



Hacettepe University Institute of Social Sciences

Department of English Linguistics

**AN EYE-TRACKING INVESTIGATION OF ATTACHMENT
PREFERENCES TO RELATIVE CLAUSES IN TURKISH**

CENGİZ TURAN

Ph.D. Dissertation

Ankara, 2018

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KABUL VE ONAY

Cengiz Turan tarafından hazırlanan "An Eye-Tracking Investigation of Attachment Preferences to Relative Clauses in Turkish" başlıklı bu çalışma, 05.06.2018 tarihinde yapılan savunma sınavı sonucunda başarılı bulunarak jürimiz tarafından Doktora Tezi olarak kabul edilmiştir.


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Yukarıdaki imzaların adı geçen öğretim üyelerine ait olduğunu onaylarım.

Prof. Dr. Musa Yaşar SAĞLAM

Enstitü Müdürü

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o Serbest Seçenek/Yazarın Seçimi

20 / 06 / 2018
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Cengiz Turan

ETİK BEYAN

Bu çalışmadaki bütün bilgi ve belgeleri akademik kurallar çerçevesinde elde ettiğimi, görsel, işitsel ve yazılı tüm bilgi ve sonuçları bilimsel ahlak kurallarına uygun olarak sunduğumu, kullandığım verilerde herhangi bir tahrifat yapmadığımı, yararlandığım kaynaklara bilimsel normlara uygun olarak atıfta bulunduğumu, tezimin kaynak gösterilen durumlar dışında özgün olduğunu, Doç. Dr. Emine YARAR danışmanlığında tarafımdan üretildiğini ve Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü Tez Yazım Yönergesine göre yazıldığını beyan ederim.


Cengiz Turan

ACKNOWLEDGEMENT

During my time in Hacettepe University and in the process of writing this thesis, there have been a number of influential people I am grateful to and I feel obliged to thank. As my advisor, Assoc. Prof. Dr. Emine Yarar has edited my thesis from top to toe and helped me improve it with her insights and guidance; thus, it is not possible to thank her enough. I hereby want to thank Prof. Dr. Özgür Aydın and Prof. Dr. Işıl Özyıldırım, who helped me make changes and shared their expertise on the field during our thesis monitoring boards. Many thanks are also reserved for jury members of my thesis defense: Prof. Dr. S. Nalan Büyükkantarcıoğlu and Assoc. Prof. Dr. Çiler Hatipoğlu. With their insights, final improvements to our thesis were made possible.

Asst. Prof. Dr. Duygu İ. AKÇAYOĞLU is the director of School of Foreign Languages. She has always been so kind and tolerant to let me take days off and go to Ankara for meetings with my advisor. Also, I wish to express my sincere gratitude to Fatih Havaioğlu and Şerife Kalaycı, who contributed a lot by proofreading this thesis.

I would like to thank all my family. They always supported and encouraged me with their unconditional love and best wishes. If only my deceased father, Halit Turan, could be with me today and share my happiness. Finally, many special thanks are reserved for my wife Fatma Turan, who has never stopped supporting me during this time. Without her help, this thesis would not be possible.

[Yazarın SOYADI, Adı]. [*Tezin/Raporun Adı*], [Tezin/Raporun Türü], Ankara, [Yılı].

ÖZET

Turan, Cengiz. *Türkçede Ortaç Yapılarına Yönelik Ekleme Tercihlerinin Göz İzleme Tekniğiyle İncelenmesi*, Doktora Tezi, Ankara, 2018.

Bu çalışmada Türkçedeki ortaç yapılarına ilişkin ekleme tercihlerinin işlenmesi göz-izleme tekniği ve kavrama soruları ile çözümlenmiştir. Ayrıca çalışmada ortaç türlerinin (özne ortaçları ve nesne ortaçları) ekleme tercihleri (yüksek, düşük ve belirsizlik içeren düşük) üzerindeki olası etkileri ve ortaç bakışsızlığının söz konusu olup olmadığı incelenmiştir. Çalışmada toplam altmış katılımcıdan elde edilen veriler kullanılmıştır. Çalışmada iki ortaç ve üç ekleme türüne (yüksek - düşük - belirsizlik içeren düşük) göre geliştirilen kırk iki tümce göz izleme tekniği kullanılarak incelenmiştir. Bu tümcelerin yanı sıra kırk iki adet dolgu tümce deneklerin çalışmada incelenen yapıları tanımasını önlemek amacıyla kullanılmıştır. Kolmogorow Smirnow testi sonuçları toplanan verilerin normal dağılım sergilediğini göstermiştir. Bu nedenle verilerin çözümlenmesinde ikili karşılaştırmalar için bağımsız t-testi, üçlü karşılaştırmalar için ise ANOVA (Varyans Analizi) testi kullanılmıştır. Çalışmada elde edilen bulgular yüksek ve düşük ekleme türleri arasında bazı farklar olduğunu göstermektedir. Yüksek ekleme şeklinin düşük ekleme ile karşılaştırıldığında istatistiksel olarak anlamlı olmasa da kısmen daha az bilişsel yük oluşturduğu görülmüştür. Ancak yüksek ekleme tümcelerinin ortaç sonrasında gelen ikinci ad öbeğinde daha istatistiki olarak daha yüksek okuma sürelerine sahip olduğu gözlemlenmiştir. Bu da ayrıştırıcının ilk işlemede dahi verilen tümcenin anlamsal özelliklerine duyarlı olduğunu göstermektedir. Ayrıca ana eylemin işlenmesi yüksek ve düşük ekleme türlerinde istatistiksel olarak anlamlı farklılıklara neden olmaktadır. Düşük ekleme türündeki tümcelerde ana eylemin işlenmesi için harcanan sürenin istatistiki olarak daha uzun olduğu görülmüştür. Bu bulgu söz konusu tümcelerde üstü kapalı da olsa anlam belirsizliğine yol açmaktadır. Belirsizlik içeren yüksek ekleme türündeki tümcelerde ayrıştırıcının belirsizliği ortadan kaldırmada birincil yolu ana eylemin temel üye yapısını kullanmaktır. Ana eylem tümce ayrıştırmada yanlış işareti olarak işlev görmekte ve ayrıştırıcının sözdizimsel tercihlerini düzenlemesine yardımcı olmaktadır. Ayrıca ortaç içeren bölüme ilişkin okuma zamanları tüm ekleme türlerinde nesne ortaçları içeren tümcelerde özne ortaçları içeren tümcelere oranla daha yüksektir. Ancak bu fark istatistiksel açıdan anlamlı değildir. Diğer yandan tümcelerin bütünü göz önüne alındığında ise katılımcıların nesne ortacı tümcelerini istatistiksel açıdan daha anlamlı olarak daha uzun sürelerde okudukları görülmüştür. Tek başına incelendiklerinde ise, ayrıştırıcı için istatistiki olarak anlamlı bir şekilde özne ortaçlarının daha kolay işlendiği gözlemlenmiştir. Bunun nedeni baş adının ve çıkarma alanı arasındaki yapısal mesafenin nesne ortaçlarında daha fazla olmasıdır. Ayrıca, Türkçenin dilbilimsel bir özelliği olarak nesne ortaçları kişi ekleri ve dolayısıyla uyum ekleri içermektedir ve bunlar da fazladan işleme yüküne

neden olmaktadır. Kavrama sorularına verilen cevaplar incelendiğinde elde edilen sonuçlar göz izleme tekniği kullanılarak elde edilen bulguları doğrular niteliktedir. Yüksek ekleme türündeki tümcelerden sonra gelen kavrama sorularına verilen cevaplar istatistiksel olarak en yüksek doğruluk oranına sahiptir. Belirsizlik içeren tümceler için sorulan soruların ise en düşük seviyede doğru cevaplanmıştır. Özne ortaçlarına sahip tümcelerden sonra gelen kavrama sorularına verilen cevaplar ise Nesne ortaçlarına sahip tümcelerden istatistiki olarak daha yüksektir. Ayırıştırıcı için erken işlemede sözdizimsel işlemler ağır basar ancak anlam karmaşası olduğu durumlarda ana eylemin taşıdığı sözlüksel-anlambilimsel bilgi öne geçer. Yüksek ekleme tümceleri düşük ekleme tümcelerine kıyasla daha kısa sürelerde işlenir. Bu yüzden Türkçenin bir yüksek ekleme dili olduğu öne sürülebilir. Okuma zamanları göz önüne alındığında, düşük ekleme tümcelerinde sınırlı bir anlam karmaşası olduğu söylenebilir. Son olarak nesne ortaçlarının bilişsel yükü tüm ekleme türlerine ait tümcelerde özne ortaçlarından daha yüksektir. Ekleme türlerine bakmaksızın, nesne ortacı bakışsızlığı Yapısal Uzaklık Varsayımı (O'Grady, 2003)'da ortaya konduğu gibi tüm tümce türlerinde gözlemlenmektedir.

Anahtar Sözcükler

Ortaç yantümceleri, özne ortaçları, nesne ortaçları, ekleme tercihleri, yüksek ve düşük ekleme, yanlış yorumlama, yapısal ve doğrusal aralık, belirsizlik çözümü, bilişsel yük

ABSTRACT

TURAN, Cengiz. *An Eye-Tracking Investigation of Attachment Preferences to Relative Clauses in Turkish*, PhD Dissertation, Ankara, 2018.

In this study, the processing of attachment preferences to relative clauses (RC) in Turkish was analyzed through an eye-tracking technique and comprehension questions presented following each experimental sentence. Within this general framework, the possible effects of the RC types (subject - object) on the processing of attachment types (low – high – high with ambiguity) and whether there was any RC asymmetry were examined. The data obtained from a total of sixty participants were analyzed in the study. Forty-two experimental sentences were developed based on two RC types and three attachment types as low, high and high with ambiguity. Therefore, in the study six conditions were tested along with forty-two filler sentences which were employed to distract the participants' attention away from the investigated structures. The Kolmogorow Smirnow test showed that the data exhibited a normal distribution. For two-way comparisons, an independent t-test was used and for three-way comparisons, the ANOVA (Analysis Of Variance) was employed. Certain differences between the two attachment types were observed. General direction of processing seemed to be that the High Attachment configuration caused slightly less cognitive load than the Low Attachment. However, the High Attachment sentences exhibited statistically significant longer reading durations on NP2 (the second noun phrase following the RC area). Therefore, it was assumed that the parser was sensitive to lexical/semantic properties of the incoming words of the given sentences during the initial processing. The processing of the main verb was another point of divergence. Significantly longer fixation durations on main verbs were observed in Low Attachment sentences, which also suggest that they included an implicit ambiguity. It was revealed that the main strategy of the parser to repair an ambiguity in High Attachment sentences was using the argument structure of the main verb. It acted as an error signal prompting the parser to adjust its syntactic preferences. It was found out that for all attachment types, on the RC Area of Interest (AoI) the object RCs are read with longer durations. However, statistically significant differences were not found. Considering the whole sentences, on the other hand, statistically significant results were found where participants spent longer durations for the processing of the object RCs. When analyzed alone, the subject RCs was comparatively easier for the parser to process than the object RCs. This is attributed to longer structural distance between the head noun and the extraction site besides linguistic-specific properties of Turkish in which the ORCs were inflected for person agreement, which caused extra processing load. Regarding the answers to the comprehension questions, the data complements the findings from online processing. The answers to the comprehension questions following High Attachment sentences had statistically the highest accuracy level. On the other hand, the comprehension questions

following the High Attachment with Ambiguity sentences had statistically the lowest accuracy rate. Considering the answers to the comprehension questions concerning the subject and object RC sentences, it was observed that the comprehension questions concerning the subject RC sentences were statistically answered more successfully. It is suggested that For Turkish parser, the early processing is dominated by syntactic operations. However, it is overridden by lexical-semantic information of the main verb when it is led into a Garden-path situation. High Attachment sentences take the parser shorter to process compared to the Low Attachment sentences. Therefore, it is suggested that Turkish is a High Attachment language. Considering the reading times, Low Attachment sentences also include a local ambiguity as in High Attachment with Ambiguity. Finally, Cognitive load of ORCs is heavier than SRCs in all attachment types except for RC AoI. ORC asymmetry is also observed across all the experimental items regardless of attachment types, which is predicted by Structural Distance Hypothesis (SDH) (O'Grady, 2003).

Key words

Relative clauses, subject relative clauses, object relative clauses, attachment preferences, high and low attachment, garden-path, structural and linear distance, ambiguity resolution, cognitive load

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LIST OF ABBREVIATIONS

1 st SG	First person Singular
3 rd SG	Third person Singular
ABL	Ablative case
ACC	Accusative case
ADVP	Adverb Phrase
ANOVA	Analysis Of Variance
AoI	Area of Interest
CP	Complementizer Phrase
CPPM	Current Partial Phrase Marker
D	Determiner
DAT	Dative case
DCFH	Discourse Context Function Hypothesis
DECL	Declarative
DLT	Dependency Locality Theory
DP	Determiner Phrase
<i>e</i>	Empty
ERG	Ergative Case
ERPs	Event-Related Potentials
FF	First Fixation (Duration)
fMRI	Functional Magnetic Resonance Imaging
fNIRS	Functional Near-Infrared Spectroscopy
GDP	Grammar Dependency Principle
GEN	Genitive Case
GER	Gerund

GP	Genitive Possessive Construction
High A.	High Attachment
Hz	Hertz
<i>i</i>	Index
L1	First Language (Mother Tongue)
LDH	Linear Distance Hypothesis
LOC	Locative case
Low A.	Low Attachment
MEG	Magnetoencephalography
MS	Microsoft
MV	Main Verb
N	Noun
NOM	Nominative Case
NP	Noun Phrase
NPAH	Noun Phrase Accessibility Hierarchy
NSPART	Non-Subject Participle
O	Object
OPART	Object Participle
ORC	Object Relative Clause
PART	Participle
PAST	Past Tense
PC	Possessive Compound
PET	Positron Emission Tomography
PFG	Possessive-free Genitive Construction
PL	Plural
POSS	Possessive

PP	Prepositional Phrase
PROG	Progressive
RC	Relative Clause
S	Sentence
SDH	Structural Distance Hypothesis
SG	SGular
Sig	Significance
SO	Spillover
SPART	Subject Participle
SPSS	Statistical Package for the Social Sciences
SRC	Subject Relative Clause
Std.	Standard
TF	Total Fixation (Duration)
TFT	Thin-Film-Transistor
V	Verb
VP	Verb Phrase
w/A.	with Ambiguity

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CHAPTER 1

INTRODUCTION

1.1. BACKGROUND

Psycholinguistics is a field of linguistics that primarily investigates psychological factors in (whether first or second) language acquisition, use, processing and production (Pickering, Clifton, and Crocker 2000). Although the history of psycholinguistics is a long one, it is usually traced back to one of the leading figures in psychology from Leipzig, Germany: Wilhelm Wundt, who claimed that psychological principles possess the capacity to explain linguistic processes (Blumenthal, 1987). Influenced by Wundt's principles, a new approach to linguistic studies was developed by Young Grammarians (Junggrammatiker) including Bloomfield, Mead, Saussure and Boas who contributed further to the field of psycholinguistics. Blumenthal (1987) also mentions Johann Herbart, philosopher-psycholinguist, as another figure of German academic community of the 19th century. Following a formalistic and mechanistic system of thought, Herbart suggested a cognitive psychology that is formed with a theory of mental associations. He proposed principles of accommodation, assimilation, fusion and other patternings that are used to explain dynamic mental schemata. Herbart's psychological concepts are observed in considerable figures such as Piaget and more noticeably in Hermann Paul (1880, cited in Blumenthal, 1987). In a more modern sense, psycholinguistic studies are traced to a conference held at Cornell University, and Osgood and Sebeok's (1965) book that described this conference. Their use of the term psycholinguistics is considered to be the milestone in embracing

psychological methods and theories with linguistic concentration. In addition, their book is regarded as a crucial attempt to “reunite” linguistics and psychology (Garnham, Garrod and Sanford, 2006). The researchers state that despite the background of consecutive endeavors to fuse psychology and linguistics, it was not until mid-to late 1960s that studies in Psycholinguistics as accepted today initiated. The advent and efficiency of psycholinguistics were harshly criticized by Reber (1987), who stated that the Wundian ideas to psychology and language such as introspectionism, empiricism, laboratory-based Structuralism were presented to the linguistic circles in the USA. On the other hand, rationalism, non-laboratory-based *Volkerpsychologie* within the same program were neglected. For Reber (1987), the short life of psycholinguistics could also be attributed to the behaviorists’ use of the Wundian approach. Five factors, according to Reber (1987: 326-339), are identified for the demise of psycholinguistics:

1. Exceptionally firm version of nativism
2. Withdrawal of psycholinguistics from mainstream psychology
3. Inclination for a formal theory and rather than empirical data
4. Hasty alterations to Standard Theory in linguistics
5. Lack of dedication to functionalism, which in the core of experimental psychology.

Despite the negative claims of the separation between linguistics and psychology, the approach to psycholinguistics today is consolidated as theoretical, and applicational trends in psychology and linguistics are interwoven.

Sentence processing is one of these study topics in psycholinguistics. The field of sentence processing, as suggested by Papadopoulo (2006: 2), investigates the following central issues:

1. The architecture of the parser
2. Tendencies of the parser to process the structural analysis of the sentence
3. The existence of a clear-cut syntactic parser
4. The role of non-grammatical factors in sentence comprehension
5. Universality of human processor

Studies on sentence processing analyze strictly controlled language properties (human or non-human host nouns, differing length and frequency of host nouns, prepositions in complex NPs, methods of disambiguation, preferentiality of hosts, number of nouns in complex NPs and so forth) through empirical methods to outline the mechanisms behind the language processing and reach conclusions about them (e.g., Traxler, Morris, and Seely, 2002; Traxler, Williams, Blozis and Morris, 2005; Just and Carpenter, 1992). Main trends in sentence processing have been to argue whether or not the human parser is universal (Abney, 1989; Crocker, 1996; Frazier, 1978, 1985, 1987; Frazier and Clifton, 1996, 1997; Frazier and Fodor, 1978; Frazier and Rayner, 1982; Philips, 1996; Weinberg, 2001) or parameterized (Bates and MacWhinney, 1982, 1987; Gibson et al., 1996; Gibson et al., 1999; Hemforth et al., 1998; MacWhinney, 1987, 1997; MacWhinney and Bates, 1989; Mazuka and Lust, 1990) and whether attachment preferences and methods of disambiguation are frequency-based or language-specific (MacDonald, 1993, 1994, 1997; MacDonald et al., 1994a, 1994b; Mitchell et al., 1995;

Spivey-Knowlton et al., 1993; Spivey-Knowlton and Tanenhaus, 1994; Taraban and McClelland, 1990; Thornton et al., 1998; Thornton et al., 1999; Trueswell and Tanenhaus, 1994; Trueswell et al., 1994).

With the technological advances in data collection tools, a number of online and offline techniques have been developed to investigate the insights about the parser's sentence processing such as Neuroimaging Techniques: Functional Magnetic Resonance Imaging (fMRI), Positron Emission Tomography (PET), Magnetoencephalography (MEG), Event-Related Potentials (ERPs), Functional Near-Infrared Spectroscopy (fNIRS); Behavioral Techniques: Self-Paced Reading and Eye Tracking. The field has improved its capability in gathering information to better testing psychological reality of linguistic theories through these techniques.

1.2. STATEMENT OF THE PROBLEM

The research on relative clauses (RC) within the field of psycholinguistics is quite prolific. The RCs have been analyzed in terms of first and second language acquisition, language processing comprehension and production. The processing of the RCs focusing on English and other typologically-similar languages (head-initial languages) has been examined in a number of studies (e.g., Caplan et al., 2001; Gibson, Hickok, and Schutze, 1994; Gordon, Hendrick, and Johnson, 2001; King and Just, 1991; King and Kutas, 1995; Pickering, 1994; Traxler, Morris, and Seely, 2002; Weckerly and Kutas, 1999). On the other hand, the studies on head-final languages, including Turkish, are needed to test the widely accepted generalizations and create a framework for language processing specifically for these languages (Papadopoulou, 2006). Moreover, the studies on the RC attachment preferences in Turkish are scarce (Kırkıcı, 2004;

Kaya, 2010 and Dinçtopal-Deniz, N., 2010). These studies analyzed certain linguistics structures of genitive possessive constructions ([NP1_{GEN}+NP2] and prepositional phrases [[NP1 P]_{PP}+NP2]) that were previously studied in other languages. However, possessive compounds [NP1+NP2_{POSS}] and[NP1+NP2_{ACC}] in the RC attachment have not been studied so far. Furthermore, an account of SRC/ORC asymmetry in the context of such attachment analysis using the online reading (for which an eye-tracker device was employed) data in tandem with the data from comprehension questions has not been analyzed. In addition, there is insufficient and also conflicting studies on Turkish SRC/ORC asymmetry (Kahraman, 2010; Bulut, 2012 and Ekmekçi, 1990) which require more studies on the topic. In addition, whether Turkish primarily prioritises high or low attachment to RCs has not been established. All these points make it clear that the RC attachment preferences should be analyzed in Turkish, and Turkish language should be described based on these features.

