is favored in Norman genitive constructions. Since the language has a Saxon genitive

construction to modify the NP2 (as in *the author's father was at the café*), the processing mechanism applies the Gricean Maxim of Avoid Ambiguity and assumes that if high attachment were aimed, the Saxon genitive construction would have been used in the complex genitive NP. In the light of this explanation, it could be argued that if the Turkish learners of L2 English failed to process the pragmatic implications of the Norman genitive, they would have simply applied the default interpretation under construal hypothesis (i.e., attach the RC modifier to the higher NP) to the target test items.

When the individual measures of the online data is analyzed in detail (i.e. per region analysis), the most important finding appears to be that native English speakers and L2 English learners showed total reading time (RT) differences at the critical region that hosts the RC. This was the main indicator of a low attachment bias for native speakers and a high attachment bias for the L2 learners. Especially the difference in the go-past RT 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 (Fernandez, 2002, Dussias, 2003; Felser et al., 2003, 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 failed to find attachment preferences for L2 learners have employed a self-paced reading methodology (Fernandez, 2003; Dussias, 2003; Felser et al., 2003; Papadopoulou & Clahsen, 2003), whereas admittedly few studies that have demonstrated attachment preferences have used eye tracking methodology (Frenck-Mestre, 1997, 2002, Witzel & Witzel, 2012). As it is argued in Chapter 1, it might be necessary to use a potentially sensitive methodology such as eye tracking to unravel this often subtle difference in the RC attachment preferences. This methodological issue can also be used as a solid ground that can account for the findings of the offline RC attachment ambiguity conducted for the purposes of the present dissertation. Another alternative possibility (or an additional contributing factor) to offer explanation for our 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 confounding sources of contextual information available to readers after seeing the RC modifier can influence the processing decisions. More specifically, readers can possibly develop some expectations about the noun to be modified basing on the context and these expectations can interact with default RC attachment preference. Furthermore, previous online reading studies have found wrap-up effects, namely, longer RTs on the last constituent of the sentence (Rayner, Kambe & Duffy, 2000), therefore, the eliminating this confounding effect by not situating the disambiguating RC as the last element of the sentence would have contributed to the present findings. Taking all into consideration, it can be suggested that the RC attachment sentences in the present study warrants a more effective investigation of whether L2 learners compute the detailed hierarchical structure essential for the application of structure-based principles.

With regard to the third research question addressing the effects of proficiency on L2 learners' processing decisions, the results did not support the claim arguing that transfer of processing strategies from the learners' L1 subsides with increasing proficiency (Rah, 2009). Our results showed that individual differences in L2 proficiency did not seem to considerably affect the processing decisions of the L2 learners participating the study in intermediate and advanced level groups because the learners displayed an L1-specific high attachment preference, which seemed to be transferred from their first language. In fact, L1 transfer effect was even stronger for the higher level proficiency group. Therefore, it can be argued that a high level of proficiency do not guarantee native-like processing. Previous research showed that even learners who performed as well as native speakers in offline tasks or spent long periods of immersion in the target language environment failed to show indications of native-like processing (Marinis, Roberts, Felser & Clahsen, 2005; Mueller et al., 2005; Felser and Roberts, 2007). Roberts (2003) found that the processing of ambiguous sentences were not influenced by proficiency at all and that the processing complex syntactic dependencies were not affected by proficiency in any qualitative way. Similarly, Rah and Adone (2010) found only comparatively small differences between the two different proficiency groups of L2 learners in their processing of VP attachment

ambiguity resolution. These results demonstrate that practice and experience might not be sufficient to acquire native-like processing skills in an L2, and brain-imaging results suggest that proficiency differences influence L2 semantics more than the processing of L2 syntax (Wartenburger et al., 2003). While this may be an issue worth researching further by systematically comparing L2 learners from a wider range of proficiency levels, there is no indication in the current results that L2 sentence processing becomes more native-like with increasing proficiency.

It may be the case that proficiency factor might have a different effect depending on the type of the construction being processed as the processing patterns of the two learner groups only slightly differed concerning their ability to use the type of information resolving the RC attachment ambiguity. As can be recalled, two different RC ambiguity resolution conditions were designed to investigate the role of structure-based processing biases and lexically driven interpretive biases (see Chapter 3 for the details). For Condition 1, reflexive pronouns with gender information (himself/herself) were used as a disambiguating cue to resolve the temporary RC attachment ambiguity, whereas for Condition 2 animacy information was used as a disambiguating cue. The results demonstrated that although both L2 learner groups displayed a strong trend to attach the RC to the high NP in both conditions, the preferences of intermediate level learners for the processing of the test items in Condition 2 did not attain statistical significance. This particular finding might seem surprising as the same learner group showed a robust high attachment preference when antecedent-reflexive gender agreement, a structure-based processing cue, was used to disambiguate the sentences. A possible explanation for this pattern of results might have to do with the markedness of the disambiguating cue used in two conditions. Unlike their equivalents in English, reflexive pronouns in Turkish are neutral with regard to gender. Since the relative markedness of the reflexive pronouns are stronger in English than they are in Turkish, the L2 learners might have created a stronger association between the given structure-based cue (antecedent-reflexive gender agreement) and the corresponding NP. This might have led to a greater sensitivity that interacted with the default RC attachment bias better than the animacy information did. Another possible explanation is also that the animacy information used as a lexically-driven disambiguation cue facilitated the resolution of the temporary ambiguity by tapping into learners' world knowledge or plausibility information. Although previous research has shown that both native speakers and the L2 learners can be highly sensitive to plausibility when constructing

and revising syntactic analyses, there is some evidence to maintain that there can be limits to L2 learners' capability to make use of this information and they might not be able to exploit this source of information comparably well in order to facilitate reanalysis in sentences that require deeper structural processing (Robert & Felser, 2011). Therefore, it can be argued that since the intermediate level L2 learners did not use the plausibility information to the same extent as the advanced level learners did, their high attachment preference might not have reached statistical significance. At this point, it should be noted that the native English speakers still demonstrated the same low attachment preference in both conditions, so it is not likely that the type of information used to disambiguate the RC attachment ambiguity yielded a general bias for lack of any attachment preference or a bias towards any attachment site. For this reason, the intermediate level learners' lack of statistically significant preference cannot be attributable to a confounding factor related to the development of test items. In conclusion, in an attempt to answer the final research question it can be said that the data set acquired from the online experiment does not confirm the argument that lexically driven interpretive biases take precedence over structure-based parsing biases in RC ambiguity resolution.

5.3.3. Offline PP Attachment Ambiguity Resolution Preferences

The rationale to examine the PP attachment ambiguities was to investigate L2 learners' attachment preferences in situations when direct transfer effects from the learners' L1 are not probable as the equivalents of the PP attachment test items used in the offline task are not ambiguous in learners' L1, Turkish. This would render the opportunity to exclude the confounding factor of L1 transfer, which indeed substantially influenced L2 learners' processing decisions in RC ambiguity resolution. Also, it would be possible to comment on the question as to whether L2 learners utilize L2-specific strategies when processing PP attachment ambiguities.