1.3. AIM OF THE STUDY

The present study aims to investigate Turkish native speakers' attachment preferences to RCs. Within this broad scope, it is aimed at describing the processing differences between High and Low attachment to RCs considering online reading times and offline comprehension question-answer pairs. Another aim of the study is to describe Turkish parser's reanalysis and disambiguating strategies when they are confronted with sentences with local ambiguities. Observing a possible RC asymmetry effect on two attachment types and investigating asymmetry in RC types within the context of attachment types are the aims of the study to be scrutinized.

1.4. RESEARCH QUESTIONS

In parallel to the aims given above, the present study attempts to answer the following research questions.

1. What are the processing differences between High and Low Attachment to RCs in Turkish?
2. What strategies are used by the Turkish parser when confronted with a potential local ambiguity?
3. Is there a processing asymmetry between SRCs and ORCs in the context of attachment preferences? If so, does SRC/ORC asymmetry affect High and Low Attachment processing in Turkish?

1.5. LIMITATIONS

Although Turkish employs a number of markers for relativization such as $-(y)An$ (SRC), $-DIK$ (ORC), $-(y)AcAK$ (SRC/ORC) (*olan* (be - SRC)/*olduK* (be - ORC)), $-mİş$ (PAST) (*olan* (be - SRC)/*olduK*(be - ORC)/*olacaK* (be-)) and *ki*, only the RC markers of $-(y)An$ (SRC) and $-DIK$ (ORC) were chosen due to their being major markers of Turkish RCs (Hankamer and Knecht, 1976; Underhill, 1974; Göksel and Kerslake, 2005). Therefore, the first limitation of the study is that only two Turkish RC markers, namely $-(y)An$ (SRC) and $-DIK$ (ORC), are analyzed in the study. The second limitation of the study is that the study sampled undergraduate students in their first year, attending an English preparation program before continuing to study at their departments, which offer English as medium of instruction. Despite the small and

probably trivial possibility, it could be stated that participants have higher linguistic awareness.

One of the aims of the study is to observe the parser's processing strategies in the event of a local ambiguity. Accordingly, a group of High Attachment sentences were manipulated so that the participants were led to process the given sentences with High Attachment parsing in the first reading. Despite the given arrangement for High Attachment sentence group, ambiguous High Attachment sentences were not configured with ambiguities due to limitations in Turkish.

In order to obtain correct amount of data to analyze, 84 sentences, followed by comprehension questions, were presented to the participants to read. For a participant to complete the experiment, 9-11 minutes were required. It could exhaust participants towards the end of the experiment. To prevent unbalanced reading times between the first and the last sentences, two sets of sentences were used. On set 1, even number of participants read the sentences and answered the questions in the normal order. For set 2, the participants with odd number read and answered from the last to the first sentence. However, it is still a limitation to mention here.

1.6. ORGANIZATION OF THE STUDY

For the present study that comprises five chapters, an outline is presented below.

In Chapter 1, the background provides a framework for psycholinguistics as a research area along with a short account of content of sentence processing. In this section, the statement of the problem is presented. In addition, the aim of the study, the research questions and limitation of the study are provided.

Chapter 2 introduces properties of the RCs providing examples from a wide range of languages. Then, the structural properties of Turkish RCs are described based on the previous studies. The hypotheses of the RC processing and previous studies on processing of RCs are presented. In the final part of the chapter, the hypotheses of sentence processing in attachment preferences and ambiguity resolution are demonstrated.

In Chapter 3, the methodology that was employed in this study is clarified. The pilot studies explain the process of developing the structure of the present study. The process of how participants were chosen and included into the experiment is demonstrated. The materials, which were presented to the participants to read and answer, were clarified. The procedure of conducting the experiment and how the obtained data were analyzed are illuminated in the chapter.

In Chapter 4, the analysis and discussion of the data in the experiment are presented. This chapter has two parts each of which attempts to answer these questions. The reading times collected from preselected areas of interests (AoI) and participants' correct answers to comprehension questions are analyzed in relation to hypotheses of RC asymmetry processing, attachment preferences and ambiguity resolution.

Chapter 5 provides the answers to the research questions considering the findings from the experiment. In addition, the limitations of the study are explained along with implications of the findings with regard to language processing. Finally, the suggestions for further research are suggested.

CHAPTER 2

LITERATURE REVIEW

In this chapter, the first section is dedicated to a comprehensive account of relative clauses (RCs) by delving into their properties through a wide range of languages. Following this general introduction to RCs, the structural properties of Turkish RCs are illustrated. In the next section, a historical perspective on RC processing is given and a comparative account of models of parsing is presented. The models on ambiguity resolution in attachment operations are presented, and finally an account of SRC/ORC asymmetry is illustrated.

2.1. GENERAL CHARACTERISTICS OF RELATIVE CLAUSES

Whether cross-linguistically or within the same language, RCs vary considerably in terms of syntactic and semantic properties. As an embedded sentence structure, RCs possess an item that gains its meaning out of an antecedent on which it structurally and semantically depends on (Radford, 2009). An anaphoric relation lies between the relativized item in RC and the antecedent that it is attached to. Despite a wide range of variations, RCs mainly modify a noun or noun phrase, and they use a structural tool inside such as relative pronouns in English to refer to an element in the main clause. According to De Vries (2001), RCs are subordinate structures linked to peripheral items through essential constituents.

(1) Please hand this over to **the man** who is wearing a red jacket. (De Vries, 2001: 1)

Regardless of the relativized phrase's theta role in the main clause, it is possible for the phrase to be licensed a different role in RC.

(2) The mouse that I caught _ yesterday was hungry. (De Vries, 2001:2)

As seen in example (2) above, although the relativized constituent is the experiencer (and also, subject) of main clause, the word *mouse* is the head of the RC and also, the object of verb in the embedded clause.

De Vries (2005) states that all languages have RCs. Despite the fact that features and variations of RCs range considerably, it has been suggested that one of human language's frequently utilized tools for recursion is relativization (Lehmann, 1984; Keenan and Comrie, 1977; Downing, 1978; Givón, 1984). Considering 231 relative strategies in 176 languages, De Vries (2002) claims that $3^2 \times 2^9 = 4608$ is the theoretical number of possible RCs that are estimated to exist. His argument is derived from the typological data collected by Comrie, (1981); Culy, (1990); Downing, (1978); Givón, (1984); Keenan, (1985); Keenan and Comrie, (1977); Lehmann, (1984); Peranteau et al., (1972); and Smits, 1988 and others. The sample patterns proposed by De Vries (2002: 17) are presented below.

- “a. *kind of modification/relation*: restrictive, appositive, degree
- b. *hierarchical status of RC*: embedded within DP (Determiner Phrase), correlative
- c. *presence of head*: headed/free relatives
- d. *presence of relative pronoun*: yes/no
- e. *presence of complementizer*: yes/no
- f. *presence of resumptive pronoun*: yes/no
- g. *hierarchical position of head*: externally/internally headed RCs
- h. *linear order of head and RC*: head initial/final relatives
- i. *inflectional completeness of RC*: finite/participial relatives
- j. *position of Det with respect to N and RC*: initial/middle/final
- k. *position of (Case) markers, if any*: on N, on N and RC”

(De Vries, 2002: 17)

Considering languages of the world, it is also suggested that four main types of RC can be observed.

- a. postnominal relatives [S-matrix... [N RC] ...]
- b. prenominal relatives [S-matrix... [RC N] ...]
- c. circumnominal relatives [S-matrix... [[RC ... N ...]] ...]
- d. correlatives [S-matrix [RC (...) N ...] [S-matrix... (Dem) ...]

(De Vries, 2002: 20)

In his study, De Vries (2002) observed throughout languages that all four RC types include a headed and free variation as well. It is stated that post nominal RCs do not include internal heads but nominalization. Prenominal RCs, on the other hand, do have internal heads but no nominalization. Circumnominals both have internal heads and nominalization. Lastly, correlative RCs include internal heads but no nominalization. It is stated that prenominal constructions possess a high degree of nominalized relatives accompanied by an affix unlike correlatives which show relatively less nominalization. Besides, correlatives make use of relative pronouns while prenominals lack this feature. Considering postnominal RCs, they are observed to be the most frequent one.

From a semantics point of view, it is stated by Grosu and Landman (1998) that head nouns and RC constructions are evenly important to resolve interpretation of a restrictive RCs.

Table 1. Syntax-Semantics Interaction (adapted from De Vries, 2001:7)

<i>syntactic type ↓</i>	<i>semantic type →</i>	appositive	restrictive	maximalizing
postnominal		+	+	+
prenominal ⁸		-	+	+
circumnominal ⁹		-	+	+
correlative ¹⁰		-	-	+
free relatives ¹¹		-	-	+

In Table 4 above, it is summarized that a plus indicates a combination of syntactic type and semantic type is plausible and observed in the languages of the world while a minus presents the vice versa. Possible arrangements for head nouns, determiners and RCs through post-nominal and prenominal relatives are presented in Table 2 below.

Table 2. Word-order variations in RC (adapted from De Vries, 2001:8)

<i>RC type</i>	<i>linear order</i>	<i>language examples</i>	
		<i>OV languages</i>	<i>VO languages</i>
postnominal	D N RC	Dutch	English
	N D RC	Oromo	Swedish
	N RC D	Lakota	Indonesian
prenominal	D RC N	Tigré	(RC N: Palauan, Chinese)
	RC D N	Korean	
	RC N D	Basque	

The linear order between head noun, determiner and RC are illustrated in Table 2 above. It is also stated that all possible permutations are attested. De Vries (2001) also states that one of the heaviest struggles for a unified theory for relatives is the word order. According to him, “a theory must not only be able to represent a certain structure, but also be able to derive it in a plausible way.” (De Vries, 2001:11) Hence, a typologically wide range of data of possible variations is needed to create a unifying theory.

Languages of the world consist of RCs with a wide range of variations. The configurations for RCs vary considerably regarding types of RCs and word order of elements and others. A formal approach to the topic brings an immense amount of data

to deal with. Having presented a general description and properties of RCs observed throughout divergent languages, a description of Turkish RCs is provided in the following section.

2.2. TURKISH RELATIVE CLAUSES

Turkish RCs have generally been considered in the context of gapping and movement (Kornfilt, 1997: 57). They are accepted to be complex nominal structures that modify noun phrases and thus functioning similar to adjectives. As in the case of adjectives, Turkish, which is a head-final language, also allows the RCs to the right of the noun they modify (Underhill, 1974). Kornfilt (2000) states that predicates are observed at the end of clauses and inflectional suffixes follow the predicate.

Kornfilt (1997) argues that Turkish RCs are nominalized structures, which means that they are non-finite. Overt relativizers such as *who*, *which*, and *that* employed for English RCs are not used in Turkish RCs. Instead, RC participles suffixed to the RC verb serve the functions carried out by these relativizers. -(y)An and –DIK are the two mainly employed RC suffixes used in Turkish. Underhill (1974) stated that -(y)An type is used when the head noun is the subject of the underlying sentence and –DIK type is used when the head noun is not subject. Thus, verbs are inflected with -(y)An and –DIK to form subject and object RCs, respectively (Kornfilt, 2009).

Kornfilt (2009) maintains that -(y)An suffix attaches to non-finite verbs, and it is not inflected for tense, case or person unlike English relatives. The lack of inflection for the verb in Turkish relatives poses possibility for ambiguity.

(3) [[e_i geçen yaz ada-da ben-i gör-en] kişi-leri]

Last summer island-LOC I-ACC see-PART person-PL

The people who saw me on the island last summer (Subject as target)

(Kornfilt, 1997:58)

However, in the case of headless RCs ambiguity in case of -(y)An is disappears.

(4) [opera-yı sev-me-yen]-ler-e (şaş-ıyor-um).
 opera-ACC like-NEG-PART-PL-DAT (surprise-PROG-1stSG)
 (I am surprised) at those [who don't like opera].

(5) [operayı sevmeyen] kişi-ler-e...
 person-PL-DAT
 ...at people [who don't like opera]

(Kornfilt, 1997:58)

Other examples for headless RCs are as follows:

(6) [Biz-im dik-ecek]-ler-imiz-de (hata var).
 [we-GEN sew-PART]-PL-1st PL-POSS-LOC (mistake exist).
 (There is a fault) with the ones [that we will be making].

(7) [biz-im dik-eceğ-imiz] elbise-ler-de...
 [we-GEN sew-PART-PL-1st] cloth-PL-LOC
 ...at the clothes [that we shall be making].

(Kornfilt, 1997:58)

Lewis (1967) suggests that when the head of RC is nominative (subject), suffixes of -(y)An, -miş (olan), -(y)AcAk (olan) are employed.

(8) [şimdi konuş-an] adam
 now talk-PART man-NOM
 the man who is talking/talked

(9) [dün gel-miş ol-an] mektup
 yesterday come-PART be-PART letter-NOM
 the letter which came yesterday

- (10) [yarın başla-yacak ol-an] kongre
 tomorrow start-PART be-PART congress
 the congress which will start tomorrow

(Lewis, 1967: 261)

It is stated that when RC pronoun is “whose” or object of “of” construction while the noun it governs is the complement of the verb in RC, the equivalent noun in Turkish takes third person suffix.

- (11) [hizmetçi-si bul - un- dug- um] adam
 servant-3rd SG find-PASS-PART-1st SG man-NOM
 the man for whom I am the servant
- (12) [vali-si ol-acağ- ınız] vilayet
 governor-3rd SG be-PART-2nd PL province-NOM
 the province of which you will be the governor
- (13) [muhtar-ı seç-il-diğ-i] köy
 chief-3rd SG choose-PASS-PART village-NOM
 the village for which he was chosen to be the chief

(Lewis, 1967: 261)

Lewis (1967) also points out that when RC is “whose” or object of “of” construction while the noun it governs is in the nominative as subject of the verb in RC, use the basibozuk construction with participle.

- (14) [baba-sı şimdi konuş-an] çocuk
 father-3rd SG POSS now talk-PART child-NOM
 the child whose father is now talking
- (15) [at-ı birinci gel-miş] cokey
 horse-3rdSG POSS first come-PART jokey-NOM
 the jokey whose horse came first
- (16) [kongre-si yarın yap-ıl-acak] cemiyet
 congress-3rd SG tomorrow do-PASS-PART community-NOM
 the community whose congress will be held tomorrow

(Lewis, 1967: 261)

It is also stated by Lewis (1967) that when RC pronoun is “whose” or object of “of” construction while the noun it governs is the object of the verb in RC or when the RC pronoun is the object of a preposition whose Turkish equivalent is a secondary position, use the basibozuk construction with participle.

- (17) [resim-ler-i-ni gör-mek-te ol-duğu-muz] ressam
 [painting-PL-3rd SG-ACC see-GER-LOC be-PART-3rd PL] painter-NOM

The painter whose paintings we are seeing

- (18) [resim-ler-i-ne bak-mak-ta ol-duğu-muz] ressam
 [painting-PL-3rd SG-DAT look-GER-LOC be-PART-3rd PL] painter-NOM

The painting whose paintings we are looking at

(Lewis, 1967: 261, 262)

Lewis (1967) finally states that when an impersonal verb is made into a qualifier, it can be either a participle or as a personal participle.

- (19) sağlık istatistiklerine göre Mart [en çok hastalanılan,
 health statistic-PL-POSS-DAT according to March the most many become sick-PASS-PART,
 hatta en çok ölünen] aydır.

even the most many die-PASS-PART month.

According to health statistics, March is the month in which people become sick and even die the most.

(Lewis, 1967: 261, 262)

The suffix -(y)An can be used for subject relativization and possessor relativization. If the relativized constituent is the subject of the verb, RC is non-case marked, which means that regardless of the subject whether it is 1st sing or 3rd person plural, it is all marked by 3rd person singular (Underhill, 1974).

- (20) [araba-sı çal-ın-an] komşu-muz
 [car-3rd SG-POSS steal-PASS-PART] neighbour-1PL-POSS
 our neighbour [whose car was stolen]

- (21) [rolü büyük ol-ma-yan] oyuncu (cf. *Oyuncunun* rolü büyük değil.)
 [role-3rd SG big be-NEG-PART] actor-NOM
 the actor [whose part isn't big] actor-NOM [who does not have a big part]

In such sentences, when the possessor is not the subject of the sentence, it is non-definite. Because of that, the possessor can be part of any non-subject constituent, such as:

A direct object:

- (22) [koyun-ların-ı kurt kap-an] köylü-ler
 [sheep-PL-3rd PL-POSS-ACC wolf catch-PART] villager-PL
 the villagers [whose sheep wolves caught]

An adverbial:

- (23) [çatı-sın-dan birkaç küçük kiremit düş-en] ev
 [roof-3rd SG-POSS-ABL a few small tile fall-PART] house-NOM
 the house [from the roof of which a few small tiles fell]

A possessive-marked postposition:

- (24) [arka-sın-da adam ol-an] çocuk
 [back-3rd SG-POSS-LOC man be-PART] child-NOM
 the child [behind whom there is a man]

(Kornfilt, 1997:59)

Göksel and Kerslake (2005) also state that although -(y)An is attached to uninflected verb stems for time and aspect, it usually states a non-future time situations.

- (25) [dün başla-yan] fırtına
 [yesterday start-PART] storm-NOM
 the storm [that started yesterday]

- (26) [iki yıldır sür-en] kuraklık
 [two year-be 3rdSG continue-PART] drought-NOM
 the drought [that has been going on for two years]

- (27) [şu anda çal-an] parça
 [now play-PART] piece-NOM
 the piece [that is playing at the moment]

(Göksel and Kerslake, 2005: 390)

Göksel and Kerslake (2005) state that just as in -(y)An, -DIK and -(y)AcAk is attached to non-finite verbs. On the other hand, although they are attached to uninflected verbs for tense and aspect, -DIK is usually used for past and ongoing verbs. Underhill (1974), on the other hand, argues that -DIK is employed when the head noun is non-subject whereas -(y)AcAk for future tenses:

- (28) [geçen hafta bitir-diğ-im] roman
 [last week finish-PART-1st SG-POSS] novel-NOM
 the novel [I finished last week]
- (29) [şu sırada oku-duğ-um] roman
 [lately read-PART-1st SG-POSS] novel-NOM
 the novel [I am reading at the moment]
- (30) [yarın oku-yacağ-ım] makale
 [tomorrow read-PART-1st SG-POSS] article-NOM
 the article [that I'm going to read tomorrow]

(Göksel and Kerslake, 2005: 391)

Kornfilt (1997) explains that unlike -(y)An, -DIK and -(y)AcAk are followed by person agreement morphology.

- (31) [[_{pro} geçen yaz ada-da e_i gör-düğ-üm] kişi-ler_i]
 [last summer island-LOC see-DIK 1st SG person-PL]
 The people who(m) I saw on the island last summer (Non-subject as target)

(Kornfilt, 1997:60)

Underhill (1974) suggests that the head noun of an object participle is observed to be the object of the main clause. In addition, it could be in a variety of adverbial relations to the verb for instance, a directional dative, a directional ablative, a dative ablative, a

noun in a locative or time adverbial phrase or a noun related to the verb with the postposition ile ‘with’ (Underhill, 1974: 88).

It is also stated by Lewis (1967) that when the head noun is in accusative either as object of the verb in RC or object of a preposition or as one whose Turkish equivalent is a secondary post position.

(32) [yaz-dığ-ım] mektup
[write-PART-1st SG] letter-NOM
the letter which I wrote

(33) [seç-tiğ-i] avukat
[choose-PART-3rd SG] lawyer-NOM
the lawyer whom he chose

(34) [gel-dik-ler-i] vapur
[come-PART-3rd PL] ship-NOM
the ship with which they came

(35) [çık-tığ-ımız] kapı
[exit-PART-1st PL] door-NOM
the door through which we exited

(36) [bak-tığ-ı-nız] dilenci
[look-PART-2nd PL] beggar-NOM
the beggar that you looked at

(Lewis, 1967: 261)

Lewis (1967) claims that when the head noun is the object of “with”, “birlikte”, “beraber” (together) could be employed.

(37) [birlikte içki iç-tiğ-i] arkadaşlar
[together beverage drink-PART-3rd SG-POSS friend-PL
The friends with whom he drank

(Lewis, 1967: 261)

Yarar (2005) points out that SRCs are constructed not only by -(y)An but also –mİş and –(y)AcAk. For non-subject relatives, the use of suffix -(y)AcAk bears similarities to -

DIK; they are both observed forming ORCs, however in terms of tense suffixes they diverge. -(y)AcAK is observed to refer to future on the other hand, -DIK is used for past or progressive situations. -DIK causes local/temporal ambiguity in this case. The verb in RC might refer to a completed past action or an ongoing present action. Thus, it is heavily context-dependent. RCs in (38) below illustrate these suffixes and their functions.

- (38) [Uyuy-an/uyu-muş/uyu-yacak] çocuk (subject participles)
 [sleep-SPART] child-NOM

The child who sleeps/is sleeping/slept

- (39) [Oku-duğ-u/oku-yacağ-ı] kitap (non-subject participles)
 [read-OPart-3rd SG-POSS] book-NOM

The book which he/she reads/is reading/read

(Yarar, 2005:132)

The verb uyu- (sleep) is added subject relative participles as shown in (38) and in (39), object relative participles suffixed to the verb oku- ‘read’. Uyuyan is locally ambiguous as it might mean “who sleeps/is sleeping/was sleeping/has slept/slept”; uyumuş, on the other hand, is not so ambiguous and means “who has slept/slept”. Uyuyacak is not ambiguous either and refers to future; “who will sleep.”

Concerning non-subject participles, okuduğu (which s/he is reading/was reading/read/has read) it is therefore temporally quite ambiguous. Finally, okuyacağı (which s/he will read) causes no temporal ambiguity. It is possible to express these relative constructions with the auxiliary ol-, which enables the addition of certain tense and aspect markers, as the examples below illustrate:

- (40) [Uyu-muş ol-an/uyu-yacak ol-an/uyu-makta ol-an] çocuk (subject participles)
 [sleep be-SPART] child-NOM

The child who has slept-slept/will sleep/is sleeping-was sleeping

(41) [Oku-yacak ol-duğ-u/oku-muş ol-duğ-u/oku-mak-ta ol-duğ-u] kitap (non-subject participles)

[Read be-OPart-3rd SG]

book-NOM

(Yarar, 2005:132)

The book which s/he will read/has read-read/is reading-was reading

As illustrated in examples in (40) and (41) the relative participles -(y)An and -DIK cause temporal ambiguity. Hence, in order to avoid the associated ambiguity, auxiliary *ol-* is added to the verb in the RC. It is argued by Yarar (2005) that along with -(y)An and -DIK, -(y)AcAK and -mİş are also observed to make use of this strategy to avert such ambiguity.

Göksel and Kerslake (2005) state that Turkish RCs are underlying restrictive. However, if a proper noun is modified with the use of a RC then they are non-restrictive. On this point, it also needs to be noted that whether it is restrictive or non-restrictive, there is not a difference in the rule that is applied or an additional rule to specify the restrictiveness.

(42) [Yaprak-lar-ı dökül-en] ağaç-lar

[leaf-PL-POSS fall-RC] tree-PL

trees that lose their leaves

(Restrictive)

(43) [Damad-ı(y)-la

hiçbir zaman

iyi

Bridegroom-POSS-with

anytime

well

geçin-me-miş

ol-an]

Hayriye Hanım

get on well-NEG-PAST

be-RC]

Hayriye Hanım

Hayriye Hanım, who had never got on well with her son-in-law (Non-restrictive)

(Göksel and Kerslake, 2005: 388)

The trees that only lose their leaves are interpreted from the sentence (42), on the other hand, “Hayriye Hanım”, a proper noun, does not require a restrictive relative to specify

who she is in the context. The use of RC provides extra information to satisfy discourse-related points.

Although the frequency of its use in daily life is quite limited and typologically rather different from the Turkish variants, *ki* is a complimentizer for relativization (not a suffix). The first difference of this RC word is that it comes from Persian and because Persian is considered to be in the same language family with English, *ki* also displays similar features compared to the use of English RC constructions. Furthermore, Göksel and Kerslake (2005) explain that unlike typical Turkish RC suffixes, this RC word does not follow the noun phrase it modifies and it is finite.

- (44) Bu araba [ki geçen sene satın al-dım]
 This car [that last year buy PAST 1st SG]
 henüz bir sorun çıkar-ma-dı.
 yet a problem cause-NEG-PAST-3rd SG
 This car which/that I bought last year has not caused any problem.

(Göksel and Kerslake, 2005: 396)

As stated above, due to its low frequency and distinct syntactical and typological features, *ki* will not be considered in this study.

Except for very complex RCs in Turkish RCs mostly lack resumptive pronouns equal to the head noun in English (Kornfilt, 1997). Moreover, if the relativized constituent is the oblique object or the adverbial modifier of the verb in the RC, in certain cases, a resumptive pronoun *kendisi* in the case of 3rd person singular and *kendileri* in the case of 3rd person plural) can be observed in the RC (Göksel and Kerslake, 2005: 384), as in (45).

- (45) Ayşe'nin kendisiyle_i [anlaştığı_i kişisi_i]
 Ayşe-GEN self-3rd SG-POSS-with_i [agree-OPART-3SG_i person]
 the person with whom Ayşe agreed

The head-final nature of Turkish and its implication on RCs constitute a major point in the present study. The head-final RCs can be considered to be the mirror reflections of head-initial word order as observed in English and other typologically and structurally similar languages. In head-initial languages such as English, the head (i.e. the filler) comes before the gap that is relativized. As soon as the filler is detected, the human parser starts searching for the gap and hypothesizes its position at the earliest possible point as words of a certain sentence incrementally read (i.e., the Active Filler Strategy, Frazier and d'Arcais, 1989). On the other hand, in the case of head-final RCs, the head and the gap are both located to the right of the RC. That is, the relativized gap comes before the filler. Lin and Bever (2011) state that identifying the gap prior to the head noun challenges the parser.

Lin and Bever (2011) also point out that the structural difference between the comprehension of head-initial and head-final RC is observed in the relative ordering between the filler and the gap. They explain that the left edge of a RC is marked by the relativizer without causing ambiguity when the filler precedes the gap in head-initial languages. Nonetheless, in head-final languages the filler comes after the gap in which the parser is additionally challenged by the structural ambiguity. As in Turkish, since the left edge of the RC is not clearly indicated, both main clause analysis and RC analysis are both probable at first reading. Having presented the general characteristics

(52) The boy_i [that the girl saw_i] went.

As seen in sentences (51) and (52) above, a modified noun can be moved from its extraction site in a RC and there is no limit for the distance. Studies in verbal working memory have focused on unbounded dependencies in language processing in a number of ways (Just and Carpenter, 1992; King and Just, 1991; Wanner and Maratsos, 1978; Waters and Caplan, 1992). Unbounded dependencies have also been investigated focusing on psychological gaps and traces (Bever and McElree, 1988; McElree and Bever, 1989; Gibson, Hickok, and Schutze, 1994; Nicol and Pickering, 1993; Nicol and Swinney, 1989; Pickering and Traxler, 2001).

2.3.1. Models of RC Attachment Processing and Ambiguity Resolution

Research on RCs in psycholinguistics has produced a considerable number of models and hypotheses that attempt to explain what stages the parser goes through and process sentences. It is postulated that human parser may be serial or parallel, modular or interactive. Regarding the method of processing, it could be universal, parameterized or dependent solely on frequency of the experienced incoming linguistic structures (Papadopoulou, 2006).

A dominant view in sentence processing research is universal approach. Universal models hypothesize that the human parser across all the natural languages is configured in the same manner. Universal Grammar is the determinant factor considering the constraints posited on parsing routines (Abney, 1989; Crocker, 1996; Gorrell, 1995; Philips, 1996; Pritchett, 1988, 1992; Weinberg, 2001). Papadopoulou (2006) states that the locality principle lies in the core of most universal parsing theories. It is required that incoming linguistic elements are added into the phrase that is currently being processed. This assumption originates in grammatical (Philips, 1996; Weinberg, 2001)

and computational constraints (Abney, 1989; Crocker, 1996; Frazier, 1978, 1987; Frazier and Fodor, 1978; Gorrell, 1995).

One of the universal sentence processing models is the Garden Path Theory (GPT). First proposed by Frazier (1978 and 1987), and later revised by Frazier and Fodor (1978) and Frazier and Rayner (1982), the theory states that language processing and interpretation take place in two distinct stages. According to Frazier (1979, 1987), in the first stage of sentence processing, the human parser analyzes incoming sequence of words and identifies which part of speech the words belong to such as noun, verb, preposition, and so on. As soon as the licensing of words is complete, the parser builds a preliminary syntactic tree for the flow of words. Regardless of meaning (semantic aspect) of words, the parser only tags incoming words with the correct category (parts of speech) on this stage. For the illustration of the first stage analysis, below it can be seen how the lexical processor tags each word a word category. The sentence *While Susan was dressing the baby played on the floor.* (Frazier and Rayner, 1982 cited in Traxler, 2012: 144), is outputted with the sequence of categories below:

Table 3. Identification of Word Categories in the First Stage of Garden Path Theory of Sentence Processing (Traxler, 2012: 144)

while	Susan	was	dressing	the	baby	played	on	the	floor
Conjunction	Noun	Auxiliary Verb	Verb	Determiner	Noun	Verb	Preposition	Determiner	Noun

As illustrated in Table 3 above, based only on word categories, a syntactic structure is drawn and the words in the sentence can be assigned positions in the tree. The initial syntactic tree is constructed by a self-governing syntactic part, which is not sensitive to semantic and thematic, pragmatic, discourse and general world-knowledge information

sources (Frazier, 1987; Ferreira and Clifton, 1986). Later, the “draft” admitted by “thematic interpreter” for checking.

The primary function of thematic interpreter is to apply set of rules that give roles to each element in the syntactic tree concerning their position in this tree and how these elements are connected to each other. If the produced draft from the interpreter goes in line with the parser’s prior knowledge or assumptions, the sentence can be integrated into the rest of the discourse. If there are semantic and structural problems concerning thematic assignment of the words, a revision is initiated, and interpretation of the sentence is revised taking lexical, syntactic and thematic roles of the words in the sentence. In this way, the meaning/sense of the sentence goes in line with the intended message and the final version of the tree diagram is produced.

Other commonly observed Garden-Path Sentences include:

NP/VP Attachment Ambiguity:

(53) The cop [saw the burglar] [with binoculars.]

(54) The cop saw [the burglar [with the gun.]]

NP/S (Sentence) Complement Attachment Ambiguity:

(55) The athlete [realized [his goals]] last week.

(56) The athlete realized [[his goals] were unattainable.]

Clause-boundary Ambiguity:

(57) Since Jay always [jogs a mile] the race doesn’t seem very long.]

(58) Since Jay always jogs [[a mile] doesn’t seem very long.]

Reduced Relative-Main Clause Ambiguity:

(59) [The woman [delivered the junkmail on Thursdays.]]

(60) [[The woman delivered the junkmail] threw it away.]

The Relative/Complement Ambiguity

(61) The doctor [told [the woman] [that he was in love with her.]]

(62) The doctor [told [the woman [thathe was in love with]] [to leave.]]

(Crocker, 2014:12)

The GPT argues that the parser interprets sentences on a word-by-word basis. Instead of delaying a decision until the end of the sentence, the parser is forced to choose between alternative tree structures.

As a whole, the GPT assumes that the parser begins to build a syntactic structure as soon as the lexical processor begins to deliver information about word categories. The thematic processor also works on a word-by-word principle as well, which means that semantic processor does not delay extraction of meaning of the sentence until it reaches the end.

The attempt to construct structural and semantic interpretations of a given sentence as each word is delivered results in correct and sometimes incorrect choices, which requires the parser to revise their decision. The GPT describes sentence processing as a serial system as opposed to a parallel one. Another principle of the GPT is that the parser relies on overarching, which states that the structure to build is supposed to be as simple as possible (Frazier, 1987).

In the event of a potential ambiguity, in which the parser is supposed to make a decision between two conflicting interpretation, the first purely syntactic analysis is completed through two models: Late Closure and Minimal Attachment (Frazier, 1987; Frazier and Fodor, 1978). It is required by Late Closure that the emerging linguistic elements be attached to the phrase that is being parsed. The Minimal Attachment commands that the incoming material be processed so that the least number of nodes are created also assuring the well-formedness of the utterance. These two principles are thought to explain the speed and efficiency of the parser in processing the linguistic input. It is claimed that the nature of the parser is identical across all human languages and the principles are thus universal. Possible differences in parsing are only attributed to unique grammatical properties of individual languages.

Considering the sentence (63) given below, the principle of the Late Closure predicts that the constituent *to Mary* is attached to “the letter”, which is last DP constituent not the previous DPs or the VP.

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

(Papadopoulou, 2006: 12)

Various studies have contributed to the predictions and principles that the Late Closure holds so far with numerous studies (Ferreira and Henderson, 1991; Frazier and Rayner, 1982; Kennedy and Murray, 1984; Mitchell, 1987).

The Late Closure and Minimal Attachment were challenged by the seminal study of Cuetos and Mitchell (1998). They dealt with the RC attachment preferences of English and Spanish speakers. The first NP *the servant*, in sentence (64) is accepted as high.

Because in the syntactic tree it is positioned further away from the RC. On the other hand, the NP *the actress* is termed as low due to its closer position to the RC. As for the Late Closure, the RC is to be attached low to the constituent *the actress*.

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

(Papadopoulou, 2006: 12)

Findings from several experiments confirm the predictions the Late Closure such as in English (Cuetos and Mitchell, 1988; Frazier and Clifton, 1996; Gilboy et al., 1995; Traxler et al., 1998), Swedish (Ehrlich et al., 1999), Norwegian (Ehrlich et al., 1999), Romanian (Ehrlich et al., 1999), Brazilian Portuguese (Miyamoto, 1998), and Arabic (Abdelghany and Fodor, 1999). Given the preference of low attachment in the languages summarized above, the Late Closure fails to explain high attachment preference in Spanish (Carreiras and Clifton, 1993, 1999; Gilboy et al., 1995). As for the GPT framework, it is assumed that the Late Closure is still the explanatory force for high attachment preference in which the parser is initially inclined to attach argument low to RC but this preference is reanalyzed considering discourse based reasons and repaired to attach RCs high as suggested in the Relativized Relevance (Frazier, 1990). Concerning the principle of Relativized Relevance, DeVincenzi and Job (1993, 1995) also conducted two studies that supported the prediction of Relativized Relevance. They implemented a self-paced reading task on RC attachment preferences of Italian speakers. They tested how participants responded in two linguistic cases. In the first case, non-theta assigning preposition (*di* – of) was used and for the second case, *con*=with, which has the opposite feature. In order to stop participants from falling into

ambiguity regarding high or low attachment, gender information on the past participle in RC was manipulated.

DP1 – di (of) – DP2 – RC

(65) L' avvocato diffida / del padre / della ragazza / che si e tradita-o / al processo.

The lawyer suspects the father of the girl who betrayed herself/himself at the trial.

DP1 – con (with) – DP2 – RC

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

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

(Papadopoulou, 2006: 13,14)

The participants initially preferred low attachment to RCs for both conditions however, when they were asked comprehension questions, they revealed low attachment for the first case (preposition con) and high attachment for the second case (preposition di). Researchers claimed that the results support Relativized Relevance in that this principle operates and overrides prior low-attachment preference as the first DP is available in *di*-sentences. However, in the *con*-sentences, the last DP is the only position for attaching to the last thematic domain. Thus, the initial DP is not a suitable location for RC and Relativized Relevance cannot interfere. Papadopoulou, (2006) states that same findings are also observed in the study of Baccino et. al (2000) in French in which the Late Closure determines initial preferences to low attachment preferences in RCs, and final decisions are made considering pragmatic and thematic aspects. It is also claimed by Papadopoulou, (2006) that vast high attachment preference in a number of other languages such as Afrikaans (Mitchell et al., 2000), Dutch (Brysbaert and Mitchell, 1996; Mitchell and Brysbaert, 1998; Mitchell et al., 2000 Wijnen, 1998), French

(Frenck-Mestre and Pynte, 2000; Zagar et al., 1997), German (Hemforth et al., 1996; Hemforth et al., 1998, 1999; Walter et al., 1999), Russian (Kempe and Radach, 1993) and Spanish (Carreiras and Clifton, 1993, 1999; Gilboy et al., 1995). cannot be explained by the principle in the GPT framework. The doubt on the Relativized Relevance principle is due to the methodology used in these studies. Online data collection tools such as self-paced reading tasks or eye-tracking experiments reveal reliable initial high attachment preferences which contradict the principle.

Along with the Late Closure and Minimal Attachment, a refinement to the GPT model is formulated by Fodor and Inoue (1998, 2000). They postulated a three-stage model to account for garden-path sentence recoveries.

Attach: On receiving a word of the input sentence, connect it to the current partial phrase marker (CPPM) for the sentence in such a way that the resulting CPPM is syntactically well-formed though possibly incomplete at its right edge.

(Fodor and Inoue, 1998:103)

The principle of *Attach* requires incoming input be attached into the phrase that is being parsed. The fact that the node already opened for previous elements includes the new materials is also in line with the Minimal Attachment (Frazier, 1987; Frazier and Fodor, 1978), the Right Association (Kimball, 1973), or the Late Closure (Frazier, 1978).

Having followed the *Attach* principle, the parser might be led through the garden path in processing the sentence structures. In this case, the principle *Attach Anyway* is employed. This principle is similar to *Attach* in that syntactic priorities take precedence and parsing is continued according to structural relations of the incoming elements. However, the parser on this point might detect that the material is maladjusted with CPPM and is not possible to be attached to it. The principle of *Attach Anyway*

commands to the parser to integrate the material into the node already opened and ignores any issues with semantics and others. The principle briefly states:

Attach Anyway: Having established that there is no legitimate attachment site in the CPPM for the current input word, attach the input word into the CPPM wherever it least severely violates the grammar, and subject to the usual preference principles that govern *Attach*.

(Fodor and Inoue, 1998:105)

Following purely syntactic integration of input into sentence processing with *Attach* and keeping this initial analysis despite maladjustments with *Attach Anyway*, the last principle *Adjust* takes place.

Adjust: When a grammatical conflict has been created between two nodes or features X and Y in the CPPM, by either *Attach* or *Attach Anyway*, eliminate the problem by altering minimally (i.e., no more than is necessary for conflict resolution) whichever of X and Y was less recently acted on, without regard for grammatical conflicts thereby created between that node and other elements in the CPPM.

(Fodor and Inoue, 1998:106)

In accordance with Minimal Everything (Frazier, 1990; Inoue and Fodor, 1995), *Adjust* requires changes to parsing to be as minimal as possible. For example, rather than creating a new node or attaching the ill-formed node to a further node in the tree, feature values are adjusted, and the outcome is checked if the problem is solved.

To illustrate all three principles, an example sentence from Ferreira and Henderson (1991:4) is given as follows:

(67) While Anna dressed *the baby* [that was small and cute] *spit up* on the bed.

Without punctuation marks when written or without required intonation patterns when listened to, the sentence above includes a garden-path for the parser. As the principle, *Attach (Anyway)*, goes, the parser integrates the incoming word ‘the baby’ into the node opened for the verb *dressed* and assigns it the patient role. However, when the main verb *spit up* is presented to the parser, the garden-path situation is created and thus, the principle of *Adjust*, in accord with Grammatical Dependency Principle (GDP) (Fodor and Inoue, 1998), is employed to correct the conflict as minimally as possible. On this point, although it is a violation of the GDP, a reanalysis operation called “theft” as described by Fodor and Inoue (1998) takes place.

The example from Ferreira and Henderson (1991, 1998: 6) illustrates the principles of the garden-path case detection and operation of reanalysis.

(68) While Anna dressed **the baby** that was small and cute **spit up** on the bed.



←
→

the head of the misanalysed phrase
the error signal

The source of the garden-path (the head of the misanalysed phrase) is *the baby*. Upon reaching the verb of the subordinate clause, the incoming words (that, was, ...) are added into the node opened for the noun “the baby” as dictated by the principle of *Attach*. It is assigned to be the direct object/patient of the main verb of the first clause. Once the main verb *spit up*, which is termed as the head of the misanalysed phrase, is presented the parser realizes to have been led down the garden path and feels the need to reanalyze the given sentence. However, the parser forces the initial interpretation of the sentence and finishes the given sentence as required by *the Attach Anyway*. For reanalysis, parsing of the phrase “the baby” is *adjusted* to be the subject of the main clause and reanalysis is completed.