The findings demonstrated that when they made offline untimed judgements of the globally ambiguous sentences including PPs which could be possibly attached to either low VP or high VP, native English speakers and L2 learners in both intermediate and advanced level groups performed very similarly by showing a statistically significant trend to attach the PP to the low VP (i.e., low attachment preference). Moreover, the proficiency level of the learners did not appear to be a reliable variable in predicting the

attachment preferences of participants, at least, as it was measured in the present experimentation, as both learner groups performed quite similarly. Therefore, the answer for the second research question addressing the proficiency effects was negative. The only difference was that while the low attachment preference of native speakers was comparatively homogeneous, the learners' decisions are a bit more diversified because the results for the individual participants demonstrated that some of the learners actually opted for the high attachment preference. This difference could simply be explained by individual differences related to general hesitance of learners in the task, which might have caused some of them to prefer high attachment as a default. It is also reasonable to think that L2 learners might have been more unclear than native speakers concerning the requirements of the verb-argument structure in the target test items. Thus, they might have gone with the requirements of the first verb (VP1) than those of the second verb despite the fact that both verbs subcategorize for a PP complement.

Finally, with reference to the third research question investigating whether L2 learners employed an L2-specific processing strategy, it could be argued that the finding of the present study could not be attributable to a learner-specific strategy because the low attachment preference would have been stronger for the learner groups than it was for the native English speakers. On the contrary, the relevant effect could be claimed to be the opposite in that the low attachment preference was the strongest in the native speakers and weakest in the advanced level learners. In fact, the results could be better interpreted through the considerations of the Late Closure and the structure-based processing principle called recency. One of the few studies that employed similar constructions was conducted by Rah (2009) with German speaking L2 English learners and the researcher reported a similar low attachment preference, which she took as evidence for Late Closure and recency as well. In comparison with Rah's study, the native English speakers in the present experiment displayed an even stronger preference for low attachment. Given that the structural principles like Late Closure and recency could be held accountable for the low attachment preference of native speakers, the results of the L2 learners show that they are also sensitive to these structure-based principles and are capable of highly native-like processing. A final point to note in the discussion of the offline experiment results is that the present findings do not provide evidence supporting the claims of the SSH, as L2 learners would have displayed no attachment preference if the predictions of the SSH had been valid.

5.3.4. Online PP Attachment Ambiguity Resolution Preferences

Since the present experiment is the online version of the previously discussed offline PP attachment ambiguity experiment, the research questions and the predictions concerned bear a similarity. Nonetheless, it should be noted that the greater processing load of the online task would be more likely to influence the L2 learners' processing decisions. The present experiment also allows to make a direct comparison of the processing of globally ambiguous sentences and temporarily ambiguous sentences disambiguated by using the information conveyed by the agreement of the preposition in the PP and the verb in the VP.

The results for the online attachment of the PP ambiguity resolution sentences revealed elevated RTs in the high-attachment-forced sentences for the native English speakers and both L2 learner groups, which indicated a low attachment bias. It is noted that both native speakers and L2 learners demonstrated processing difficulty at the disambiguating region of the high attachment-forced condition. The processing difficulty at the region of the PP was entirely expected and can be taken to imply the reanalysis of the sentence from VP2-attachment interpretation to VP1-attachment interpretation. The tendency to do reanalysis is also apparent in the longer go-past RTs, which reflect the checking of the verbs when the preposition mismatched the meaning of the local verb (VP2). In this respect, both native speakers and L2 learners seemed to resolve the misprocessing with specifically targeted regressive eye fixations to the regions that were essentially relevant for recovering the accurate interpretation. This preference to attach the PP to the local VP, hence showing a low attachment bias, was consistent with Gibson's locality principles and the findings were interpreted to indicate that both native English speakers and Turkish learners of English were able to apply recency principle in the online attachment of PP modifiers. On this account, it can be maintained that the participants employed a structure-based processing strategy in the interpretation of these sentences. Another way to account for the present findings might also relate to construal theory. Within this account, as it is elaborated in detail above, the nonprimary phrases, constituents that do not directly relate to the main predicate and its argument, are preferably associated with the current thematic processing domain (Frazier & Clifton, 1997). PPs are nonprimary and they would be preferably associated within the domain established by the closest theta-assigning verb.

Since the L2 learners' online attachment preferences for PPs did not differ from those of native English speakers, the answer to the first research question was negative. Similarly, because the same low attachment bias observed for the globally ambiguous PP sentences in the offline task persisted in the online task as well, the answer was negative for the third research investigating whether there was a difference between the results of the offline and online task. In the offline task the low attachment preference displayed by the L2 learners was not as strong as that of native English speakers, whereas there was no significant difference between the groups in the online task. In this respect, it can be argued that even though they did not refer to recency principle in their L1 and L2 processing of RC attachment ambiguities, Turkish learners of L2 English might have used this structure-based processing principle for the processing of more complex PP attachment ambiguities in order to reduce the increased processing load by simply preferring short-distance relations (attaching the PP to the most recent VP) or to compensate for their relative lack of access to complex grammatical representations. In an attempt to answer the final research question, it can be suggested that L2 learners did not actually applied a learner-specific processing strategy when we consider the finding that native English speakers also used the recency strategy in their processing of the target sentences. This, rather, implies that L2 learners was able to make use of this structure-based processing strategy in a native-like manner.

A final remark can be made with regard to the findings of the present experiment which pose a challenge to the propositions of SSH. The results cast doubt on the assertions that L2 sentence processing is driven primarily by lexical and semantic information instead of syntactic (structure-based) information and that L2 processing is therefore necessarily less sensitive to structure-based processing strategies than L1 processing. Based on these assumptions, the L2 learners should have indicated no attachment preference as their processing decisions would be made randomly depending on the semantic information conveyed by the constituent of the sentences. This particular set of results, however, suggests that L1 and L2 processing are both guided by structure-based processing strategies/biases in the computation of abstract relationships among syntactic constituents and processing decisions can be made by relying on the hierarchically deep structural information.

CHAPTER VI

CONCLUSION

6.1. Introduction

This chapter presents the conclusions drawn from the study in order to give an overall interpretation of the findings of the experiments discussed in the previous sections. It also explains the implications of the study by highlighting some methodological issues that facilitate teaching in language classrooms. The chapter finally reports the recommendations for future research to be conducted on similar issues.