Fodor and Inoue (1998) claims that *the Attach Anyway* principle describes a solid scenario of parsing steps unlike other open-ended approaches. Dependence on the grammar is suggested to be the driving force for the parser to check whether the newly attached input is compatible with the rest of the sentence. In case of a parsing problem, the grammar indicates the exact location and the type of the problem. Checking and repairing mechanisms are described to be interwoven processes.

In their study on a literature review on sentence processing models on English and Japanese, Kess and Miyamoto (1999) indicate that theoretical claims of Universal Grammar is reflected on universal processing model that presumes all languages to follow an absolute uniformity. However, the results of the psycholinguistic studies on sentence processing produce some models that should allow for variability. They claim that there are undeniable similarities in the global strategies. However, the informative strategies in natural language processing are language-specific.

Sekerina et al. (2004) studied the RC attachment preferences in Bulgarian using multiple methods. In the first experiment, paper-and-pencil format was preferred. In the experiment, the length and order of RCs were manipulated. Seventy four participants were made to read fifty-five items which consisted of three practices, thirty-six fillers and sixteen experimental sentences, which included globally ambiguous sentences where it was possible to attach RC to either of the two nouns in the complex NP. The result of the study indicated that Bulgarian speakers prefer to attach RC to NP1 (low). It is stated by the researchers that this constitutes a resemblance to other Slavic languages such as Croatian (Lovric, 2003), Polish (Nowak, 2000) and Russian (Sekerina, 2002).

In order to assess the role of semantic/pragmatic complexity on RC attachment preferences, Sekerina et al. (2004) conducted the second experiment in the study. Instead of including using NPs such as *the brother of the teacher*, the NPs of abstract geometric shapes were used such as *the tip of the triangle*. Twenty-one native speakers of Bulgarian were given twenty-one items which consisted of two practice, nine experimental and ten filler sentences to read. Each item was presented with a biasing context and a comprehension question. The results of the study indicated that the disambiguation towards low attachment was higher than high attachment. The difference between the two experiments was claimed to be a pragmatic consideration. It is suggested that attachment preferences are initially low in line with the universal principle of the Late Closure. However, when non-syntactic factors come into play, as in the first experiment, the parser prefers high attachment depending on the pragmatic principles or prosodic phrasing preferences.

In their study of the RC preferences in Japanese, Miyamoto et al. (1999) investigated attachment preferences of three possible NPs to RCs. The example below shows the word order characteristics of the head final RCs in Japanese.

(69) RC N₃ postposition N₂ postposition N₁

(Miyamoto et al., 1999:665)

Thirty-nine native speakers of Japanese participated in the study. Thirty-six sentences were randomized and presented to the participants. They were read on a computer screen in a self-paced presentation with button-box. Following each sentence, the comprehension questions were asked. The results of the experiment indicated that the low attachment condition was significantly more frequent than middle and high

attachment. The high attachment preference was also higher than middle condition. However, it was not significant. Miyamoto et al. (1999) claim that attachment preferences are influenced by certain factors. The first factor is locality as the percentage of correct answers to the comprehension questions backs preference of RC attachment to the nearest noun. The other factor is a preference toward high attachment which is supported by predicate proximity and anaphor resolution. It is assumed that discourse complexity is another factor that may influence processing .

Hemforth et al. (2015) studied the effect of the position and length in the RC attachment in German, English, Spanish and French. In their experimental sentences, both SRC and ORC clauses were used. For both RC types short and long RCs were created as can be seen in the example below.

(70) a. The son of the colonel [who died] had written five books on tropical diseases.
(SRC/Short)

b. The son of the colonel [who tragically died of a stroke] had written five books on tropical diseases. (SRC/Long)

c. The doctor met the son of the colonel [who died]. (ORC/Short)

d. The doctor met the son of the colonel [who tragically died of a stroke].
(ORC/Long)

(Hemforth et al., 2015:46)

Twenty-two experimental sentences were arranged and then translated into the aforementioned languages. Forty-eight undergraduate students were included in the study. The procedure of the experiment involved a paper-based sentence list to be read

by the participants. Upon reading each sentences, a sentence completion task was presented in order to gather the participants' RC attachment preferences. For instance, the following sentence is presented.

(71) The boss of the woman [who had a long gray beard] was on vacation

(Hemforth et al., 2015:47)

Following this sentence, the sentence that contains a blank is given and the participants are asked to fill it with one of the NPs given in the sentence above.

(72) The _____ had a long gray beard.

(Hemforth et al., 2015:47)

Baseline attachment preference in these languages is that German and French possess more high attachment than Spanish and English. Hemforth et al. (2015) attributes this result to the fact that the former languages include case-marked RC that are interpreted following binding principles on the other hand, the latter languages are non-case-marked languages and they are interpreted following attachment preferences (e.g., Late Closure).

A conclusion on the length of RCs, it is confidently stated that longer RCs caused more high attachment preferences than shorter RCs. It is attributed to the Balanced Sister Hypothesis, (Fodor, 1998) which briefly predicts that longer RCs result in longer high attachment preferences.

About the position of RCs, Hemforth et al. (2015) suggest that the ORCs possess higher degree of high attachment preferences than the SRCs. It is claimed that focus properties in the ORCs is generally observed while it is not the case in the SRCs.

The next section provides a review of the literature on how the SRCs and ORCs are processed. The asymmetry of processing is described and hypotheses on the asymmetry are provided.

2.3.2. Processing of Subject/Object RCs

Numerous studies on SRCs and ORCs conclude that cognitive difficulty is more in processing ORCs than SRCs in English (Caplan et al., 2002; Gibson, Hickok, and Schutze, 1994; Gordon, Hendrick, and Johnson, 2001; King and Just, 1991; King and Kutas, 1995; Pickering, 1994; Traxler, Morris, and Seely, 2002; Weckerly and Kutas, 1999), in Dutch (e.g., Frazier, 1987; Mak, Vonk, and Schriefers, 2002, 2006), French (e.g., Cohen and Mehler, 1996; Frauenfelder, Segui, and Mehler, 1980; Holmes and O'Regan, 1981), in German (e.g., Mecklinger, Schriefers, Steinhauer, and Friederici, 1995; Schriefers, Friederici, and Kühn, 1995), Spanish (Betancort, Carreiras and Sturt, 2009), Portuguese (Gouvea, 2003), French (Frauenfelder, Segui and Mehler, 1980; Cohen and Mehler, 1996; Holmes and O'Regan, 1981).

The ORC disadvantage has also been presented in typologically distant languages to English and other Indo-European languages, for instance, Basque (Carreiras et al., 2010), Chinese (e.g., Chien-Jer and Bever, 2006; Hsiao and Gibson, 2003; Lin and Bever, 2006; Lin and Garnsey, 2011), Japanese (e.g., Ishizuka, 2005; Ueno and Garnsey, 2008), and Korean (e.g., Kwon, Polinsky, and Kluender, 2006; Kwon, Lee, Gordon, Kluender, and Polinsky, 2010). However, unlike the common ground in English and other typologically related languages, this head-initial group of languages

include conflicted results too, for instance, Hsiao and Gibson (2003) and Carreiras et al. (2010).

In order to explain the SRC/ORC asymmetry, there are hypotheses that focus on distance. The definition of distance is accepted in two distinct approaches as described by Carreiras et al. (2010). Among them, the Linear Distance Hypothesis (LDH), suggested by Gibson (1998, 2000) in the Dependency Locality Theory (DLT), predicts the difficulty of the RC processing based on the intervening words/terminal nodes in the syntactic tree. The Structural Distance Hypothesis (SDH), on the other hand, proposed by O'Grady, Miseon, and Miho (2003) suggests that the difficulty of the RC processing can be predicted considering the number of intervening syntactic nodes/projections.

An overall assumption of the SDH is that structural distance is bound to be further in the ORCs than in the SRCs whether it is a head-initial or head-final language (Carreiras et al., 2010). Hence, for the SDH, the ORCs imposes a universal asymmetry in which the SRCs are processed in a shorter period.

The sentences (73a) and (73b) given below illustrate the structural distance discrepancies between the SRCs and ORCs. In sentence (73a), the gap position *e* is coindexed with the head noun “the man” within the same IP. However, in sentence (73b), the gap is out of the IP that it is extracted from and embedded deeper within the IP. Hence, the SDH predicts that regardless of the properties of a given language, SRCs are preferred and they cause less of a cognitive burden for the parser.

(73) a. The man_i [CP that_i [IP e_i kissed the lady]]

b. The man_i [CP that_i [IP the lady [VP kissed e_i]]]

(O'Grady, Miseon, and Miho, 2003:434)

On the other hand, the LDH computes complexity of RC structures in terms of linear distance between filler and gap. The assumption in the LDH is that potential processing difficulties occur within unbounded dependencies, such as the ones in RCs, due to the fact that the removed entity must be kept in memory until the location where the integration occurs is observed. Integration in this context refers to the integration of head-dependencies in phrase structure; that is, connecting an incoming word to its head. Considering the above sentences in the LDH account, the word “the man” is extracted from the site it is located however no discourse referent, which is the defining factor for complexity, is observed in (73a). On the other hand, in (73b), the intervening elements between the head “the man” and the gap, “the girl” are seen. For the LDH, the SRCs are easier to process than ORCs as the intervening elements between the head and the gap is bound to be more in ORCs.

In their study, Hsiao and Gibson (2003) support ORC preference. In their experiment, the participants of Chinese native speakers were given the subject and object extracted RCs. In this self-paced reading experiment, the participants read singly- and doubly-embedded RCs, both of which were subject and object extracted. It is stated that in Chinese RCs, the empty category is closer in the ORC to head than in SRC. The LDH and SDH were tested considering these two relatives. Using the data from the self-paced reading task and true-false comprehension questions after each experimental sentences, the findings from comprehension questions reveal that sentences with ORC is comprehended better than SRC sentences. Reading time analysis also supports their data. They state that their results are in the same direction with the LDH. On the other hand, they argue that the SDH and NPAH cannot explain their results.

Following Hsiao and Gibson (2003), Lin and Bever (2006) investigated the SRC/ORC asymmetry with two self-paced reading tasks. In the first one, the participants read sentences with the ORC and SRC sentences. The reading times gathered from relativizer and head noun regions suggested that more time was spent on the ORC than the SRC. The first task, therefore, concluded a preference for the SRC compared to the ORC. For the second task, the possessor RCs, corresponding to “whose” relativizer in English, was employed in the self-paced reading task. To test the effect of distance between the filler and gap, sentences were controlled with varying distances. Depending on the results they gathered, they argued that locality of dependencies does not play a certain role in reading times. Structural distance was claimed to be the factor to explain the ORC difficulty, which contradicts the findings of Hsiao and Gibson (2003). They also statistically supported their results stating that regardless of typological differences, studies on the SRC/ORC asymmetry reveal a SRC advantage.

Chen et al. (2008) concluded the ORC preference over SRC in their study on Chinese relatives. They included a self-paced reading task accompanied by another variable, which was comparing low working memory and high working memory span readers. The comprehension questions after each experimental sentence was also considered and analyzed. As for comprehension questions, the results revealed that ORCs were easier than SRCs for both groups. However, in terms of the reading times, it took low working memory span readers longer to read sentences with the SRC than ORC. For high working memory span readers, a significant difference between RC types was not reached. It is concluded that universal tendency towards SRC advantage is not the case and nor is structural distance hypothesis.

The SRC/ORC asymmetry was examined on Basque by Carreiras et al. (2010). Basque is a head-final language and an ergative language with prenominal RCs. In their experiment, two self-paced reading tasks and an ERP task were employed. Two of the SRC and ORC sentences that were given to read are exemplified below.

(74) SRC:

[e_i Irakasleak aipatu dituen] ikasleak_i lagunak ditu.

[e_i teacher-PL mentioned has-RC] student-SG-ERG_i friend-PL has.

The student that mentioned the teachers has friends

(75) ORC:

[Irakasleak e_i aipatu dituen] ikasleak_i lagunak dira.

[teacher-SG-ERG e_i mentioned has-RC] student-PL_i friend-PL are.

The students that the teacher mentioned are friends.

(Carreiras et al., 2010:83)

For both of the self-paced reading tasks, similar results were collected, in which SRCs were observed to have been read longer than ORCs.

In the third part of the experiment, ERP times were evaluated. The electrodes were placed on certain regions on participants' scalps. Higher amplitude was found on certain parts of the sentences, which is associated with ambiguity or a cognitive load. Results of the experiment were interpreted as counterargument to the SRC advantage. The SDH, as shown in most of the studies in the field, was not supported. They explained their results not through the LDH but with the ergative nature of Basque language. They concluded that objects and intransitive subjects are unmarked whereas transitive subjects are marked.

Another study that dealt with the SRC/ORC asymmetry is concerning Korean language which is carried out by Kwon et al. (2010). Korean is another head-final language with pre-nominal RCs as shown below.

(76) SRC

[e_i uywon-ul kongkyekha-n] enlonin-i_i phyencipcang-ul silheha-n-ta
 [e_i senator-ACC attack-RC] journalist-NOM_i editor-ACC dislike-PRES-DECL
 The journalist who attacked the senator disliked the editor.

(77) ORC

[uywon-i e_i kongkyekha-n] enlonin-i_i phyencipcang-ul silheha-n-ta
 [senator-NOM e_i attack-RC] journalist-NOM_i editor-ACC dislike-PRES-DECL
 The journalist who the senator attacked disliked the editor.

(Kwon et al., 2010: 548)

A notable feature of Korean relatives is that linear distance between the gap (e_i) and the filler (enlonin_i) in the SRCs is greater than the ORCs, which creates a new ground to compare the LDH and SDH. For their first experiment, the processing of the SRC and the ORC were compared using different RC constructions, one of which was subject modifying the ORC and the SRC (as shown above). The second group of relatives tested was in-situ object modifying SRCs and ORCs, and scrambled object modifying SRCs and ORCs. For the first experiment, the participants of Korean native speakers were given sentences with the SRC and ORC on a screen to read and their eye movements were recorded through an eye-tracker. The sentence readings were accompanied by true/false comprehension questions, which also provided proof for comprehension. The reading times obtained from the eye-tracking device suggested that the SRCs were processed easier compared to the ORCs except for in-situ relatives. They concluded that their findings can be explained through the SDH and NPAH but not the LDH. For their second experiment, Kwon et al. (2010) included a context for the following RC sentences inspired by Ishizuka (2006)'s argument briefly stating that the

ORCs could be processed faster should they be provided with context. The reading times gathered from the eye tracking device. However, they did not provide a significant advantage for ORC. The results were consistent with the first one without context.

2.3.3. RC Processing in Turkish

In this section, studies on Turkish RC processing are presented. The studies cover a wide range of topics e.g. agrammatism, attachment preferences to RCs, ambiguity resolution, the role of context in ambiguity resolution and processing asymmetry in the SRCs and ORCs.

Özçelik (2006) studied the RC comprehension by L2 speakers of Turkish. A picture-selection task was the main tool for data collection. 3 groups of participants were included: native speakers of English, native speakers of SOV languages and native speakers of Turkish. Unlike the previous studies that support the SDH, Özçelik (2006) argued that ORCs were comprehended better. The LDH is claimed to explain the greater distance between the filler and the gap in SRC.

Conducted on L2 learners of Turkish and agrammatic aphasics, the study of Aydın (2007) investigated the RC processing in Turkish. Findings gathered from both groups were analyzed comparing the LDH and SDH. Similar to the methodology used in Özçelik (2006), Aydın (2007) used a picture selection task in which participants were asked to choose a picture after listening to a sentence with SRC or ORC. The results show that intermediate level L2 learners of Turkish performed significantly better on SRCs than they did on the ORCs. However, for basic level L2 of Turkish and agrammatic aphasics such significant divergence was not observed in their responses, which is argued to support the SDH.

Yarbay Duman et al. (2008) investigated the production of finite main clauses and non-finite RC in Turkish agrammatic speech. In their study, they used a sentence completion task with three conditions that were main clause condition, the SRC and ORC. Each condition included twenty items. In total sixty items were manipulated with two variables using the presence/absence of the overt movement of the NP and verb inflection. The procedure included pictures and the patients were asked to complete the sentences that were initiated by the researchers. It was found that non-finite RCs were more challenging for Turkish agrammatic speakers compared to finite main clauses despite the fact that all the finite main verbs were in their base position. The researchers' main assertion is that Turkish agrammatics find it more difficult to produce structurally derived clauses and their production of verbs is affected by linguistic factors such as the overt movement of the NP.

Kırkıcı (2004) is one of the few studies that investigated the RC attachment ambiguities. In his offline experiment, the sentences were manipulated so that complex noun phrases marked with genitive case ([NP1_{GEN}+NP2]) could be attached to the RCs site, which causes the ambiguity. The result of the experiment shows that participants were observed to attach RCs to low NPs. Furthermore, it is stated that lexical-semantic information, animacy information of the potential NPs establish conclusive arguments for NP choice to be attached to RCs.

Dinctopal-Deniz (2010) also studied sentences with ambiguous RCs. The aim of the study was to observe how attachment ambiguities were handled in sentences with RCs. Ambiguities used in online study were of two kinds as temporal and global. For the disambiguation of temporal ambiguities, animacy information on NPs included in complex genitive NPs was provided. Global ambiguities were planted in sentences of

the offline task. Three groups of participants (Turkish monolinguals, Turkish learners of English at high levels and English monolinguals) participated in the study. The data from the participants were gathered through online self-paced reading tasks and offline questionnaire answering. Overall results of the experiment suggest that Turkish and English monolinguals preferred low attachment to the RCs in both tasks. Turkish learners of English group exhibited low attachment preference in the online task although it was not statistically more significant than high attachment.

Kahraman (2015) investigated the SRC/ORC asymmetry in context. It is stated that the ORCs are mostly context-bound structures and the reason for difficulty in processing of the ORCs as observed in previous studies can be cleared if they are accompanied by context. Inspired by the Discourse Context Function Hypothesis (DCFH) (Roland et al., 2012) he paired his experimental sentences with two types of contexts as seen below:

Neutral context:

- (78) Üniversite yolsuzluk yüzünden inceleme-ye al-ın-dı.
 University corruption due to investigation-DAT taken-PAST.
 The university was investigated due to corruption.

SRCs:

- (79) [Dekan-ı suçla-yan] rektör okul-u düşün-üyor-du.
 [Dean-ACC blame-SPART] rector school-ACC think-PROG-PAST
 The rector who blamed the dean was thinking of the school.

ORCs:

- (80) [Dekan-ın suçla-dığ-ı] rektör okul-u düşün-üyor-du.
 [Dean-GEN blame-NSPART-3rd SG] rector-NOM school-ACC
 think-PROG-PAST-3rd SG
 The rector who the dean blamed was thinking of the school.

Topic context:

- (81) Dekan fakülte-deki işleri-ne fazla önem ver-mez-di.

Dean faculty-LOC work-DAT much care give-NEG-PAST-3rd SG

The dean did not care much about his work at the faculty.

SRCs:

(82) [O-nu suçla-yan] rektör okul-u düşün-üyor-du.

[He-ACC blame-SR] rector school-ACC think- PROG-PAST

The rector who blamed him was thinking of the school.

ORCs:

(83) [O-nun suçla-dığ-ı] rektör okul-u düşün-üyor-du.

[He-GEN blame- NSR-3SG] rector school- ACC think- PROG-PAST

The rector that he blamed was thinking of the school.

(Kahraman, 2015:101)

The NPs used in neutral context do not appear in RC on the other hand, the NP used in RC is the topic NP in topic context. Before the implementation of their self-paced reading experiment, it was claimed that if processing difficulty with ORC sentences had been due to a lack of context, such asymmetry would have been eliminated with the inclusion of context. True/False comprehension questions were also added to the analysis of the experiment for observing comprehension accuracy. Their conclusion on SRC/ORC asymmetry is that the processing difficulty of ORCs did not differ compared to the SRCs even when provided with a context. Their results do not comply with the DCFH by (Roland et al., 2012).

Bulut (2012) also studied the SRC/ORC asymmetry in Turkish. In his study, an eye-tracking device was used to have native speakers of Turkish read a set of sentences with the target structure. The experimental sentences are also followed by comprehension questions to observe comprehension asymmetry in the target structure. Both reading times from the eye-tracking device and comprehension question accuracy scores were analyzed. It is argued that a significant processing difficulty is observed in reading

times especially in spillover areas following the noun phrases and low comprehension accuracy scores for ORC sentences. The Structural Distance Hypothesis is found to be the explanatory force for his conclusion. Accompanying his conclusion, other complementary factors such as word-order canonicity and frequency are also determining factors in explaining the SRC/ORC asymmetry in Turkish.