6.2. Conclusion

The aim of the four experiments reported in the present study was to acquire a better understanding of the nature of L2 online and offline processing by examining the attachment preferences of two groups of Turkish learners of English at different proficiency levels for two different syntactic ambiguities, namely, RC attachment ambiguities and PP attachment ambiguities. The studies were designed to identify possible differences between L1 and L2 processing and each experiment was meant to address the same broad research agenda with a slightly different perspective. As it is outlined in the previous sections, some interesting results were obtained regarding the nature of L1 and L2 sentence processing. In this respect, a striking finding concerned the issue of L1 transfer. This issue was examined in the offline and online experiments on RC attachment ambiguities, which provided some evidence in favor of cross-linguistic transfer in relation to processing strategies. The offline RC ambiguity resolution experiment indicated that Turkish and English RC attachment preferences differed by revealing a low attachment preference for native English speakers and a high attachment preference for Turkish participants in their first languages. Even though the same offline task fell short of detecting an attachment bias for the Turkish participants in the target language, English, the findings from a more sensitive online measure, the eye tracking task, indicated that the Turkish learners of L2 English tended to transfer the Turkish high attachment preference when processing English RC attachment ambiguities. 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 begin acquisition with L1 parsing procedures, 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, the details of which are elaborated in Chapter 2, 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 for the present study is that many researchers presuppose some cross-linguistic transfer in L2 learners, which is expected to lessen or disappear with the developing L2 proficiency. Interestingly enough, though, the L2 learners of the present study in intermediate and advanced level groups showed almost equally strong high attachment preference, which suggests that the observed transfer effects did not subside with the participant groups employed in this study. This particular finding brings up the discussion as to whether transfer is a mechanism inherent in L2 processing or whether L2 learners only resort to transfer when faced with specific processing difficulties as suggested by Frenck-Mestre (2005). In the light of the available data and the inconclusive findings from the research in the relevant literature, it seems more probable to argue that the processing difficulties that could stem from working memory capacity limitations or faulty access to grammatical representations might take effect and that L1 transfer effects might not be the characteristic feature of L2 processing.

Another interesting finding of the present study concerns the predictions of the Shallow Structure Hypothesis (SSH). Since the SSH maintains that L2 learners do not form deep syntactic representations, an overdependency on lexical, semantic and pragmatic information and an underspecification of syntactic representations are assumed. In this respect, the SSH anticipates no attachment preference for the L2 learners in the RC and PP attachment ambiguity experiments. This claim, however, was debunked by the results from online RC and offline and online PP attachment resolution tasks, in which the L2 learners showed statistically significant attachment preferences. While it is likely to explain part of the results by assuming a role for lexical, semantic, pragmatic or plausibility information, it is difficult to explain the entire pattern of results without appealing to the role of syntactic processing based on structure-based parsing biases in L2 sentence processing. When we consider that these biases can be interpreted to indicate rich syntactic processing, it seems that native speakers and L2 learners are

able to perform hierarchically deep and detailed syntactic processing of structures during real-time sentence comprehension. The realization of syntactic processing is highlighted by the general reading time patterns in the online tasks. For instance, both native speakers and L2 learners seemed to resolve temporary ambiguities with specifically aimed regressive eye fixations to the regions that were essentially relevant for recovering the accurate interpretation. To illustrate this pattern, the reading times of L2 learners from RC ambiguity resolution sentences in the online task can be taken into consideration. When the reflexive pronoun (or the animacy information) forced the attachment of the RC to the low NP (i.e., low attachment), there were elevated total reading times (which included fixations as a result of regression eye movements) at the critical region hosting the RC and at the default attachment site preferred by the L2 learners (i.e., the nonlocal high NP). Likewise, for the PP attachment sentences, when the preposition forced the attachment to the nonlocal high VP (i.e., high attachment), there were elevated total reading times at the region of PP and the preferred attachment site, the local VP. One can acknowledge that achieving this sort of effective reanalysis requires the formation and retention of structured representations of sentences in real time. It is necessary to emphasize that eye tracking seems to be the only measure that could yield such precise indications of analysis. For this reason, it is considered as the appropriate methodology that fits well into the investigation of real-time structural processing.

6.3. Implications of the Study

The results of the present study demonstrated that L2 learners rely on L1 processing strategies to process syntactic ambiguities in L2 and that in addition to addressing the lexical-semantic information conveyed in the L2 input, they are capable of making use of syntactic processing strategies based on structure-based parsing biases. Based on these results, it is necessary that second language instruction needs to focus on how learners perceive the L2 data. That is, any L2 language pedagogical intervention must take into account the processes L2 learners exploit to get linguistic data from the input they receive in the classroom setting. The identification of the certain strategies and biases that L2 learners utilize to process L2 input facilitates the development of instructional techniques that take advantage of these processing tendencies. In this respect, language instructors can refer to a pedagogical intervention such as processing

instruction (PI), which presents a model for a type of intervention taking into consideration the less-than-optimal processing strategies L2 learners may utilize and trains them to overcome those strategies by pushing them to rely more on native-like way of processing input (VanPatten, 2004, 2007).

Unlike the traditional ways of teaching grammar that depend on drill and mechanical practice, PI was developed by VanPatten as an alternative to teach grammar by aiming to alter the processing strategies of L2 learners to provide them with better form-meaning connections than they would develop on their own with positive evidence only. VanPatten (2004) considers the possibility that learners may begin acquisition with L1 strategies instead of using more locally-based strategies. This consideration is integrated into the PI model and utilized through the use of referential activities in which learners are given the opportunity to process the form in the input in a controlled situation. Within PI, the processing problem is dealt with by providing activities that manipulate input such that learners are literally forced to abandon their reliance on nonnative-like processing strategies. PI has three basic components. First, learners are provided with explicit information (EI) about how the target grammatical feature works, which is more like a grammatical rule explanation that can be found in any traditional grammar classroom. Second, learners are informed about a particular input processing strategy that may or may not affect their picking up of the form or structure during comprehension. As for the third component of PI, learners are given structured input activities which get them to alter any processing strategies they may be using to process input. Through structured input activities, input is manipulated in particular ways to force learners to become dependent on form or structure to get meaning, which might bring about better form-meaning connections compared to less controlled situations (Uludag & VanPatten, 2012).

Several studies have been carried out to test the efficiency of PI (e.g., VanPatten & Cadierno, 1993; VanPatten & Oikkenon, 1996; VanPatten & Wong, 2004, see Uludag, 2010 for a review). The results of the studies have shown that learners who received instruction through PI acquired the ability to process input better. Moreover, their developing L2 system is positively influenced in such a way that they could access the targeted linguistic features when producing output.

Even though several studies on language teaching pedagogy are needed to test the indirect suggestions of the present study, the findings can be used in a way that would guide the development of PI-based instructional techniques and designing structured

input activities to teach English grammar topics including but not limited to RC constructions, verb subcategorization, sentence sequences with PP attachments and ambiguity resolution in L2. However, it should be noted that PI can only be used as a means to supplement a communicative curriculum and thus it would only make up part of the input that learners receive. It should also be taken into consideration that incorporating PI into the teaching practices of language classrooms will depend on other methodological issues such as the learning objectives, needs, motivations and attitudes of L2 learners. Therefore, the extent to which PI can be a useful pedagogical intervention depends on the consideration of these multiple factors.

6.4. Limitations of the Study

As with any study, the present one is limited by the participants, location, and conditions under which the study was conducted. First of all, the participants in the present study were intermediate and advanced level learners enrolled in an academic English course at the same university. Apart from the various levels of exposure to English prior to the experimentation, the level of formal instruction in English that the participants received was similar. Therefore, this study cannot account for what effects L1 transfer might have on the L2 processing with learners coming from significantly different background and have a different amount of exposure to L2 English. Further research with more advanced learners on the one hand and less proficient learners on the other hand is necessary to examine how exactly L2 processing develops, whether learners make use of transfer from early on and whether it is possible for highly proficient learners to acquire native-like processing. A final issue regarding the limitations due to the participants is that the present study employed Turkish learners of L2 English to identify the attachment preferences in L1 Turkish. Since learning a second language might lead to certain cognitive changes in the human mind, using a bilingual participant group to identify L1 processing preferences might have influenced the acquired results. Therefore, further research should include monolingual Turkish learners with a research design using the materials of this study.

Secondly, the assumption underlying the use of online measures to investigate real-time sentence processing is that processing difficulties are reflected in increased reading times. However, this assumption might be problematic because reading times might be impacted by some external factors that could relate to distraction and fatigue felt during

data collection, or other issues concerning the age and gender of participants or time of testing. Although eye tracking methodology, a measure that is more exact and less susceptible to external factor, was used in the data collection and additional care was taken to minimize the effects, one cannot claim that the impacts of these external factors were fully avoided.

Finally, even though syntactic ambiguities are commonly addressed to explore processing mechanisms in general and the relationship between processing and mental grammar, they are comparatively rare in everyday language use and therefore it is extremely difficult to create sentences that sound fairly natural. The naturalness and plausibility of the test items used in the present experiment were judged by two native English speakers who did not participate in the study and necessary changes were applied in line with the offered suggestions. Still, the limitation that might have been caused by this issue must be acknowledged at this point. In order to avoid this problem, corpora can be used to identify the most common syntactic ambiguities and develop materials accordingly.

6.5. Recommendations for Future Research

The field of sentence processing has witnessed an increase in interest over the past few decades. This interest has been facilitated by the employment of recent experimental designs such as eye tracking, self-paced reading and ERPs and resulted in a substantial body of research along with the formulation of several theoretical sentence processing models. Even though the proposed models can account for much of the experimental data, 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. Given that some processing mechanisms are transferred from learners' first language to the second as it is suggested by the present results, more conclusive findings on general processing considerations would potentially help devise a compelling theory of L2 processing. Although the present study offers interesting insights into the mechanisms underlying the L2 processing, further research is necessary to test whether the obtained pattern of results would be replicated in other languages or other target structures than those that have been

investigated thus far. Besides, more findings on the processing decisions of other learner groups at various proficiency levels and in other learning settings are needed to have a better understanding of the development of L2 processing. It would be especially interesting to compare early and late bilinguals or learners in the ESL versus EFL environments. Another potentially revealing action that would help gain more insights into the time course of processing decisions would be to combine the reading time measurements with the other psycholinguistic methods such as event-related potentials or brain imaging techniques, which might provide correlating evidence on L2 processing procedures.

Another alternative route for future research is also that since the present study in part focused on the differences and similarities between L1 and L2 processing and regarding the extent L2 learners make use of L2-specific processing, the next step to take for analysis would be to examine the probable reasons for the observed differences or similarities. As the differences in processing preferences could be explained by the cognitive resource limitations or the lack of automaticity in processing, future research could also consider exploring working memory or automaticity as an independent construct.

Finally, since it is evinced that the processing performance of L2 learners is negatively influenced by the increased task demands, the effects of processing load on L2 learners can be compared to the native speakers' performance by manipulating the sentence length or increasing the time pressure through well-timed grammaticality judgement tests. This line of research could be revealing in the sense that a further understanding of the reasons for the reduced processing pace and processing accuracy in comparison to the performance of native speakers could offer essential pedagogical implications. Therefore, a better grasp of the processing mechanism could result in better instructional interventions as well as the development of measures differentiating between the optimal and nonoptimal L2 development.

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APPENDICES

Appendix 1. Experimental Items for Offline RC Attachment Ambiguity Resolution

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. tohum
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 makinenin 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

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 2. Experimental Items for Online RC Attachment Ambiguity Resolution

RC Ambiguity Resolution through Syntactic Information

High Attachment Forced

1. The uncle of the schoolgirl that prepared himself for the race was a great athlete.
2. The father of the bride that embarrassed himself at the wedding felt humiliated.
3. The son of the queen that devoted himself to the kingdom died very young.
4. The brother of the waitress that burned himself at the café was usually careless.
5. The husband of the woman that trained himself to cook surprised the family members.
6. The grandfather of the girl that hurt himself at home shocked the whole family.
7. The mother of the boy that complimented herself in public looked very elegant.
8. The wife of the man that bought herself acar caused financial trouble.
9. The daughter of the actor that introduced herself in the party was very popular.
10. The sister of the schoolboy that dressed herself nicely attracted much attention.
11. The aunt of the businessman that killed herself at home was in a lot of debt.
12. The grandmother of the groom that injured herself at the wedding worried the guests.

Low Attachment Forced

1. The father of the girl that taught herself advance mathematics felt very proud.
2. The son of the actress that fooled herself in front of cameras blushed with shame.
3. The husband of the woman that blamed herself for the breakup wanted a divorce.
4. The nephew of the maid that cut herself with the knife called the doctor.
5. The brother of the waitress that improved herself in business opened up a restaurant.
6. The boyfriend of the bridesmaid that undressed herself in public had too much alcohol.
7. The wife of the actor that shot himself on the set suffered from depression.
8. The daughter of the salesman that praised himself all the time was very rude.
9. The aunt of the schoolboy that found himself in trouble phoned the police.

10. The girlfriend of the waiter that criticized himself too often had no self-confidence.
11. The mistress of the man that enjoyed himself at the bar was very intelligent.
12. The daughter of the headmaster that hated himself for failing always seemed unhappy.



RC Ambiguity Resolution through Lexical-Semantic Information

Animacy Forced Condition: (A) High attachment forced (B) Low attachment forced

1. (A) The manager of the company that gave speeches on the radio became very famous.
(B) The company of the manager that gave speeches on the radio became very famous.

2. (A) The rector of the university that met with the Prime Minister appeared on television.
(B) The university of the rector that met with the Prime Minister appeared on television.

3. (A) The author of the book that wrote about human psychology impressed the readers.
(B) The book of the author that wrote about human psychology impressed the readers.

4. (A) The doctor of the hospital that believed in alternative medicine promoted herbal drugs.
(B) The hospital of the doctor that believed in alternative medicine promoted herbal drugs.