The acquisition of English RCs by Turkish native speakers was investigated by Turan (2012). His study indicated that accessibility of the Universal Grammar (UG) is a defining factor in the acquisition of English RC in lower levels (Pre-intermediate or A2). However, in higher levels, access to UG is limited and transfers from Turkish as a native language is administered more. Thus, it was concluded that in the acquisition of English RCs by Turkish native speakers, Full Transfer/Partial Access (White, 2000) defines the acquisition of this construction.

Özge, Marinis and Zeyrek (2015) investigated pre-nominal RC processing tendencies of two groups of children who were all native speakers of Turkish. Their aim was to observe whether there were qualitative processing differences between the two groups, whether there was a SRC/ORC asymmetry and how sentence processing accounts capture moment-by-moment processing. The first group of children involved sixteen kindergarten attendees and the second group included nineteen primary school students. As a control group, adults who were thirty-seven university students were included into the study. An online self-paced listening experiment was devised that included thirty-two experimental, thirty-two filler and seven practice items. The experimental sentences were manipulated with RC type (SRC, ORC) and RC role (role of the head NP: subject or object). The comprehension questions were also given following all the items. Özge, Marinis and Zeyrek (2015) found that primary-school children performed better on the

experiment than the kindergarten children. However, considering RC-type and RC-role, a statistically significant difference was not found. Between the groups of children and adults a significant RC asymmetry was not identified. The common pattern in processing between the groups of children and the adults suggests that children and adults are influenced by similar parsing constraints. In accordance with the processing accounts that are employed in the study, such factors as the type of referential expression and animacy constrain parsing of children and adults. Their implications from the experiment state that neither groups waited until the end of the clause filler to expect the incoming structure. It is also concluded that morpheme level ambiguities and morphosyntactic expectations guide both groups.

In her PhD dissertation, Başer (2018) studied syntactic priming effect of attachment on RCs in monolingual Turkish speakers and Turkish learners of English with various proficiency levels. The aim of the study was to compare the strategies practiced for ambiguity resolution in Turkish and English. The data collection was carried out by an offline (written questionnaire) test, an online (self-paced reading) test and an eye-tracking test. The findings of the study reveal several constraints on the RC attachment preferences. Whether the host NP is animate or not, semantic relations between the host NPs, the semantic association of the host NPs with proximal and the distal predicate and active/passive RC condition are the factors that influence both groups in their processing strategies to RC attachment preferences and ambiguity resolution. It is also stated that high attachment preference is associated with processing difficulty.

CHAPTER 3

METHODOLOGY

The present study aims at investigating the attachment preferences of Turkish native speakers under certain conditions. Within this scope, presenting the processing differences between High and Low attachment to RCs is one of the main aims of the study. Investigating the parser's reanalysis and disambiguating strategies when confronted with the sentences with local ambiguities is also aimed. The last aim of the study is to investigate whether there is a processing difference between SRCs and ORCs and whether they have an effect on attachment preferences of the parser to RCs. The methodology chapter is organized considering the aims of the present study, namely participants, materials, data collection tool, procedure, data analysis and theoretical framework as explained below.

3.1. PILOT STUDIES

Before the final version of the present study was developed, two pilot studies were conducted. Based on the findings of these studies, the design of the study including materials, data collection tools, participants and data analysis are finalized.

Each pilot study is elaborated below explaining the results and how they were improved prior to the final version of the present study.

3.1.1. Pilot Study I

In this section, main parts of the study, which are participants, materials, data collection tools, procedure, data analysis and results/suggestions are presented.

3.1.1.1. Participants

A total of seventeen students participated the experiment in return for a certain amount of money. One of the unplanned aspects of creating a participant group was their linguistic background. Their exposure to a second language environment, which could have considerable effects on language processing, was not considered. Therefore, participants of varying linguistic backgrounds were gathered into the same group.

3.1.1.2. Materials

The materials included forty-two target sentences and eighteen filler sentences. However, they covered a number of sentences, which caused difficulties on collecting an accurate account of reading times because sentences were observed to have unbalanced lengths.

(84) [Dükkan-ı aç-ıp temizle-yen] bakkal çırağ-ı
 [Grocer-ACC open-ADV clean-REL] grocery owner apprentice-ACC
 etraf-a göz kulak olma-sı konusunda sıkı sıkı tembih-le-di.
 around- DAT care taking be-3rd SG about firmly caution-PAST-3rd SG.
 The grocery owner who opened and cleaned the shop cautioned the apprentice strongly.

(85) [Dükkanı aç-ıp temizle-yen] bakkal çırağı müşterileri
 [Grocer-ACC open-ADV clean-PART] grocery owner apprentice customer-PL-ACC
 beklemeye başlamış-tı ki çocuklar birden dükkanı doldurdu.
 wait-PL-ACC start-PAST PART children suddenly store-ACC fill-PAST-3rd SG.

The grocery apprentice who opened and cleaned the shop started waiting for the customers when the children burst into the shop.

The experimental sentences some of which are given above are divided into three AoIs as RC area, Spillover area and Main Verb area. Some of the longer sentences were displayed on the screen in two lines, which also impaired reading times to be collected. Experimental sentences were of two sorts as High/Low Attachment sentences and SRC/ORC sentences.

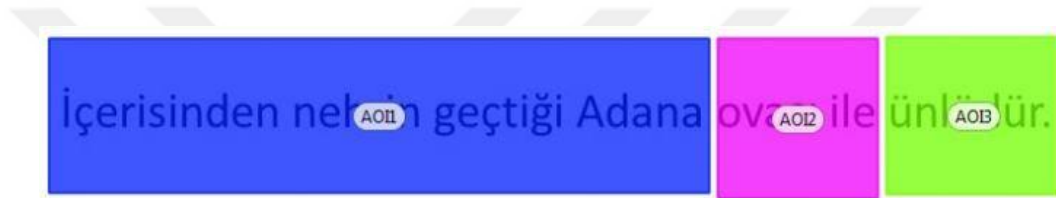


Figure 1. Areas of Interests Used in the SRC Sentences



Figure 2. Areas of Interests Used in the ORC Sentences

3.1.1.3. Data Collection Tool

Tobii Technology 1750 eye-tracker with a 17" TFT monitor (1280x1024 pixels) was used to collect the reading times and answers to the comprehension questions. The device is located in the Human Computer Interaction Research and Application Laboratory in Middle East Technical University.

3.1.1.4. Procedure

A series of procedures were followed before the implementation of the pilot study. Each participant was seated in front of the screen approximately within 60-70cm. The participants were instructed regarding the implementation of the study, i.e. which buttons to press to change the sentences and how to answer the comprehension questions.

3.1.1.5. Data Analysis

A normality test was not conducted on the data gathered from the participants. Furthermore, any statistical analysis was not used to analyze the data. Instead, mean and standard deviation results gathered from the two types of sentences were compared manually considering the first and total fixation reading times. The same was applied to the answers to the comprehension questions.

3.1.1.6. Results / Suggestions

A processing divergence between high and low attachment in Pilot Study I was not reached. More importantly, structural improvements were suggested at the end of the presentation. The first improvement was brought to the profile of the participants. It was decided that they would be selected from Turkish speakers only, and their exposure to a second language environment would also be considered. A new sentence list was suggested to be formed as the ones used in the pilot study failed to include a standard number of words and structural complexity. For the second pilot study, the order of target sentences presented below was maintained.

[[NP + VP] NP1, NP2, ADVP, NP3, MV]

It was also stated that the number of filler sentences had to be equal to the experimental sentences. Three AoIs were determined to be insufficient. With the aim of gaining more specific analysis of the processing tendencies, two additional AoIs were suggested as NP1 (the first noun that follow the RC area) and NP2 (the second noun that follow the RC area). An improvement was suggested to procedure of the study. A star sign would be placed on a random location on the screen so that the participants would start reading the given sentences wherever they wish to.

3.1.2. Pilot Study II

Considering all the feedback of the first pilot study, Pilot Study II was carried out at the same lab at Middle East Technical University. The participants, data collection tool and other methodological details of pilot study 2, as well as the results are elaborated below.

3.1.2.1. Participants

Fifteen participants were included into the experiment for which a certain amount of money was awarded. For this experiment, a controlled profile of the participants was maintained. Students were chosen from the ones who are monolingual Turkish speakers; they had not been exposed to a second language environment abroad. Also, for accurate eye-movement and reading time data, participants included to the experiment had normal eye sight and they were asked not to wear makeup.

3.1.2.2. Materials

The final version of the materials to be used in the study was formed. A standard number of words and sentence complexity was maintained. The number of experimental and filler sentences was equalized.

3.1.2.3. Data Collection Tool

The same lab and the same device used in Pilot Study I (Tobii Technology 1750 eye-tracker) was used to collect the reading times and answers to the comprehension questions. The device is located in the Human Computer Interaction Research and Application Laboratory in Middle East Technical University.

3.1.2.4. Procedure

In addition to the proposed procedure and the suggested changes, two sets of sentences were created. In the first set, the experimental and filler sentences were jumbled and a set was formulated. For the second set, the opposite order of the first one was used with the aim of preventing order effect (Schuman and Presser, 1981) in which participants' reading times could be longer towards the end of the study due to being exhausted.

3.1.2.5. Data Analysis

The data obtained in the experiment were analyzed using the SPSS (Statistical Package for the Social Sciences) package program. A normality test was run to see whether or not the data had a normal distribution. Hence, the T-test for two-way comparison and the ANOVA test for three-way comparisons were employed.

3.1.2.6. Results / Suggestions

The result of the pilot study suggested that the low attachment sentences were read in shorter duration in both first and total reading times thus, processing low attachment sentences caused a less amount of cognitive load on participants. The only improvement suggested to the study was to alter some of the main verbs among the experimental sentences. Certain verbs included idiomatic expressions, which were composed of two

words and this would unbalance the gathered reading times. Except this review, the final version of the present study was developed and it was ready to conduct the study on a larger study group.

3.2. PARTICIPANTS

The number of participants in the study was sixty-eight native Turkish speakers. All of them were undergraduate students in their first year at a state university in Adana, Turkey. The participants were chosen among volunteer students of the researcher and some extra points were also given for their participations at the end of the semester. Considering the results of the gaze sampling data, six participants were excluded from the study as their gaze samplings were below 80%, which was considered as a baseline. Besides, two participants' data were not considered in the experiment as their grades were lower than 75% which is the second criteria for the participants to meet. Therefore, the final number of participants is sixty (Female: 32, Male: 28). All of them were monolingual, native Turkish speakers, and they had never been abroad and exposed to another language until critical age. All of the participants had normal or corrected to normal vision.

3.3. MATERIALS

The total number of sentences in the study is eighty-four. Out of these sentences, the target sentence set, which included forty-two sentences, was divided into two groups as SRCs (twenty-one) and ORCs (twenty-one). Under each group attachment preferences, High Attachment (fourteen), High Attachment with Ambiguity (fourteen) and High Attachment (fourteen) groups are manipulated. Thus, in the study six conditions were

tested. These conditions included two RC types and three attachment types, which are shown below:

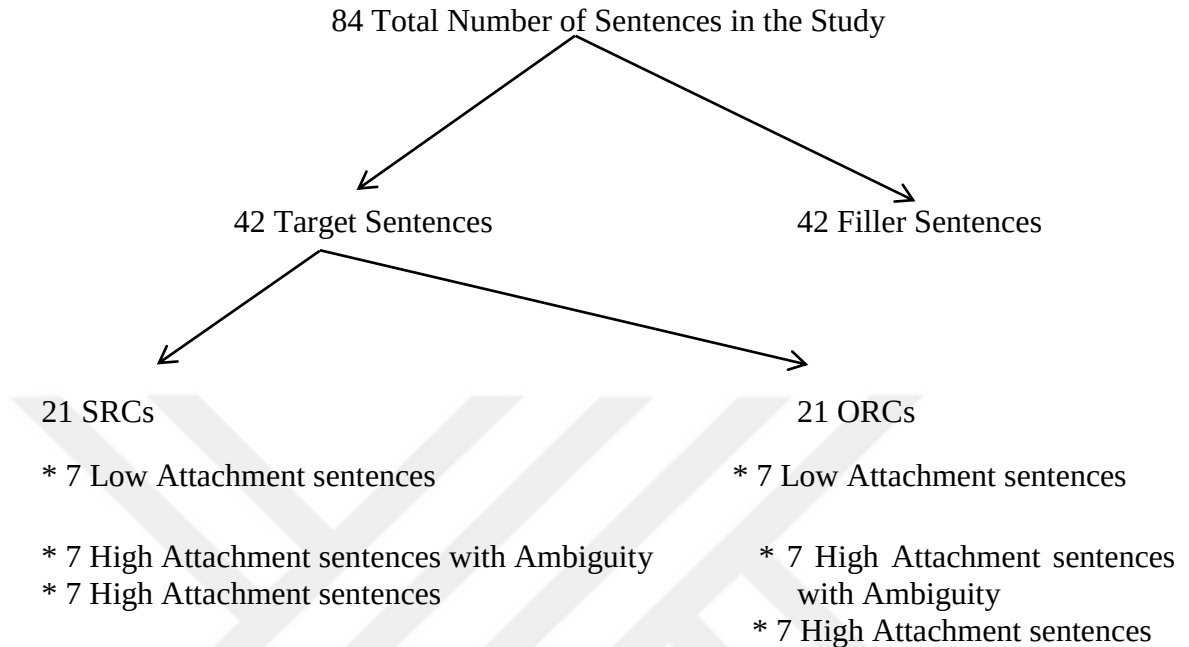


Figure 3. Design of Experimental Sentences

The rationale for the total number of forty-two experimental sentences in the study is due to maintaining an optimum working memory load of participants. Completion of each experiment by the participants lasted approximately 9-11 minutes. A longer duration is supposed to impair their performance on reading the given sentences and their answers to comprehension questions. An even number of experimental items is the key to collecting accurate data, therefore in essence seven items of each manipulation is determined. The sum of all items amounts to forty-two and combined with the other half of filler sentences, the total number of the items is eighty-four, which are also accompanied by comprehension questions.

The sentences below are the examples of target sentences containing RCs and distinct attachment patterns.

(86) SRC/Low Attachment

[Zabıta-yı gör-en] bakkal çırağ-ı hemen içeri girdi.

SRC

LOW

[Police-ACC see-PART] grocery assistant-POSS immediately inside enter-PAST-3rd SG.

SRC

LOW

The grocery (owner) assistant who saw the police went inside immediately.

(87) SRC/High Attachment with Ambiguity

[Zabıta-yı gören] bakkal çırağ-ı hemen ev-e gönderdi.

SRC

HIGH (with Ambiguity)

[Police-ACC see-PART] grocery owner assistant –ACC immediately home-DAT send-

SRC

HIGH (with Ambiguity)

PAST-3rd SG.

The grocery owner who saw the police sent the assistant home immediately.

(88) SRC/High Attachment

[Zabıta-yı gören] bakkal telefon-u hemen elin-e

SRC

HIGH

[Police-ACC see-PART] grocery owner telephone-ACC immediately hand-POSS-DAT

SRC

HIGH

aldı.

take-PAST-3rd SG.

The grocery owner who saw the police took the telephone in his hand immediately.

(89) ORC/Low Attachment

[Şehr-in sevdiğ-i] takım kaptan-ı çabucak ilgi-ye alıştı.

ORC

LOW

[The city-GEN love-PART-POSS] team captain-POSS quickly interest-DAT adapt-PAST-3rd SG.

ORC

LOW

The team captain whom the city loves quickly adapted to attention.

(90) ORC/High Attachment with Ambiguity

[Şehr-in sevdiğ-i] takım kaptan-ı çabucak yönetim-e

ORC

HIGH (with Ambiguity)

[The city-GEN love-PART-POSS] team captain-ACC quickly administration-DAT

ORC

HIGH (with Ambiguity)

gönderdi.

send-PAST-3rd SG.

The team which the city loves quickly sent to the administration.

(91) ORC/High Attachment

[Şehr-in sevdiğ-i] takım baklava-yı çabucak eller-i-ne

ORC

HIGH

[The city-GEN love-PART-POSS] team baklava-ACC quickly hand-POSS-PL-DAT
 ORC HIGH
 aldı.

hold-PAST-3rd SG.

The team which the city loves quickly held the baklava in their hands.

The term ‘high’ or ‘low’ is attributed to the distance of the NP to the RC. The NP that is closer to the RC is termed as low and the second NP following the RC is high. Central to the discussion of NP attachment to RCs in Turkish, Öztürk and Erguvanlı (2015) state that three structures can be used for possession relation: genitive possessive construction (GP), possessive-free genitive construction (PFG) and the genitive-free construction, also known as the possessive compound (PC).

(46) Kadın-**ın** doktor-**u** (GP)

woman-GEN

doctor-3PS-POSS

The doctor of the woman

(47) Kadın-**ın** doktor (PFG)

woman-GEN

doctor

The doctor of the woman

(48) Kadın doktor-**u** (PC)

woman

doctor-3PS-POSS

Women’s doctor (gynecologist)

(Öztürk and Erguvanlı, 2015:623)

In the present study, PCs that are given in (48) are employed to investigate attachment preferences of Turkish speakers to RCs. Öztürk and Erguvanlı (2015) indicate that PC structures along with PFGs (yukarıdaki numarayı ver) imply the presence of a PP. Unlike the GP (ilgili numarayı ver), the possession relation in PC and PFG does not include temporal value. Thus, it is parallel to an individual-level interpretation. It is

argued that the relation between two nominals in possessive phrases resembles to the relations established by prepositions.

As seen in the target sentences above, the main verbs which are used also differ according to their argument structure. In the Low Attachment sentences, the main verbs are transitive and take only one argument.

[DP__] V– gir- (to enter), - alı- (adopt)

In the High Attachment and High Attachment with Ambiguity sentences, the main verbs are all ditransitive and take two arguments.

[DP ____ DP {DP/PP}] V – gönder- (send), - al- (hold)

The experimental sentences described above are used in an online eye-tracking experiment to collect the data on reading time of the participants. The comprehension questions are asked the participants following each sentence in the study. An example True-False sentence following a target sentence is presented below.

Doğru/Yanlış? Bakkal çırağı hemen içeri girdi.
--

Figure 4. Sample Comprehension Question Item

There are also forty-two filler sentences to distract participants from the exact purpose of the experiment. While designing the filler sentences, subordinate sentence structures including RCs in Turkish are chosen in order to achieve a balance between sentences in terms of structural complexity. Below are some examples of the filler sentences that are used in the experiment.

(92) [Köpeğ-i öl-en] arkadaş-ım-ı dün gördüm.

[Dog-POSS die-PART] friend-POSS-ACC yesterday see-PAST-1st SG.

Yesterday, I saw my friend whose dog died.

(93) [Pırasa-dan nefret ed-en-ler] çoğunluk-ta-dır.

[Leek-ABL hatred practice-PART-PL] majority-DAT-be-3rd SG

(The ones) who hate leek are the majority.

(94) [150. kez soy-ul-an] ev sonunda yık-ıl-dı.

[150th time rob-PASS-PART] house finally demolish-PASS-PAST-3rd SG

The house that was robbed for the 150th time has finally been demolished

3.4. DATA COLLECTION TOOL

The data of the study were collected using a Tobii Technology 1750 eye-tracker with a 17" TFT monitor (1280x1024 pixels) integrated to it. The device collects eye-movements and fixations at a rate of 120Hz. The device was rented from a supplier in Ankara and shipped to the researcher's office. The data collection was carried out between 11 November 2016 and 14 November 2016. The participants read the sentences displayed on a computer screen while the integrated eye tracking system recorded their eye movements, in terms of where and how long the participants fixated. As a second measure, the comprehension questions appeared on the screen after each sentence that tested comprehension, which provided a comparison with the eye-tracking data.