5. (A) The driver of the truck that had a deadly heart attack caused multiple accidents.
(B) The truck of the driver that had a deadly heart attack caused multiple accidents.

6. (A) The student of the class that developed new computer programs deserved the praise.
(B) The class of the student that developed new computer programs deserved the praise.

7. (A) The pilot of the plane that argued with angry passengers left the airport.
(B) The plane of the pilot that argued with angry passengers left the airport.
8. (A) The lady of the house that preferred luxurious life style hosted expensive parties.
(B) The house of the lady that preferred luxurious life style hosted expensive parties.
9. (A) The president of the country that learned to speak English welcomed foreign guests.
(B) The country of the president that learned to speak English welcomed foreign guests.
10. (A) The director of the movie that worked with rich producers attracted media attention.
(B) The movie of the director that worked with rich producers attracted media attention.
11. (A) The engineer of the project that worked day and night became finally successful.
(B) The project of the engineer that worked day and night became finally successful.
12. (A) The professor of the seminar that always asked difficult questions required much reading.
(B) The seminar of the professor that always asked difficult questions required much reading.

Inanimacy Forced Condition: (A) High attachment forced (B) Low attachment forced

1. (A) The house of the architect that cost millions in the auction looked very impressive.
(B) The architect of the house that cost millions in the auction looked very impressive.
2. (A) The song of the singer that became worldwide famous blockbuster inspired many people.
(B) The singer of the song that became worldwide famous blockbuster inspired many people.
3. (A) The study of the professor that involved many detailed experiments offered new results.
(B) The professor of the study that involved many detailed experiments offered new results.
4. (A) The farmer of the land that sold avocados in the market encouraged organic farming.
(B) The land of the farmer that sold avocados in the market encouraged organic farming.
5. (A) The trip of the guide that lasted hours in the city center disappointed the tourists.
(B) The guide of the trip that lasted hours in the city center disappointed the tourists.
6. (A) The restaurant of the chef that had a beautiful Bosphorus view satisfied the customers.
(B) The chef of the restaurant that had a beautiful Bosphorus view satisfied the customers.

7. (A) The picture of the painter that cost one million dollars received heavy criticism.
(B) The painter of the picture that cost one million dollars received heavy criticism.
8. (A) The club of the player that invested in younger talents promised ultimate success.
(B) The player of the club that invested in younger talents promised ultimate success.
9. (A) The invention of the scientist that resulted from hard work changed drug industry.
(B) The scientist of the invention that resulted from hard work changed drug industry.
10. (A) The newspaper of the journalist that included the job adverts helped the unemployed.
(B) The journalist of the newspaper that included the job adverts helped the unemployed.
11. (A) The show of the comedian that ended late at night entertained the viewers.
(B) The comedian of the show that ended late at night entertained the viewers
12. (A) The ship of the captain that carried valuable electronic products escaped the storm.
(B) The captain of the ship that carried valuable electronic products escaped the storm.

Appendix 3. Experimental Items for Offline PP Attachment Ambiguity Resolution

Globally Ambiguous Test Items:

Instruction: The following sentences are ambiguous, which means that they have two possible interpretations, depending on how you interpret them. Please read the sentences carefully and decide which of the two interpretations you prefer (which is easier for you to understand or which sounds more natural).

1. Jack received the camera that he had bought from Mary.
 - a) Jack bought the camera from Mary.
 - b) Jack received the camera from Mary.
2. Margaret hid the money that she had borrowed from her friend.
 - a) Margaret hid the money from her friend.
 - b) Margaret borrowed the money from her friend.
3. Laura sent the report that she had shown to Richard.
 - a) Laura sent the report to Richard.
 - b) Laura showed the report to Richard.
4. Linda recommended the laptop that she had sold to John.
 - a) Linda recommended the laptop to John.
 - b) Linda sold the laptop to John.
5. James copied the notes that he had kept from Julia.
 - a) James copied the notes from Julia.
 - b) James kept the notes from Julia.
6. Mike wanted the present that he had expected from his father.
 - a) Mike wanted the present from his father.
 - b) Mike expected the present from his father.

7. Sarah demanded the cookies that she had ordered for her students.
 - a) Sarah demanded the cookies for her students.
 - b) Sarah ordered the cookies for her students.

8. Kevin offered the pizza that he had brought to Jason.
 - a) Kevin offered the pizza to Jason.
 - b) Kevin brought the pizza to Jason.

9. Anthony mailed the letter that he had written to Carol.
 - a) Anthony wrote the letter to Carol.
 - b) Anthony mailed the letter to Carol.

10. Steven delivered the bags that he had transferred to Maria.
 - a) Steven delivered the bags to Maria.
 - b) Steven transferred the bags to Maria.

11. Jennifer passed the newspaper that he had read to her father.
 - a) Jennifer passed the newspaper to her father.
 - b) Jennifer read the newspaper to her father.

12. Karen announced the duties that she had assigned to her employees.
 - a) Karen assigned the duties to her employees.
 - b) Karen announced the duties to her employees.

Appendix 4. Experimental Items for Online PP Attachment Ambiguity Resolution

High Attachment Forced

1. Julia sold the book that she had hidden to her friend yesterday.
2. John offered the CD that he had bought to his children yesterday.
3. Carrie handed the money that she had borrowed to her father yesterday.
4. Mary sent the letter that she had prepared to her mother yesterday.
5. Janet hid the present that she had promised from her friend yesterday.
6. Mike took the prize that he had won to the bank yesterday.
7. Mary passed the papers that she had received to her boss yesterday.
8. Laura served the cake that she had baked to her cousin yesterday.
9. Jacob built the tent that he had showed for his wife yesterday.
10. Sarah lent the money that she had saved to her brother yesterday.
11. Rachel gave the food that she had cooked to the homeless yesterday.
12. Martin told the secret that he had heard to his friend yesterday.

Low Attachment Forced

1. Martin told the secret that he had heard from his friend yesterday.
2. Mike took the prize that he had won from the bank yesterday.
3. Janet hid the present that she had promised to her friend yesterday.
4. Tom responded the letter that he had expected from his friend yesterday.
5. Lily offered the CD that she had bought from her cousin yesterday.
6. Carrie handed the money that she had borrowed from her father yesterday.
7. Mary passed the papers that she had received from her boss yesterday.
8. Ashley sold the necklace that she had hidden from her husband yesterday.
9. Laura served the cake that she had baked for her cousin yesterday.
10. Jacob built the tent that he had shown to his wife yesterday.
11. Sarah lent the money that she had saved for her brother yesterday.
12. Rachel received the book that she had lent to his friend yesterday.

Appendix 5. Filler Items for Offline RC Attachment Ambiguity Resolution

1. Çocuğa alınan oyuncaklara babası çok para ödedi.
 - Çok para ödeyen kimdir?
 - a. çocuk b. baba
2. Misafire yapılan keki çocuklar gizlice yedi.
 - Keki kim yedi?
 - a. misafir b. çocuklar
3. Öğrencilere verilen ödev velileri çok rahatsız etti.
 - Rahatsız olan kimdir?
 - a. öğrenciler b. veliler
4. Bankanın reklamı izleyicileri çok başarılı bulundu.
 - Başarılı bulunan nedir?
 - a. reklam b. banka
5. Takımın eğitmeni oyunculara büyük ceza verdi.
 - Ceza alan kimdir?
 - a. oyuncular b. eğitmen
6. Yazarın makaleleri gazetede ki yarışmada birinci oldu.
 - Birinci olan nedir?
 - a. makale b. gazete
7. Yönetmenin sekreteri patrona yol gösterdi.
 - Yol gösteren kimdir?
 - a. yönetmen b. sekreter
8. Yöneticinin kararları kiracıların huzurunu kaçırdı.
 - Huzuru kaçan kimdir?
 - a. yönetici b. kiracılar

9. Kararları alan müdür işçiler tarafından sorgulandı.

- Sorgulanan kimdir?
 - a. işçiler
 - b. müdür

10. Parlak renklere sahip odanın perdeleri görenleri hayran bıraktı.

- Parlak renklere sahip olan nedir?
 - a. oda
 - b. perdeler

11. Sergideki heykel katılımcıların beğenisini topladı.

- Beğenilen nedir?
 - a. sergi
 - b. heykel

12. Adamın çocukları kavgadan sonra evi terk etti.

- Evi terk eden kimdir?
 - a. çocuklar
 - b. adam

13. Yağan kar yoldaki işaretlerin kapanmasına sebep oldu.

- Kapanan nedir?
 - c. yol
 - b. işaretler

14. Bakımı yapılan havaalanı uçakların kullanımına müsait.

- Kullanıma müsait olan nedir?
 - c. uçaklar
 - b. havaalanı

15. Ameliyat olan arkadaşım patronun düğününe katıldı.

- Düğüne katılan kimdir?
 - a. patron
 - b. arkadaş

16. Editöre gönderilen mektup postanedeki torbalarda kayboldu.

- Kaybolan nedir?
 - a. torbalar
 - b. mektup

17. Caddeye giden yol fırtınada yıkılan ağaç yüzünden kapanmış.

- Kapanan nedir?

- a. yol b. cadde

18. Televizyonda yayınlanan film kitabın başarısını gölgede bıraktı.

- Başarısı gölgede kalan nedir?

- a. film b. kitap

19. Doktorun açıklamaları hasta yakınlarını memnun etti.

- Açıklama kimi memnun etti?

- a. hastayı b. yakınlarını

20. Tehdit edilen memur patronun tavrından memnun olmadı.

- Memnun olmayan kimdir?

- a. memur b. patron

21. Soruya verilen cevap profesörü memnun etmedi.

- Memnun etmeyen nedir?

- a. cevap b. Soru

22. Yemeklerden şikayet eden işçiler aşçıya memnuniyetsizliklerini belirttiler.

- Memnuniyetsiz olan kimdir?

- a. aşçı b. işçiler

23. Okulun yanındaki mağaza yangın sebebiyle boşaltıldı.

- Boşaltılan neresidir?

- a. mağaza b. okul

24. Maaşını alan adam kızını ziyarette kalp krizi geçirdi.

- Kalp krizi geçiren kimdir?

- b. adam b. kızı

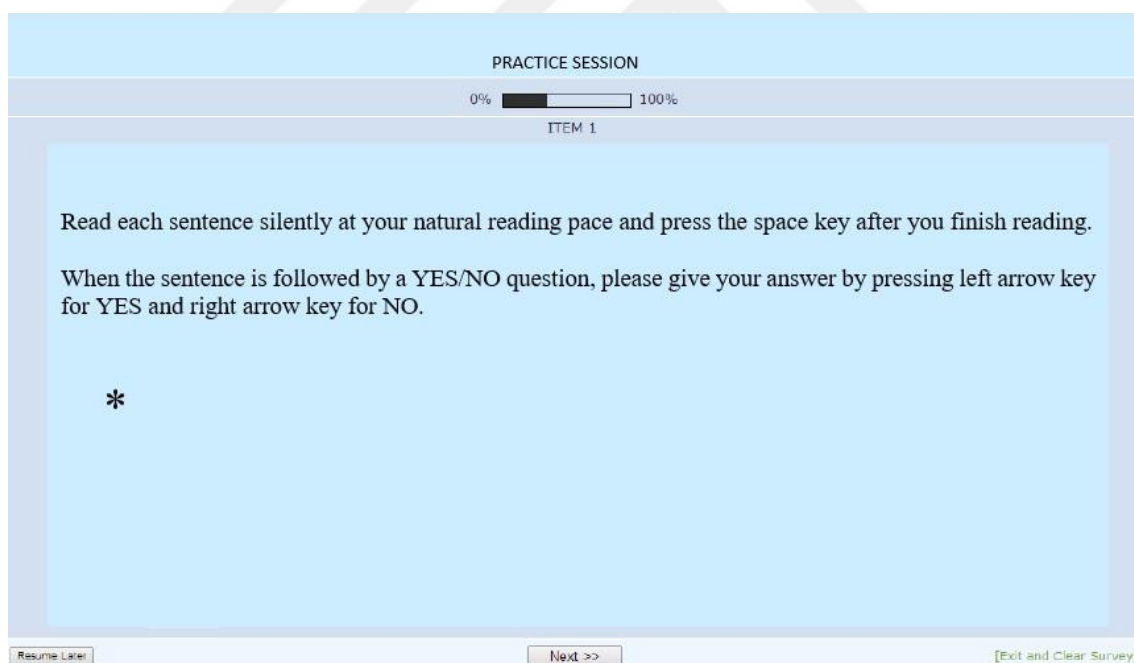
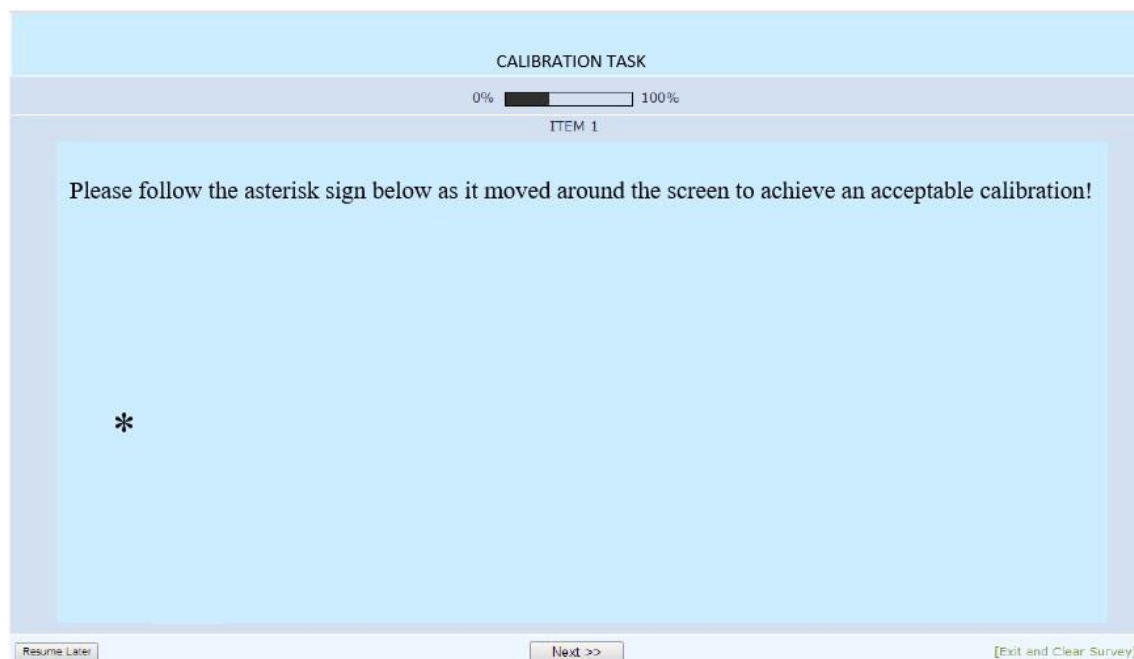
Appendix 6. Filler Items for Online RC Attachment Ambiguity Resolution