3.5. PROCEDURE

Before the experiment started, some questions were asked to gather information about the participant profiles such as "Is Turkish your native language?", "Do you speak

another language?”, “How old are you?”, “Have you lived abroad and if yes, how long?” Participants were chosen from students who did not wear glasses. Female participants were asked not to wear make-up as it could deteriorate the eye-tacker camera results due to reflecting lights. Then, each participant was instructed about how to use the software and what to do after each sentence which would appear on the screen. Then, their eye pupils were calibrated with the device. Distance to the monitor and sensors below it are crucial to collecting accurate data. Therefore, each participant was made to sit in front of the monitor within 60-70cm. In order to stop participants fixating their gazes at the very beginning of sentences so that they could start reading the sentences however they prefer, a star was placed on a random place on each slide. Prior to the beginning of the experiment, each participant was given instructions by the researcher. It was told that they were supposed to press space button on the keyboard after they silently read the given sentence and fully comprehend it. Participants were allowed to press “TRUE” or “FALSE” button after reading the comprehension question about the given sentences. Having pressed either button, the cycle restarts with the star on the next slide. In order to prevent “order effect” (Schuman and Presser, 1981), two sets of stimulants were presented to participants to read and answer. The first set follows a certain order of experimental (target) sentences jumbled with the filler sentences. The other involves the opposite order so that possible higher reading times for the initial items and lower reading times for the last items would be eliminated. The participants with even numbers were given data set 1 sentence list while participants with odd numbers were given data set 2.

Tobii eye-tracking device software allowed jpeg formatted pictures for the experiment. Thus, the sentences were first written on MS Word, then transferred into MS

PowerPoint. The transformed sentence list was later saved as a separate file, in which each of the slides were converted into individual jpeg formatted pictures, which were finally compatible with the software of the eye-tracker. Calibri font and 26 character size were used for the experimental sentences. The sentences were black in color while the background was white.

In order to collect reading times of participants from the given sentences in the study, the device recorded each participant's reading times for critical parts of the target sentences, which are called area of interest (AoI), as they read the sentences. The software of the device calculates how long each participant spends reading a certain AoI and also, provides a number of descriptive statistics such as Mean, Median, Standard Deviation and others. Reading times (Sum) were collected from the software of the eye tracker program.

An example illustration of AoI collected from the eye-tracker is below.

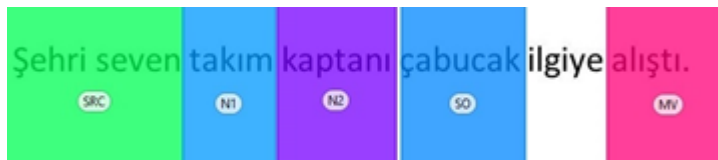


Figure 5. An Example AoI

The AoIs specified above are considered in the analysis of the first and second research questions. All AoIs are handled individually and factors that influence reading times are discussed across the three sentence types. For the third research question, the sentences were divided into two AoIs, the first of which is the RC area and the second is the entire sentence. The main motivation for analyzing the entire sentence as an AoI is that the analysis through separate AoIs do not yield meaningful data to discuss on.

3.6. DATA ANALYSIS

The reading time data and answers to the comprehension questions gathered from the eye-tracking device are analyzed in order to describe the attachment preferences and the RC asymmetry in Turkish in the present study. For the comprehension questions, the independent variables are the attachment types (Low Attachment, High Attachment (with Ambiguity)) and the RC types (SRC, ORC) and the dependent variable is correct answers to the question. Considering the reading times collected from the eye-tracking device, the independent variables are again the attachment types (Low Attachment, High Attachment (with Ambiguity)) and the RC types (SRC, ORC) while the dependent variable is reading times. For reading time analysis, two reading time measures (first fixation duration and total fixation duration) are used.

Initially, from a statistical point of view, participants' reading times and the answers to comprehension questions are analyzed whether they display normal distribution or not. If the data in a study has a normal distribution, it means that differences in participants' responses are within acceptable ranges. It also suggests that the study has a relatively more homogenous population. Normal distribution according to Tabachnick and Fidell (2013) is accepted to be between +1,5 and -1,5 while George and Mallery (2010) states that it is between +2,0 and -2,0.

Whether there is normal distribution or not also determines tests to be used in the data analysis. If the normal distribution of the data is observed, the parametric tests are used. However, if there is no normal distribution, the non-parametric tests are to be employed. In the study, as normal distribution is observed, the parametric tests are utilized. Büyüköztürk (2007) indicates that in studies with more than 50 participants, the

Kolmogorow Smirnow test is administered and if the number is below 50, the Shapiro-Wilkis test is used. It is also stated that the significance value of more than 0,05 implies a significant normal distribution. As the present study includes 60 participants, the Kolmogorow Smirnow test is employed. Eymen (2007) suggests that t-tests are used on two related but different data sets of a certain group. Büyüköztürk (2007) states that three conditions are required for t-tests to be used. The first is that the data must be within interval scales, the second is that the data must show a normal distribution and the third is that variance homogeneity must be maintained. Therefore, in the analysis of both reading times and comprehension questions, the independent t-test is used for two-way comparisons. In cases where the number of the data sets exceeds two, ANOVA (Analysis Of Variance) is preferred (Siegel and Castellan, 1988; Hollander and Wolfe, 1973; Friedman, 1937: 39, 40).

3.7. THEORETICAL FRAMEWORK

In the literature of sentence processing models, three main trends dominate the field, namely Universal Sentence Processing Models, Parameterized Models of Parsing and Experience-based Models of Sentence Processing (Papadopoulou, 2006). As a Universalist account of sentence processing, the Garden Path Model (Frazier, 1978, 1987; Frazier and Fodor, 1978; Frazier and Rayner, 1982) is employed in the present study. The model suggests that parsing of a given utterance is realized in two distinct stages. The first stage involves word licensing and building a primary tree regardless of considering non-syntactic features. On the second stage, the parser analyzes semantic and pragmatic well-formedness and corrects its interpretation if necessary. In the model, certain principles are investigated to sentence processing and garden-path recoveries. Late Closure (Frazier and Fodor, 1978) necessitates that the incoming linguistic

elements be attached to the phrase that is being parsed. The following principles *Attach*, *Attach Anyway* and *Adjust* (Fodor and Inoue, 1998, 2000) are scrutinized in the study in order to explain garden-path recoveries. *Attach* requires incoming input be attached into the phrase that is being parsed. In case of ambiguity detection, *Attach Anyway* is employed which mandates that syntactic priorities take precedence and parsing is continued according to structural relations of the incoming elements. Finally, the principle of *Adjust* is employed to make minimal changes and reach the intended interpretation of a given utterance. In the study, factors and conditions are tested to observe whether the mentioned model and principles accurately predicts the RC attachment preferences in Turkish.

The distance hypotheses, namely SDH and LDH (O'Grady, Miseon, and Miho, 2003), are central to scrutinizing the processing asymmetry of the SRCs and ORCs in the study. the SDH suggests that the difficulty of the RC processing can be predicted considering the number of intervening syntactic nodes/projections. On the other hand, the LDH predicts the difficulty of the RC processing based on the intervening words/terminal nodes in the syntactic tree.

CHAPTER 4

FINDINGS AND DISCUSSION

In the present study, investigating the processing of attachment preferences to relative clauses (RC) is the main aim. Within this framework, the effect of subject/object relative clause (SRC/ORC) asymmetry on attachment preferences is another point to be scrutinized. In addition, how participants handle local ambiguities in certain sentences is observed. Lastly, the processing preferences of participants in terms of attachment preferences and the RC types are compared to the final decisions of the participants considering their answers to the comprehension questions following the experimental sentences.

This chapter analyzes the data obtained from the participants in light of the research questions that are listed below:

1. What are the processing differences between High and Low Attachment to RCs in Turkish?
2. What strategies are used by the Turkish parser when confronted with a potential local ambiguity?
3. Is there a processing asymmetry between SRCs and ORCs in the context of attachment preferences? If so, does SRC/ORC asymmetry affect High and Low Attachment processing in Turkish?

For the implementation of the experiment, forty-two experimental and forty-two filler sentences were included. Out of the experimental sentences, RC type and attachment

types were manipulated. Twenty-one sentences include SRCs while the other twenty-one sentences include ORCs. Concurrently, for each RC type, seven sentences are High Attachment, seven sentences are Low Attachment and seven sentences are High Attachment with Ambiguity sentences. Consequently, six conditions were obtained and analyzed in the study.

Before the analysis of the data was presented, the normality distribution tests were used. The Kolmogorov-Smirnov (see Appendix III) tests indicate that the reading times across the sentence types present normal distribution. For two-way comparisons, the independent t-test is used and for three-way comparisons, The ANOVA is employed.

4.1. ANALYSIS OF ATTACHMENT PREFERENCES TO RELATIVE CLAUSES

In accordance with the first and second research questions, which are “What are the processing differences between High and Low Attachment to RCs in Turkish?” and “What strategies are used by the Turkish parser when confronted with a potential local ambiguity?”, all the experimental sentences are arranged under the headings of the High Attachment, Low Attachment with Ambiguity and Low Attachment, and the AoIs as RC (Relative Clause), NP1 (the first NP that immediately follows RC), NP2 (The second NP that follows RC) Spillover (The word that follows NP2) and MV (Main Verb) are analyzed in terms of these sentence types.

The specific AoI (RC, NP1, NP2, SO and MV) reading times are analyzed in a three-way comparison among the Low Attachment, High Attachment with Ambiguity and High Attachment sentences in terms of first fixation duration and total fixation duration reading times. The aim was to reveal which attachment type is processed in longer or

shorter time. Furthermore, the factors and strategies affecting the processing were further scrutinized.

As stated before, the data had a normal distribution. Therefore, ANOVA was employed to seek whether the attachment types are significantly different from each other regarding the AoIs.

In order to bring more insight into the analysis of attachment types, each AoI in the tables are scrutinized separately. Initially, the content of a given AoI is illustrated with example sentences from the materials used in the study. Following this part, the mean and standard deviation values for each AoI are presented and ANOVA results are also given later. Finally, the analyses of the results are presented.

AoI 1, which is abbreviated as “RC”, is analyzed through sentence types in terms of the first fixation duration reading times among the sentence types. As can be seen in the sentences below, AoI 1 is given in italics. They are the first two words of the sentences and they are the RC component. Regardless of the attachment or RC type, they are comprised of the same words and structure.

(95) ORC/Low Attachment

AoI1

[*Şehr-in* *sevdiğ-i*] takım kaptan-ı çabucak ilgi-ye alıştı.
 ORC LOW
 [The city-GEN love-RC-POSS] team captain-POSS quickly interest-DAT adapt-PAST-3rd SG.
 ORC LOW
 The team captain whom the city loves quickly adapted to attention.

(96) ORC/High Attachment with Ambiguity

AoI1

[*Şehr-in* *sevdiğ-i*] takım kaptan-ı çabucak yönetim-e
 ORC HIGH (with Ambiguity)
 [The city-GEN love-RC-POSS] team captain-ACC quickly administration-DAT
 ORC HIGH (with Ambiguity)
 gönderdi.

send-PAST-3rd SG.

The team which the city loves quickly sent to the administration.

(97) ORC/High Attachment

AoI1

[*Şehr-in sevdiğ-i*]

ORC

takım baklava-yı

HIGH

çabucak eller-i-ne

[The city-GEN love-RC-POSS] team baklava-ACC quickly hand-POSS-PL-DAT

ORC

HIGH

aldı.

hold-PAST-3rd SG.

The team which the city loves quickly held the baklava in their hands.

In Table 4 below, the descriptive statistics for three target sentence types are listed. The participants encounter RC areas as they incrementally read the target sentences. For this reason, the analysis of findings starts with presenting reading times for this AoI.

Table 4. Descriptive Statistics on Attachment Types for AoI 1 (RC) in First Fixation Duration

Type of Attachment	Mean	Std. Deviation	N
Low Attachment	,1346	,02255	60
High Attachment with Ambiguity	,1405	,02170	60
High Attachment	,1447	,01895	60

In Table 4 above, the descriptive statistics about AoI 1 ‘RC’ collected from all attachment types considering the first fixation duration reading times are presented. Considering the mean values, the reading times for the Low Attachment sentences ($X=,1346$) have the lowest while reading times for the aforementioned AoI is the highest for the High Attachment sentences ($X=,1447$). The High Attachment sentences that include a local ambiguity ($X=,1405$) are processed longer than the Low Attachment sentences and shorter than the High Attachment sentences.

In order to see whether the differences have a statistical significance, the ANOVA test is employed. Table 5 below shows the results of the ANOVA test.

Table 5. ANOVA Results on Attachment Types for AoI 1 (RC) in First Fixation Duration

Source of variation	Type III Sum of Squares	df	Mean Square	F	p	Significance
Between-Subjects	,125	59	,002			<i>None</i>
Within-Subjects	,002	2	,001	1,473	,233	
Error	,082	118	,001			
Total	,209	179				

Table 5 indicates that among the Low, High attachment with Ambiguity and High Attachment sentences there is no statistically significant difference in the first fixation duration reading times for AoI 1 (RC area).

The findings suggest that the insignificance in the reading times yields significant results for the sake of the study as it only increases the reliability of the implementation. The participants, in the first fixation duration, process the same incoming data including the same RC and NP. Similar as well as insignificant reading times suggest that the participants face the same cognitive load during the first fixation duration. Also, the fact that the two data sets (one with the opposite order of the other) were used also balances the order effect (Schuman and Presser, 1981), and presents more equally distributed reading times.

For the second part of the analysis of AoI 1, the total processing durations are considered. In this part, all the regressive fixations including the first fixations are combined and the figures in Table 6 are presented. Depending on the difficulty of processing of each sentence types, the reading times present diverging reading times as seen in Table 6 below.

Table 6. Descriptive Statistics on Attachment Types for AoI 1(RC) in Total Fixation Duration

Type of Attachment	Mean	Std. Deviation	N
Low Attachment	1,1367	,39232	60
High Attachment with Ambiguity	1,1221	,53472	60
High Attachment	,9601	,39299	60

Table 6 shows that when means of the sentence types are concerned, the highest reading time is observed on the Low Attachment type ($X=1,1367$) which is followed by the High Attachment with Ambiguity ($X= 1,1221$). The shortest reading time belongs to the High Attachment sentence type ($X=,9601$) as seen in Table 6 above.

In order to see whether the differences in these mean values have a statistical significance, the ANOVA test is administered. The results are given in Table 7 below.

Table 7. ANOVA Results on Attachment Types for AoI 1(RC) in Total Fixation Duration

Source of variation	Type III Sum of Squares	df	Mean Square	F	p	Significance
Between-Subjects	29,923	59	,507			Low A. - High A. High A. w/A. - High A.
Within-Subjects	1,216	2	,608	13,749	,001	
Error	5,219	118	,044			
Total	36,358	179				

Considering the ANOVA test results for the sentence types, Table 7 above shows that significant differences ($p=,001$) are observed between the Low and High Attachment sentences. More specifically, significantly more amount of time is spent for the Low Attachment sentences. Furthermore, a statistically significant difference ($p=,001$) between the High Attachment with Ambiguity and High Attachment sentence occurs, which is to the advantage of the High Attachment type. The cognitive load for parsing

the RC area for the High Attachment sentences seems to be the least. On the other hand, between the Low and High Attachment with Ambiguity sentence types, a significant difference is not observed.

A clear difference between the first and the total fixation duration is observed in terms of the Low and High Attachment sentences. Although the Low Attachment sentences have the shortest reading times for AoI 1 in the first fixation duration, the High Attachment sentences are observed to be read in the shortest time in the total fixation duration. The total processing time which is spent to successfully attach the RC area to only one NP in the High Attachment sentences is completed with significantly less cognitive load than in the Low Attachment sentences. It could be stated that the Low Attachment analysis causes heavier burden for the parser. It is discussed later in the further AoI analyses. Nevertheless, it could be briefly stated here that although leaving the node for NP1 open for further incoming words can be thought as an economical nature of the parser, it causes conflicting situation. The Late Closure (Frazier and Fodor, 1978) is the case in the Low Attachment and High Attachment with Ambiguity sentences. During the parsing of the RC area, a high level of animacy-sensitiveness enables the reader to include NP2 in the opened node and to attach it to the argument of the RC area. The fact that the reading times of the Low Attachment and High Attachment with Ambiguity sentences do not significantly differ also provides results to discuss on. As stated before, both sentence types include the same NPs following AoI 1 area. In parsing of the Low Attachment sentences, the second NP is the agent/patient of the action in the sentence. On the other hand, it is the direct object of the main verb in the High Attachment with Ambiguity sentences. Although there are structural differences between the attachment types, the participants may still feel a garden-path

when reading the Low Attachment sentences. This may cause statistically similar reading times of the RC area. Finally, it is safe to say that significantly shorter reading times are the case for the High Attachment sentence type in terms of the RC area.

AoI 2 which is abbreviated as ‘NP1’ is analyzed through the sentence types in terms of the first fixation duration reading times. NP1 is the very first noun that follows the RC area. This AoI is once again the same word across all attachment types as can be seen in Italics below.

(98) SRC/Low Attachment

AoI 2

[Zabıta-yı gör-en] bakkal çırağ-ı hemen içeri girdi.
SRC LOW

[Police-ACC see-RC] grocery assistant-POSS immediately inside enter-PAST-3rd SG.
SRC LOW

The grocery (owner) assistant who saw the police went inside immediately.

(99) SRC/High Attachment with Ambiguity

AoI 2

[Zabıta-yı gören] bakkal çırağ-ı hemen ev-e gönderdi.
SRC HIGH (with Ambiguity)

[Police-ACC see-RC] grocery owner assistant –ACC immediately home-DAT send-
SRC HIGH (with Ambiguity)
PAST-3rd SG.

The grocery owner who saw the police sent the assistant home immediately.

(100) SRC/High Attachment

AoI 2

[Zabıta-yı gören] bakkal telefon-u hemen elin-e
SRC HIGH

[Police-ACC see-RC] grocery owner the telephone-ACC immediately hand-POSS-DAT
SRC HIGH

aldı.

take-PAST-3rd SG.

The grocery owner who saw the police took the telephone in his hand immediately.

The descriptive statistics for three target sentence groups (Low Attachment, High Attachment with Ambiguity and High Attachment) are presented in Table 8.

Table 8. Descriptive Statistics on Attachment Types for AoI 2 (NP1) in First Fixation Duration

Type of Attachment	Mean	Std. Deviation	N
Low Attachment	,1748	,03405	60
High Attachment with Ambiguity	,1678	,03997	60
High Attachment	,1649	,02831	60

Table 8 indicates that the reading times for the Low Attachment sentence type ($X=,1748$) have the highest mean. The High Attachment with Ambiguity ($X=,1678$) comes second while the High Attachment has the lowest ($X=,1649$) mean value.

In order to see whether the differences in reading times have significance, the ANOVA test is administered, and the results can be seen in Table 9.

Table 9. ANOVA Results on Attachment Types for AoI 2 (NP1) in First Fixation Duration

Source of variation	Type III Sum of Squares	df	Mean Square	F	p	Significance
Between-Subjects	,151	59	,003			Low A. - High A.
Within-Subjects	,003	2	,002	3,148	,047	
Error	,059	118	,000			
Total	,213	179				

As can be seen in Table 9 the differences in mean values are significant as they are less than 0,05. The table above also illustrates the results for the ANOVA test in order to present specifically which pairs have significant differences. Considering Table 9 above the significances are observed in mean differences between the reading times of the Low and High Attachment sentence types in terms of the first fixation duration.

($p=0,015$). Significantly more time is spent reading the noun phrase that immediately comes after the RC area. However, there is not a significant difference between the Low Attachment and High Attachment with Ambiguity, and between the High Attachment with Ambiguity and High Attachment.

For further analysis of the AoI 2, the total fixation duration reading times are presented below. In this part, all the regressive fixations including the first fixations are combined and the figures in Table 10 are presented. Depending on the difficulty of processing of each sentence types, the reading times present diverging reading times as seen in Table 10 below.

Table 10. Descriptive Statistics on Attachment Types for AoI 2 (NP1) in Total Fixation Duration

Type of Attachment	Mean	Std. Deviation	N
Low Attachment	,5529	,16692	60
High Attachment with Ambiguity	,5600	,20834	60
High Attachment	,4497	,16880	60

The means /standard deviations values for the total fixation duration reading times from the three sentence types (Low Attachment, High Attachment with Ambiguity and High Attachment) are presented in Table 10 above. Considering the mean values, it is seen that the High Attachment with Ambiguity ($X=,5600$) has the highest mean value. The Low Attachment sentence type ($X=,5529$) has the second highest mean value while the High Attachment ($X=,4497$) has the least. In order to see whether the differences in these mean values have a statistical significance, the ANOVA test is administered. The ANOVA test results below present which sentence types have significantly different reading times.