1. The car of the waitress that enjoyed herself at the bar was stolen.
2. The book of the author inspired the man that prepared the plan.
3. The job of the woman that admired herself required hard work.
4. The campus of the university welcomed students that came from Europe.
5. The task of the policeman that put himself in danger scared everybody.
6. The clinic of the doctor attracted customers that wanted hair implant.
7. The results of the student that expected herself to pass disappointed the teachers.
8. The question of the reporter annoyed the actor that made a new movie.
9. The office of the man that ordered himself a pizza smelled terrible.
10. The decision of the manager upset the workers that expected pay rise.
11. The news of the robber that reported himself to the police was very surprising.
12. The success of the student encouraged his friends that admired him.
13. The tweet of the politician gave hope to the supporters that waited the results.
14. The behaviors of the girl that wrote herself a postcard made her friends laugh.
15. The medicine of the patient was served by the nurse that stayed late at work.
16. The command of the general that considered himself smart proved useless.
17. The suggestions of the guide disappointed the tourists that paid for the tour.
18. The idea of the director that excused herself from the meeting was brilliant.
19. The lawyer of the thief convinced the jury that attended the case.
20. The clothes of the girl that admired herself in the mirror looked funny.
21. The editor of the magazine pleased the readers that expected a discount.
22. The interview of the minister who criticized himself irritated the president.
23. The driver of the bus annoyed the passengers that waited for a stopover.
24. The scandal of the man who bankrupt himself in the casino shocked his family.

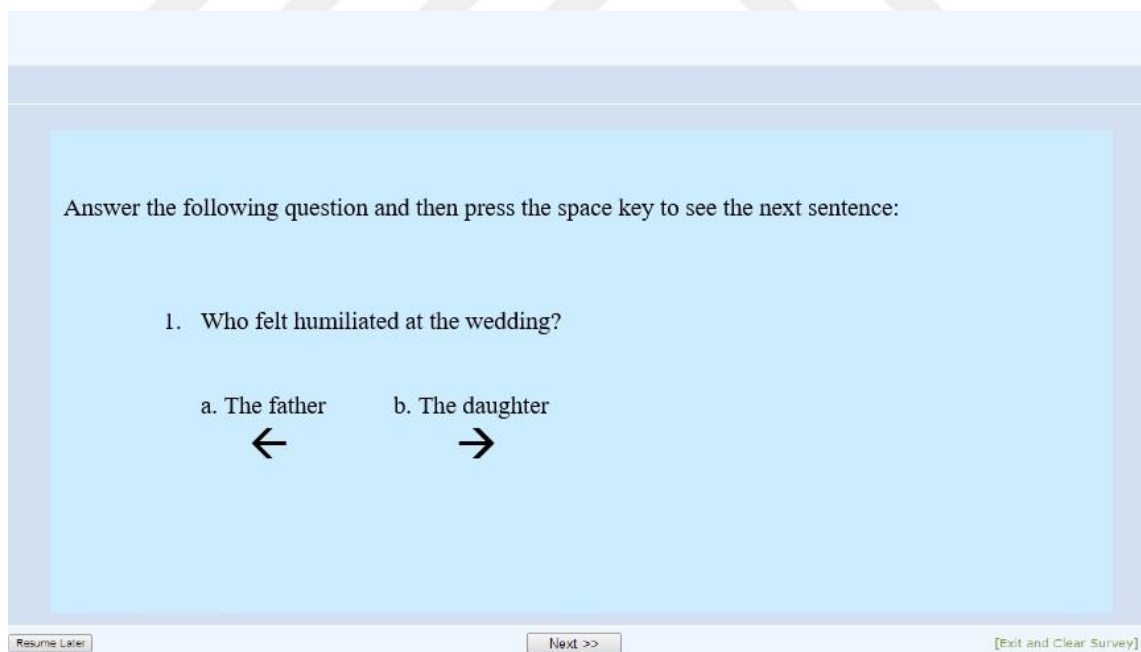
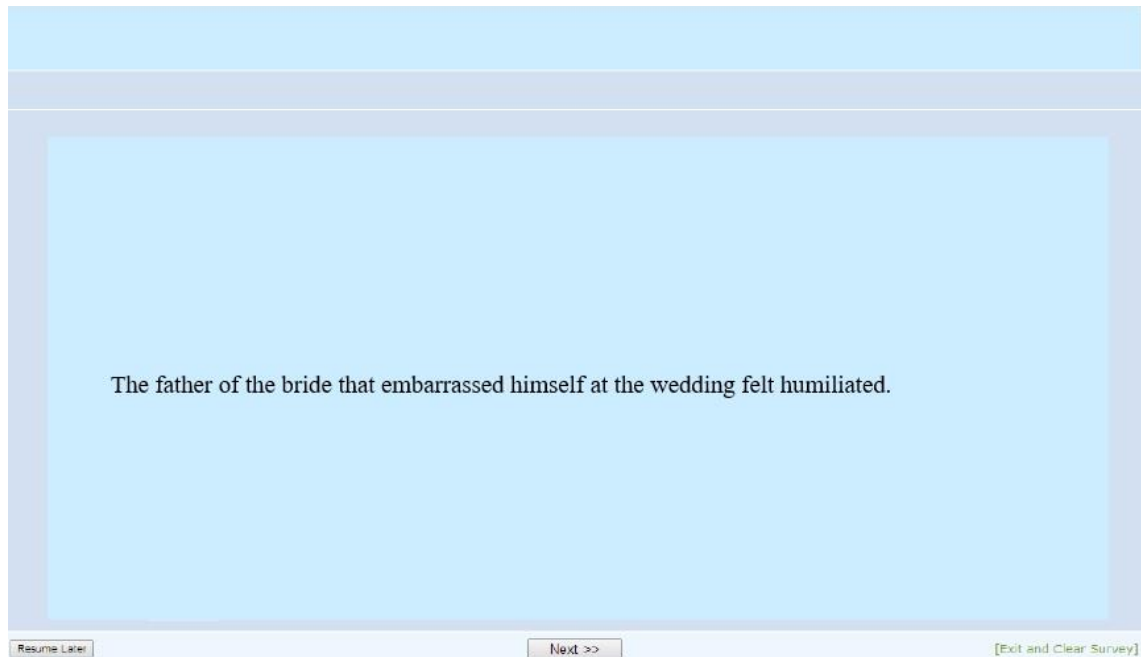
Appendix 7. Filler Items for PP Attachment Ambiguity Resolution

1. Lucas played the music in the ceremony that his girlfriend had filmed.
2. Lindsey had the surgery at the hospital that her cousin had suggested.
3. Jerry introduced the product in the company that his partner had contacted.
4. Marry bought the shoes from the store that her mother had seen.
5. Thomas sent the papers to the magazine that his friend had read.
6. Allison spent the money on the dress that her brother had liked.
7. Arthur cut the tree in the garden that his grandfather had mown.
8. Amber sold the ring in the auction that her friend had organized.
9. Betty started the business in the shop that her parents had financed.
10. Harry considered the offer in the meeting that his boss had held.
11. Miranda served the cake at the party that her mother had attended.
12. Kevin added the player in the team that his boss had sponsored.
13. Fernando described the plan for the tour that his uncle had arranged.
14. Cindy corrected the mistakes in the exam that her colleague prepared.

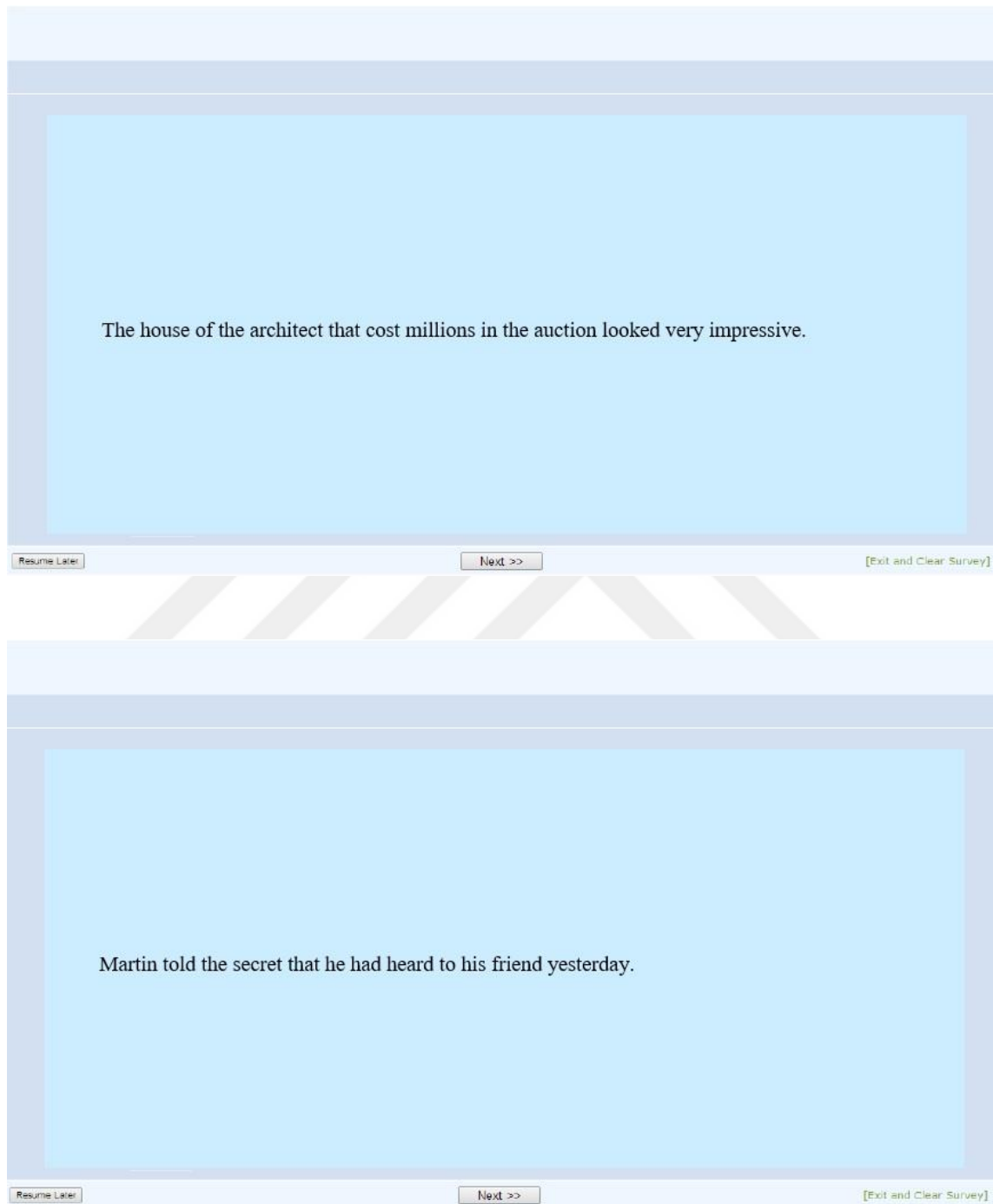
Appendix 8. Screen Shots from the Calibration Task and Practice Session



Appendix 9. Screen Shots from the Trial (Condition 1 in RC attachment ambiguities) and Follow-up Questions



Appendix 10. Screen Shots from the Trials (Condition 2 in RC attachment ambiguities & PP attachment ambiguities)



ÖZGEÇMİŞ

1. **Adı Soyadı** : Onur ULUDAĞ
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Derece	Alan	Üniversite	Yıl
Lisans	İngilizce Öğretmenliği	Çukurova Üniversitesi	2008
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Doktora	İngiliz Dili Eğitimi	Çukurova Üniversitesi	2018

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Görev Unvanı	Alan	Üniversite	Yıl
Okutman	Classical and Modern Languages Department	Texas Tech University	2008 - 2010
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Öğretim Görevlisi	İngiliz Dili Eğitimi	Yıldız Teknik Üniversitesi	2013 -

8. Yayınlar

8.1. Uluslararası hakemli dergilerde yayınlanan makaleler (SCI, SSCI, Arts and Humanities)

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9. Uluslararası ve Ulusal Bilimsel Toplantılarda Sunulan Bildiriler

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10. İdari Görevler

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