Table 11. ANOVA Results on Attachment Types for AoI 2 (NP1) in Total Fixation Duration

Source of variation	Type III Sum of Squares	df	Mean Square	F	p	Significance
Between-Subjects	4,153	59	,070			Low A. - High A. High A. w/A. - High A.
Within-Subjects	,440	2	,220	14,140	,001	
Error	1,836	118	,016			
Total	6,429	179				

As can be observed in Table 11 above, the significant reading time differences ($p=,001$) were observed between the Low and High Attachment, and between the High Attachment with Ambiguity and High Attachment sentence types ($p=,001$). In total processing time of this AoI, there is a significant ease for the High Attachment sentences. It is assumed that the parser verifies the initial processing strategy while reading the given sentences with the High Attachment. This could be attributed to the fact that the processing of NP1 as the only agent/theme of the action in RC (AoI1) area depending on whether it is a SRC or ORC sentence. In the Low Attachment and High Attachment with Ambiguity sentences, NP1 is not the only candidate for agent/theme of the action in RC. NP2 (AoI 3) is the agent of the Low Attachment sentences and that causes the significantly higher reading times than that of the High Attachment. Also, in the High Attachment with Ambiguity sentences, exactly the same noun is licensed as the direct object of the main verb. This is a similar result to the one that is gathered from the RC (AoI1) area. The Low Attachment sentence type reading times for the specified area is significantly longer than that of the High Attachment sentences. Also, the fact that the Low Attachment and High Attachment with Ambiguity sentences do not possess significantly different reading times is another feature of Turkish parser with

fewer tendencies toward the Low Attachment. It can again be attributed to the fact that the parser inherently assumes that the Low Attachment sentences include a local ambiguity.

AoI 3 which is abbreviated as ‘NP2’ is analyzed in terms of the first fixation duration reading times among the sentence types. NP2 is the second NP that follows the RC area. In the Low Attachment sentences, the noun in this area is licensed as the agent/theme of the action in the RC. However, although it is the same noun with the same suffix on the surface structure, NP2 in the High Attachment with Ambiguity serves as the theme/direct object of the main verb. The NP in question in the High Attachment sentences is another word with a different meaning as can be seen as follows:

(101) ORC/Low Attachment

		AoI 3	
[Ailesinin	kızdığı]	<u>köylü çocuğu</u>	aniden evden
ORC		LOW	
[Family-GEN	get mad-PART-3 rd SG.]	<u>village child-POSS</u>	quickly house-ABL
ORC		LOW	
ayrıldı.			
leave-PAST-3 rd SG.			
The village child who his family got mad at left the house quickly.			

(102) ORC/High Attachment with Ambiguity

		AoI 3	
[Ailesinin	kızdığı]	<u>köylü çocuğu</u>	aniden evden
ORC		HIGH with Ambiguity	
[Family-GEN	get mad-PART-3 rd SG.]	<u>village child-ACC</u>	quickly house-ABL
ORC		HIGH	
kovdu.			
expel-PAST-3 rd SG.			
The villager who his family got mad at expelled the child from the house.			

(103) ORC/High Attachment

		AoI 3	
[Ailesinin	kızdığı]	<u>köylü çapayı</u>	aniden elinden
ORC		HIGH	
[Family-GEN	get mad-PART-3 rd SG.]	<u>village hoe-ACC</u>	quickly hand-ACC-ABL
ORC		HIGH	

attı.

throw-PAST-3rd SG.

The villager who his family got mad at threw the hoe out of his hand.

In Table 12 below, the descriptive statistics for the Low, High with Ambiguity and High attachment sentence types are given.

Table 12. Descriptive Statistics on Attachment Types for AoI 3 (NP2) in First Fixation Duration

Type of Attachment	Mean	Std. Deviation	N
Low Attachment	,2047	,03639	60
High Attachment with Ambiguity	,1837	,03742	60
High Attachment	,2155	,05466	60

Table 12 above shows that the High Attachment sentence type has the highest mean value ($X=,2155$). The Low Attachment sentences ($X=,2047$) come second with the second highest mean value while the High Attachment with Ambiguity has the least ($X=,1837$).

In order to see whether the differences in these mean values have a statistical significance, the ANOVA test is administered, and the results are given in Table 13 below.

Table 13. ANOVA Results on Attachment Types for AoI 3 (NP2) in First Fixation Duration

Source of variation	Type III Sum of Squares	df	Mean Square	F	p	Significance
Between-Subjects	,284	59	,005			Low A. - High A. w/A High A. w/A. - High A.
Within-Subjects	,031	2	,016	25,910	,001	
Error	,071	118	,001			
Total	,386	179				

As can be seen in Table 13 a significance exists between the Low and High Attachment with Ambiguity types ($p=0,00$). In addition, between the High Attachment with Ambiguity and High Attachment sentences, a significant difference of $-,044$ ($p<0,05$) occurs. However, the significance value of $,068$ between the Low and High Attachment sentences indicate that this difference is not statistically significant ($p<0,05$).

Before comparing AoI 3 “NP2” among the three sentence types in terms of the total fixation duration reading times, the mean and standard deviation values are presented in Table 14 below.

Table 14. Descriptive Statistics on Attachment Types for AoI 3 (NP2) in Total Fixation Duration

Type of Attachment	Mean	Std. Deviation	N
Low Attachment	,5840	,22716	60
High Attachment with Ambiguity	,7044	,32501	60
High Attachment	,6741	,27528	60

As can be seen in Table 14 the longest time is spent at the High Attachment with Ambiguity sentence type ($X=,7044$). The High Attachment sentence type comes second ($X=,6741$), and the Low Attachment sentence type ($X=,5840$) involves the least time spent in terms of the total fixation duration reading times.

Following the ANOVA test, significant differences between sentence types are presented in Table 15 below.

Table 15. ANOVA Results on Attachment Types for AoI 3 (NP2) in Total Fixation Duration

Source of variation	Type III Sum of Squares	df	Mean Square	F	p	Significance
Between-Subjects	8,882	59	,151			Low A. - High A. w/A Low A. - High A.
Within-Subjects	,336	2	,168	8,667	,001	
Error	2,289	118	,019			
Total	11,507	179				

Table 15 above shows that a significant mean value difference exists between the Low and High Attachment with Ambiguity sentences ($p=.003$) and between the Low and High Attachment sentences ($p=0.001$). However, the reading times of AoI3 in the High Attachment sentences are not significantly different ($p=1.000$) from the High attachment with Ambiguity sentences.

For AoI 3, the second NP following the RC area, the highest reading times are observed for the High Attachment sentences ($X=,2155$) in terms of the first fixation duration reading times. On the other hand, the High Attachment with Ambiguity yields the lowest reading times for this area ($X=,1837$). These reading times yield statistically different results and according to the other statistical calculations within the SPSS program, between the Low and High Attachment with Ambiguity sentences, and between the High Attachment with Ambiguity and High Attachment sentences there are significant differences. This rather different result can be interpreted in this way. In the initial analysis of the Low and High Attachment with Ambiguity sentences, AoI3 is another possible agent/theme candidate for the action in the relative clause. Thus, when reading is continuing, this area, without losing time, is added into the node opened for the previous NP (AoI2) which presents evidence for the Late Closure (Frazier and

Fodor 1978). The semantic properties of NP2 also raises its chance to be included into the opened node. Hence, the initial processing of this area is relatively shorter than that of the High Attachment sentences as it includes a different type of NP.

Besides its semantic/pragmatic properties of NP2, morphological structure of this NP also causes ambiguity to discuss on. The suffix that NP2 holds is an agreement marker in the Low Attachment sentences. The same morphological (on the surface) marker acts as accusative case suffix in the High Attachment with Ambiguity sentences, making it the direct object of the main verb. At the end of the initial reading when the main verb is reached, this local ambiguity is detected and the parser concludes that this NP cannot be a candidate for the action in the RC area of the High Attachment with Ambiguity sentences. Following this decision, a new node is opened for this NP. It makes it direct object of the main verb, which initiates repair operation and this increases the processing time.

Table 14 shows that the High Attachment sentences are processed in unprecedentedly longer time. Considering the semantic/pragmatic properties of the High Attachment sentences, it is safe to state that AoI 3 is not a candidate for the agent/theme position of the action in the RC area. Unlike the incremental and smooth processing of the aforementioned attachment types, the parser's initial analysis of this area takes particularly longer than it does in other AoIs. It results from the fact that on this point, the parser selectively stops and perceives NP2 as the direct object of the main verb thus creating a separate node for it even at the initial reading of the given sentences. This realization and the related operations are carried out even in initial reading, which is considerable. It proves that the Turkish parser possesses syntactic parsing and semantic/pragmatic awareness at the same time even in initial analysis. Inflated reading

times decrease to reach an equilibrium and the High Attachment sentences do not involve the highest reading times when the total fixation duration reading times are considered.

For the total fixation duration reading times, the initial analysis for the Low Attachment sentences and especially the High Attachment with Ambiguity sentences are revised. The highest amount of time is spent in the High attachment with Ambiguity sentences ($X=,7044$) while the shortest time is observed for the Low Attachment sentences. As stated before, AoI1/2/3 are the same for the Low Attachment and for the High attachment with Ambiguity. However, -(s)I suffix in AoI3 acts as possessive marker in the Low Attachment sentences and it is the agent/theme of action in the RC. On the other hand, the same suffix acts as an agreement marker in the High Attachment with Ambiguity, making it direct object of the main verb. For the Low Attachment sentences, initial analysis is kept constant and also in later analysis, it provides an advantage as to lower reading times. It is observed that a clear cut statistical difference between the Low and High Attachment sentences is observed. In regard to the High Attachment sentences, extra processing load in the initial analysis is confirmed. Therefore, it does not have the highest reading times for this category. For the Turkish parser on this point, it is possible to postulate that Turkish supports the Late Clouse (Frazier and Fodor 1978). As processing incrementally continues, the incoming materials are added into the analysis of the opened node. However, the High Attachment sentence analysis shows that the parser is also sensitive about semantic properties of the incoming words. Even at the early stages of analysis, incremental processing is accompanied by semantic/pragmatic awareness.

The spillover area (AoI 4) is worth considering as it provides insights into the cognitive load of the previous AoIs. AoI3 (NP2) is one of the central parts of the study that is why, analyzing the word next to it in terms of reading times (means, standard deviations) and seeking statistically significant differences possibly gives us better understanding into the parsing strategies. As a reminder, this AoI is exemplified in the experimental sentences below.

(104) SRC/Low Attachment

AoI 4

[Medyayı	seven]	<u>şirket patronu</u>	<i>memnuniyetle</i>
SRC		LOW	
[Media-ACC like- PART]	<u>company boss-POSS</u>	<i>gladly</i>	
SRC		LOW	

soruları cevapladı.
question-PL-POSS answer-PAST-3rd SG.
The company boss who likes the media gladly answered the questions.

(105) SRC/High Attachment with Ambiguity

AoI 4

[Medyayı	seven]	<u>şirket</u>	patronu	<i>memnuniyetle</i>
SRC		HIGH with Ambiguity		
[Media-ACC like- PART]	<u>company</u>	boss-ACC	<i>gladly</i>	
SRC		HIGH with Ambiguity		

programa gönderdi.
event-DAT send-PAST-3rd SG..

The company which likes the media gladly sent the boss to the event.

(106) SRC/High Attachment

AoI 4

[Medyayı	seven]	<u>şirket</u>	kapıları	<i>memnuniyetle</i>	ziyaretçilere
SRC		HIGH			
[Media-ACC like- PART]	<u>company</u>	door-PL-ACC	<i>gladly</i>		guest-PL-DAT
SRC		HIGH			

açtı.
open-PAST-3rd SG.
The company which likes the media gladly opened the doors to guests.

As seen in the sentences above, the spillover words are the same among all sentences. They are also selected to be adverbs. The main motivation for choosing adverbs for this position is to help the parser stop adding more incoming materials into the attachment operation.

In Table 16 below, the descriptive statistics for the Low, High with Ambiguity and High attachment sentence types are given.

Table 16. Descriptive Statistics on Attachment Types for AoI 4 (Spillover) in First Fixation Duration

Type of Attachment	Mean	Std. Deviation	N
Low Attachment	,2114	,04213	60
High Attachment with Ambiguity	,2002	,04544	60
High Attachment	,2031	,03652	60

Table 16 clearly indicates that the means for the sentence types have quite similar results considering the first fixation duration reading times. The High attachment with Ambiguity sentence type has the lowest mean reading time ($X=,2002$) compared to the other types. The highest reading time belongs to the Low Attachment sentence type ($X=,2114$) followed by High Attachment ($X=,2031$).

In order to see whether the differences in these mean values have statistical significance, the ANOVA test is administered, and the results are given in Table 17 below.

Table 17. ANOVA Results on Attachment Types for AoI 4 (Spillover) in First Fixation Duration

Source of variation	Type III Sum of Squares	df	Mean Square	F	p	Significance
Between-Subjects	,244	59	,004			Low A. - High A.
Within-Subjects	,004	2	,002	3,945	,022	
Error	,061	118	,001			
Total	,309	179				

Table 17 shows that there are significant differences only between the Low and High Attachment sentence types ($p=.021$). No statistically significant difference is observed between the High Attachment with Ambiguity sentences and the Low/High Attachment sentence types in terms of the first fixation duration.

The total fixation duration reading times for spillover area (AoI 4) are presented in Table 18 below.

Table 18. Descriptive Statistics on Attachment Types for AoI 4 (Spillover) in Total Fixation Duration

Type of Attachment	Mean	Std. Deviation	N
Low Attachment	,5784	,21438	60
High Attachment with Ambiguity	,6517	,26606	60
High Attachment	,5721	,20425	60

The highest reading times for this area, as can be seen in Table 18 above, belong to the High Attachment with Ambiguity sentences ($X=.6517$). The lowest reading times are observed at the High attachment sentences ($X=.5721$) closely followed by the Low attachment sentences ($X=.5784$).

In order to see whether the differences in these mean values have statistical significance, the ANOVA test is administered, and the results are given in Table 19 below.

Table 19. ANOVA Results on Attachment Types for AoI 4 (Spillover) in Total Fixation Duration

Source of variation	Type III Sum of Squares	df	Mean Square	F	p	Significance
Between-Subjects	7,619	59	,129			Low A. - High A. w/A High A. w/A - High A.
Within-Subjects	,235	2	,118	8,024	,001	
Error	1,730	118	,015			
Total	9,584	179				

Table 19 shows that the total fixation duration reading times of the High Attachment with Ambiguity sentences are significantly higher than that of the Low and High Attachment sentences ($p=,002$ in both cases). However, a statistical significance is not observed between the Low Attachment and High Attachment sentence types ($p=,889$).

The spillover area in this study consists of adverbs that modify main verbs. In the incremental trajectory of sentence processing, the inflated reading times for spillover area provide valuable information for observing the cognitive load of the previous word especially regarding the total fixation duration reading times. From this point of view, interpretation of NP2 (AoI3) in the High Attachment with Ambiguity requires heavy revisions in the late processing. In the first fixation duration of NP2, parsing continues to hold it in the opened node for NP1 as the candidate for the agent/patient of the action in RC area. Having reached the main verb of the sentence, the parser's interpretation is revised to make NP2 the direct object of the main clause. Significantly longer fixation durations in spillover area are another indicator of this result.

The last AoI that is investigated in the study is the main verb. It is one of the key elements that help us observe the attachment processing load and preferences. Licensing of arguments assigned by the main verbs can be explained by scrutinizing reading times. As a reminder of the experimental sentences, the sentences are presented below with AoI 5 given in *Italics*.

(107) ORC/Low Attachment

[Doktorun beklediği] hasta yakınları
 ORC AoI 5 LOW
 [Doctor-GEN wait-PART-3rd SG.] patient relative-PL-POSS
 ORC LOW

üzüntüyle kapıya *baktı.*
 sadly door-DAT look-PAST.

The patient relatives who the doctor was waiting sadly looked at the door.

(108) ORC/High Attachment with Ambiguity

[Doktorun beklediği] hasta yakınları
 ORC AoI 5 HIGH with Ambiguity
 [Doctor-GEN wait-PART-3rd SG.] patient relative-PL-ACC
 ORC HIGH with Ambiguity

üzüntüyle dışarı *gönderdi.*
 sadly outside-DAT send-PAST.

The patient who the doctor was waiting sadly sent the relatives out.

(109) ORC/High Attachment

[Doktorun beklediği] hasta resmi
 ORC AoI 5 HIGH
 [Doctor-GEN wait- RC-3rd SG.] patient photo-ACC
 ORC HIGH

üzüntüyle masaya *bıraktı.*
 sadly table-DAT leave-PAST.

The patient who the doctor was waiting sadly left the photo on the table.

As seen in the sentences above, all the main verbs consist of different actions. In addition, in order to satisfy the attachment type criteria, the verb in the Low Attachment sentence is a transitive verb. On the other hand, the verbs in the High Attachment and High Attachment with Ambiguity sentences are ditransitive.

Three-way comparisons for AoI 5 “MV” are presented below in terms of the first fixation duration reading times. In Table 20 below, the descriptive statistics for the Low, High with Ambiguity and High attachment sentence types are given.

Table 20. Descriptive Statistics on Attachment Types for AoI 5 (MV) in First Fixation Duration

Type of Attachment	Mean	Std. Deviation	N
Low Attachment	,1703	,03618	60
High Attachment with Ambiguity	,1800	,03993	60
High Attachment	,1558	,04036	60

Table 20 above shows that the High Attachment with Ambiguity sentence has the highest mean value ($X=,1800$) followed by the Low Attachment sentences ($X=,1703$) while the High Attachment sentence type ($X=,1558$) has the shortest reading time. In order to detect where significant reading times stem from, the ANOVA test is administered, and the results are in Table 21 below.

Table 21. ANOVA Results on Attachment Types for AoI 5 (MV) in First Fixation Duration

Source of variation	Type III Sum of Squares	df	Mean Square	F	p	Significance
Between-Subjects	,159	59	,003			Low A. - High A. w/A High A. w/A - High A.
Within-Subjects	,018	2	,009	9,770	,001	
Error	,108	118	,001			
Total	,285	179				

As can be seen in Table 21 above, the ANOVA test scores reveal that there are significant differences between the Low and High Attachment sentence types ($p=,005$), and between the High Attachment with Ambiguity and High Attachment sentences ($p=,001$). However, between the Low Attachment and High Attachment with Ambiguity, a significant difference is not observed ($p=,034$).

AoI 5 which is abbreviated as “MV” is also analyzed through sentence types in terms of the total fixation duration reading times among the sentence types. In Table 22 below, the descriptive statistics for three target sentence types are given.

Table 22. Descriptive Statistics on Attachment Types for AoI 5 (MV) in Total Fixation Duration

Type of Attachment	Mean	Std. Deviation	N
Low Attachment	,3051	,09788	60
High Attachment with Ambiguity	,4438	,16815	60
High Attachment	,2673	,07763	60

Table 22 indicates that the High Attachment with Ambiguity sentence type has the highest mean value ($X=,4438$) and the Low Attachment sentence type the second ($X=,3051$) while the High Attachment the least ($X=,2643$).

In order to determine which groups have significantly different reading time values, the ANOVA test is employed. Regarding the results of this test, significant differences are observed among all groups as significance values are lower than 0,05 as seen in Table 23 below.

Table 23. ANOVA Results on Attachment Types for AoI 5 (MV) in Total Fixation Duration

Source of variation	Type III Sum of Squares	df	Mean Square	F	p	Significance
Between-Subjects	,159	59	,003			Low A. - High A. w/A High A. w/A - High A. Low A. - High A.
Within-Subjects	,018	2	,009	9,770	,001	
Error	,108	118	,001			
Total	,285	179				

Table 23 above shows that when three-way comparisons for the main verb (AoI5) are analyzed for total fixation duration reading times, it is seen that the High Attachment sentences ($X=,1558$) have the lowest reading times. For the High Attachment with Ambiguity sentences, reading time is the highest ($X=,1800$).

In case of the High Attachment with Ambiguity, the main verb reading has the highest time because the initial analysis of AoI 3 (NP2) is not confirmed when the end of the sentence is reached. In these sentences, main verb is a ditransitive verb. Upon processing it, the parser feels “being led into the Garden Path”, which automatically increases the reading times. The main verb acts as an “error signal” as suggested by Ferreira and Henderson (1991, 1998). This is the location in a given sentence where the parser notices the ill-formed syntactic tree for the locally ambiguous sentence. Unlike their experiment, the lowest reading time for the High Attachment sentences can be attributed to the successful parsing of the AoI 3 (NP2) in the initial analysis before the main verb is reached. The parser reaches the main verb, confirms his/her analysis and does not need heavy reanalysis or repair operations.

For the total fixation duration times, significant differences across all the sentence types are observed when compared to one another. Once again, the High Attachment sentences have the lowest reading times ($X=,2673$) while the High attachment with Ambiguity sentence type the highest ($X=,4438$). Analysis for the first fixation duration reading times can also account for the total fixation duration reading times. Necessary parsing revisions for NP2 inflated the reading times of the main verb at the High Attachment with Ambiguity sentences. The parser interprets AoI3 (NP2) in this sentence type as the Low Attachment; however, once the main verb of the sentence is reached, it reveals that it is not the case. An operation termed as “theft”, first proposed

by Fodor and Inoue (1998) and supported by Ferreira, Christianson and Hollingworth (2001), takes place. According to their model “*Attach (Anyway)*” and “*Adjust*” (Fodor and Inoue, 1998, 2000), when the “error signal” main verb (ditransitive) is reached, it is signaled that the theme is not licensed as required by the main verb. The parser then goes back to the head of the misanalysed phrase “NP2”. It is stolen and licensed as the theme of the main verb. In short, the parser spends more time than on the other sentence types to repair his/her interpretation.

General Discussion of Findings about Processing Attachment Preferences

The analyses given in the section 4.1 were carried out to answer the first and the second research questions: “What are the processing differences between Low and High Attachment to RCs in Turkish?” and “What strategies are used by the Turkish parser when confronted with a potential local ambiguity?” A general overview of the findings and related discussion is provided and answer to the research question is presented in this section.

The table below summarizes the results presented and discussed in this section. Each slot in Table 24 provides information about the reading times belonging to the sentence types in terms of AoIs and processing types. The sentence types are ordered from the highest to the lowest reading times in slots. For instance, in the slot that AoI1 (RC) and the first fixation duration reading time intersect, the highest reading times belong to the High Attachment sentence type, the second lowest belong to the High Attachment with Ambiguity and the shortest reading time belong to the Low Attachment sentence type. Below the ordering of sentence types, subheading “Significance” presents which

sentence types possess a significant relation considering reading times and the AoI in question. All findings are summarized in Table 24.

Table 24. Summary of Processing Ranking through Attachment Types and Significances

AoI	First fixation duration	Total Fixation Duration
RC (AoI1)	1. High Attachment 2. High Attachment with Ambiguity 3. Low Attachment <u>Significance:</u> None	1. Low Attachment 2. High Attachment with Ambiguity 3. High Attachment <u>Significance:</u> Low A. – High A. High A. with Ambg. - High A.
NP1 (AoI2)	1. Low Attachment 2. High Attachment with Ambiguity 3. High Attachment <u>Significance:</u> LowA. – High A.	1. High Attachment with Ambiguity 2. Low Attachment 3. High Attachment <u>Significance:</u> LowA. – High A. High A. with Ambg. - High A.
NP2 (AoI3)	1. High Attachment 2. Low Attachment 3. High Attachment with Ambiguity <u>Significance:</u> LowA. – High A. with Ambg. High A. with Ambg. - High A.	1. High Attachment with Ambiguity 2. High Attachment 3. Low Attachment <u>Significance:</u> LowA. – High A. LowA. – High A. with Ambg.
SO (AoI4)	1. Low Attachment 2. High Attachment 3. High Attachment with Ambiguity <u>Significance:</u> LowA. – High A. with Ambg.	1. High Attachment with Ambiguity 2. Low Attachment 3. High Attachment <u>Significance:</u> LowA. – High A. with Ambg. High A. with Ambg. – High A.
MV (AoI5)	1. High Attachment with Ambiguity 2. Low Attachment 3. High Attachment <u>Significance:</u> LowA. – High A. High A. with Ambg. – High A.	1. High Attachment with Ambiguity 2. Low Attachment 3. High Attachment <u>Significance:</u> LowA. – High A. High A. with Ambg. – High A. LowA. – High A. with Ambg.

A close look at the High and Low Attachment sentences reading times presents insights into attachment preferences in Turkish as can be seen in Table 24 above. In the first fixation duration, the Low Attachment sentences are, in most of the instances,

statistically higher in reading times. In rare cases, the High Attachment sentences are higher but they lack significance.

Similar trends can also be observed when the total fixation duration is examined comparing the two sentence types. The only area where the participants spend more time processing the High Attachment sentences longer is NP2 (AoI3).

To mention the High Attachment with Ambiguity sentences, the findings confirm what is hypothesized before the experiment is conducted. When the first fixation duration reading times are taken into consideration, the consensus view seems to be that participants' initial analysis is very close to the reading times of the Low Attachment sentences. It supports the prediction that the parser is prone to perceiving this sentence type as a Low Attachment sentence. In the first fixation duration, this initial parsing scenario is kept until main verb is reached. Although reading times for other AoIs show High Attachment with Ambiguity as the lowest or the second lowest sentence type in processing, MV (AoI5) reading time completely changes the direction of reading times. This area lies at the center of discussion in parsing preferences. Supposing it as a Low Attachment sentence until the end of the sentence, the parser realizes that her/his initial processing collapses especially when reaching a ditransitive verb. In the parsing draft, there is no node opened for a second argument. Hence, when the parser struggles for reaching the intended meaning of the sentence, a need for revision arises. The proposed direction of parsing in this locally ambiguous sentence type follows the Garden-path theory. The already opened node captures the incoming materials as long as they are consistent with the semantic features of the elements in the node. However, the ambiguity is realized and it is resolved when only the end of the sentence is reached. For ambiguity resolution in processing of the given sentences in the experiment, using

argument structure and licensing information of the main verb is the strongest strategy. As seen in the model of Fodor and Inoue (1998), the Garden-path effect is resolved after reaching the essential information presented by the main verb. In the present study, the main verb acts as “the error signal” as illustrated by Ferreira and Henderson (1991, 1998). This is the location where the parser “attaches anyway” what is already postulated at the beginning. However, the parsing draft of the Low Attachment configuration is ill-formed both semantically and more importantly syntactically. Reanalysis of this sentence type later involves heavy cognitive load and regarding AoI reading times for the main verb, this sentence type has the highest reading times. In an attempt to repair the misanalysed NP, the parser “adjust” the first draft of processing and this time attach NP1 low to RC.

In the general direction of sentence processing in Turkish where attachment preferences to RC constructions are considered, a few conclusions are reached. First of all, the Turkish parser is observed to license incoming data according to its structural properties in tandem with semantic features. Secondly, in case of a potential ambiguity, which is experienced in attachment preferences to RCs and licensing, the main verb is the location for the parser to realize this and it is a guide to reassess the processing of a given sentence. Another conclusion to point is that considering the early/total fixation duration, the High Attachment sentences take the parser shorter to process compared to the Low Attachment sentences. In the High attachment sentences, a new node for NP2 is created unlike Low Attachment resulting in higher fixation times during the first reading (first fixation duration) the parser is exposed to the incoming flow of information. However, observed lower reading times in the main verb is an indication that this online decision embracing both syntactic and more importantly semantic

information is checked at the main verb shortly (lower fixation durations for High attachment sentence type). The preference for the High Attachment is also verified considering the total fixation duration with consistent lower reading times. The predictions of the Late Closure as a part of the Garden Path framework are confirmed regarding the ease of high attachment sentence processing. *Attach (Anyway)* also successfully explains the course of ambiguity detection and reanalysis in the experimental sentences with ambiguity.

4.1.1. Analysis of Answers to Comprehension Questions

Accompanying the findings from sentence type processing section, the data from the answers to the comprehension questions are revealed, and it is discussed whether there is a correlation between the online processing preferences and offline comprehension questions. As a reminder, a pair of comprehension questions is provided below.

(110)

[<i>Şehr-in</i>	<i>sevdiğ-i</i>]	<u>takım kaptan-ı</u>	çabucak ilgi-ye	alıştı.
ORC		LOW		
[The city-GEN love-PART-POSS] <u>team captain-POSS</u> quickly interest-DAT adapt-				
ORC		LOW		
PAST-3 rd SG.				

The team captain whom the city loves quickly adapted to attention.

Comprehension Question

- Takım çabucak ilgi-ye alış-tı. False
- The team-NOM quickly interest-DAT adapt-PAST-3rd SG.
The team quickly adapted to attention.

The gathered data from the comprehension questions are divided into three groups based on the sentence types. The table below presents descriptive statistics and normality distribution.

The Kurtosis Normality test indicated that the data obtained had a normal distribution as seen in Table 25.

Table 25. Descriptive Statistics and Normality Distribution of Attachment Types for Correct Answers to Comprehension Questions

Type of Attachment	N	Min.	Max.	Mean	Std. Deviation	Kurtosis Statistic	Std. Error
Low Attachment	60	,00	14,00	12,0333	4,18215	2,262	,608
High Attachment with Ambiguity	60	,00	14,00	10,1833	5,02027	-,507	,608
High Attachment	60	4,00	14,00	12,9667	2,64233	7,090	,608

Table 25 indicates that an overview at descriptive statistics pertaining to sentence types presents rough but relevant information for discussion. Similar to reading time analysis, answers to comprehension questions after reading the High Attachment with Ambiguity sentences seem to be the least ($X=10,1833$), followed by the Low Attachment ($X=12,0333$). Correct answers for the High Attachment sentences seem to be the highest ($X=12,9667$). Table 25 also shows that a review of the RC types reveals comparable information to reading time analysis.

With the results in hand, the ANOVA test is used for three-way sentence type assessment for further analysis, and the results can be seen in Table 26 below.

Table 26. ANOVA Test Results of Attachment Types for Correct Answers to Comprehension Questions

Source of variation	Type III Sum of Squares	df	Mean Square	F	p	Significance
Between-Subjects	2490,328	59	42,209	32,252	.001	Low A. - High A. w/A High A. w/A - High A. Low A. - High A.
Within-Subjects	240,811	2	120,406			
Error	440,522	118	3,733			
Total	3171,661	179				

The results of the ANOVA test given in Table 26 indicate that a significant relation exists among all the three sentence types ($p=.001$) in terms of correct answers to the comprehension questions. The High Attachment sentences possess significantly higher accuracy than the Low and High attachment with Ambiguity sentences ($p=.001$). The Low Attachment sentences include means that are also significantly higher than the High Attachment with Ambiguity sentences ($p=.003$).

In line with the findings gathered from reading time analysis through eye-tracking device, the High Attachment sentences involve the highest success rates. It implies that the parsing and licensing of this type of sentence cause the least cognitive load in sentence processing.

Regarding syntactic and pragmatic constraints gathered from the online eye-tracking data and offline comprehension questions, it is safe to discuss that Turkish is a language that allows High Attachment to RCs. In this preference, there seems to be a strong correlation between the online and offline data.

4.2. ANALYSIS OF SRC/ORC ASYMMETRY EFFECT ON ATTACHMENT PREFERENCES TO RELATIVE CLAUSES

In line with the third research question, which is “Is there a processing asymmetry between SRCs and ORCs in the context of attachment preferences? If so, does SRC/ORC asymmetry affect High and Low Attachment processing in Turkish? the possible effects of the RC types (namely, SRC and ORC) on the attachment types (namely, the Low Attachment, High Attachment with Ambiguity and High Attachment) are the main concerns in this part. Therefore, what types of RCs cause significantly more cognitive load on which attachment type in processing is analyzed. In other words, the findings are examined to reveal whether participants process the SRCs and ORCs in a different way. The findings are discussed in relation to the distance accounts (namely, the Structural Distance Hypothesis or Linear Distance Hypothesis).

AoIs for the experimental sentences are modified in order to analyze a possible SRC/ORC asymmetry on the High/Low Attachment types. Only the RC area is considered for its total fixation duration reading times. The first fixation duration is excluded as all experimental sentences start with the same RC structure and initial processing times will not yield data to successfully discuss on. Despite marginally, ORCs are longer than SRCs with one syllable (two letters) such as in “gördüğü” and “gören” respectively. Even in this case, the length discrepancy is considered when the results are discussed. Other AoIs as described and evaluated in the previous part are not used in this part. Rather, the entire sentences are observed in terms of the total fixation duration for the sake of the research questions in this section.

As stated before, the data had a normal distribution. Therefore, the independent t-test is administered to seek whether the RC types are significantly divergent from each other based on the attachment types.

The following part of analysis below handles each pair demonstrated above individually and examines whether the significance is observed between the RC types through attachment considering each AoI.

The first part of the reading time analysis of the RC asymmetry on attachment types involves the Low Attachment sentences. On the point of attachment, the second noun phrase is attached to the RC and the main verb is a transitive verb, which does not require a second argument to license as a direct object. An example for the Low Attachment sentence for SRCs and ORCs are presented below for reference.

(111) SRC/Low Attachment

[*Zabıta*yı *gören*] bakkal *çırağı* hemen *içeri* *girdi*.

[Police-ACC see-PART] grocery assistant-POSS_immediately inside enter-PAST-3rd SG.

The grocery (owner) assistant who saw the police went inside immediately.

(112) ORC/Low Attachment

[*Şehrin sevdiği*] takım *kaptanı* *çabucak* *ilgi-ye* *alıştı*.

[The city-GEN love-PART] team captain-POSS quickly interest-DAT adapt-PAST-3rd SG.

The team captain whom the city loves quickly adapted to attention.

Table 27 below presents the statistical information including mean, standard deviation and others for the Low Attachment sentences divided into the SRCs and ORCs. In

addition, the reading times for the total fixation duration reading times are also presented later.

Table 27. Descriptive Statistics on RC Asymmetry Effect on Attachment Types Considering Total Fixation Duration in RC Area

RC Area	Mean	N	Std. Deviation	Std. Error Mean
SRC-Low Attachment	1,1200	60	,54274	,07007
ORC-Low Attachment	1,1517	60	,39453	,05093

Considering Table 27 above, it is seen that the Low Attachment sentences with SRC configuration ($X=1,1200$) is processed shorter than sentences with ORC($X=1,1517$).

Table 28 below presents the results of the t-test administered on the Low Attachment sentences and whether the RC types reveal a significant asymmetry.

Table 28. T-test Results on RC Asymmetry Effect on Low Attachment Sentences Considering Total Fixation Duration for RC Area

RC Area	N	Mean	Std.Deviation	T	df	p
SRC-Low Attachment	60	1,1200	,54274	,484	59	,630
ORC-Low Attachment	60	1,1517	,39453			

Table 28 above indicates that the two groups (namely, the SRC and the ORC Low Attachment sentences) are different from each other ($t_{0,05:59} = ,484$). However, the Low Attachment sentences with ORC ($X=1,1517$) do not have significantly ($p>0,05$) lower reading times than that of the Low Attachment sentences with the SRC manipulation ($X=1,1200$) considering the RC area.

Considering the total processing reading times of the Low Attachment sentences in the SRC and ORC groups, a statistical significance does not exist in the RC area. A clear-

cut distinction between the RC types in late processing does not require revision during sentence processing. The parser continues to find a successful candidate to attach to this site.

Considering the RC reading time differences between the two types, it can be stated that the SRC marker -(y)An in Turkish does not bear person agreement but ORC marker – DIK does. On the other hand, ORCs involve deeper embedding for relativization when structurally compared to the SRCs. It is attributed to the emerged divergence between ORC and SRC in the experiment.

The second attachment type to be analyzed is the Low Attachment with Ambiguity sentences. The sentences exemplify the attachment type.

(113) (SRC/High Attachment with Ambiguity)

[*Zabıta-yı gören*] bakkal çırağ-ı hemen
 [Police-ACC see-PART] grocery owner assistant-ACC immediately
 ev-e gönderdi.
 home-DAT send-PAST-3rd SG.

The grocery owner who saw the police sent the assistant home immediately.

(114) (ORC/High Attachment with Ambiguity)

[*Şehr-in sevdiğ-i*] takım kaptan-ı çabucak
 [The city-GEN love-PART-POSS] team captain-ACC quickly
 yönetim-e gönderdi.
 administration-DAT send-PAST-3rd SG.

The team which the city loves quickly sent to the administration.

Table 29 below presents the descriptive statistics for reading times of the Low and High attachment types.

Table 29. Descriptive Statistics on RC Asymmetry Effect on Attachment Types Considering Total Fixation Duration for RC Area

RC Area	Mean	N	Std. Deviation	Std. Error Mean
SRC-High Attachment with Ambiguity	1,0892	60	,56184	,07253
ORC-High Attachment with Ambiguity	1,1550	60	,59131	,07634

The reading times in Table 29 suggest that the ORC ($X=1,1550$) reading times are longer than that of the SRCs ($X=1,0892$). It could be stated that the SDH (O'Grady, 2003) is supported in the context of the High Attachment with Ambiguity sentences. To briefly state, this sentence type includes two possible nouns that are semantically and pragmatically possible candidates to be attached to the RC preceding them. As it is a High Attachment type of sentence, despite this potential, the second noun is the direct object of the main verb. The requirement results from the fact that the main verb is a ditransitive verb, which needs to find a direct object for checking its argument structure.

Table 30 below presents the results of the t-test administered on the High Attachment with Ambiguity sentences and whether the RC types reveal a significant asymmetry.

Table 30. T-test Results on RC Asymmetry Effect on High Attachment with Ambiguity Sentences Considering Total Fixation Duration

RC Area	N	Mean	Std.Deviation	T	df	p
SRC-High Attachment with Ambiguity	60	1,0892	,56184	1,179	59	,243
ORC-High Attachment with Ambiguity	60	1,1550	,59131			

Following the t-test to compare the means of two groups, as can be seen in Table 30, there occurs a certain difference between the two groups ($t_{0,05:59} = 1,179$). However, the ORC group reading times ($X=1,1550$) are not significantly ($p>0,05$) higher than that of SRC group ($X=1,0892$) in terms of the RC area.

The High Attachment with Ambiguity sentences, along with the other AoIs, have the highest reading times when the reading times are compared to the other sentence types as seen in the previous part. Considering the t-test results, it can be seen that cognitive difficulty does not stem from the asymmetry between SRC and ORC sentences. Higher reading times for this sentence can be attributed to the attachment sites and the ambiguity of choosing NP1 (AoI2) or NP2 (AoI3) as the agent/patient of the action in RCs.

Considering the total fixation reading times, it is suggested that once the initial processing is complete and the parser makes required reanalysis, it reaches the intended message of the given sentence. On this analysis, the operation is in line with *Adjust* proposed by Fodor and Inoue (1998, 2000). Upon realizing that the main verb requires a theme to fill the direct object position, NP2 (the second NP that follows the RC) is stolen from the node attached to RC in the initial processing. However, while doing so, the cognitive load for processing SRCs and ORCs do not significantly diverge.

Analyzing the reading times dedicated to the RC area is finalized with the High Attachment sentences. For this sentence type, the parser is supposed to attach the first noun after the RC to this area. The second noun to the left of the RC is the direct object of the main verb. Therefore, it is not a semantically potential candidate for the action in the RC. For reference, the sentences below are given.

(115) SRC/High Attachment

[*Zabıta* *gören*] bakkal telefonu
 [Police-ACC see-PART] grocery owner telephone-ACC
 hemen eline aldı.
 immediately hand-POSS-DAT take-PAST.

The grocery owner who saw the police took the telephone in his hand immediately.

(116) ORC/High Attachment

[*Şehrin sevdiği*] takım baklavayı
 [The city-GEN love-PART] team baklava-ACC
 çabucak ellerine aldı.
 quickly hand-PL -DAT hold-PAST.

The team which the city loves quickly held the baklava in their hands.

The descriptive statistics for the reading times in the High Attachment sentences divided into SRC and ORC are presented in Table 31 below.

Table 31. Descriptive Statistics on RC Asymmetry Effect on Attachment Types Considering Total Fixation Duration

RC Area	Mean	N	Std. Deviation	Std. Error Mean
SRC-High Attachment	,9212	60	,42298	,05461
ORC-High Attachment	,9888	60	,45542	,05879

Table 31 presents that the ORC-High Attachment ($X=,9888$) includes a relatively more laborious processing load than the SRC-High Attachment sentences ($X=,9212$). However, the mean values require statistical analysis by means of the t-test.

In the next section, the RC type groups in the High Attachment sentences are compared to observe whether they present a statistical divergence. In order to verify whether the

results involve statistical significance, an independent t-test is employed and the results are given in Table 32 below.

Table 32. T-test Results on RC Asymmetry Effect on High Attachment Sentences Considering Total Fixation Duration for RC Area

RC Area	N	Mean	Std.Deviation	T	df	p
SRC-High Attachment	60	,9212	,42298	1,245	59	,218
ORC-High Attachment	60	,9888	,45542			

The results of the t-test given in Table 32 indicate that both the SRC and ORC High attachment sentences are different ($t_{0,05:59} = 1,245$). However, there is not a significant difference ($p < 0,05$) between the ORC ($X = ,9888$) and the SRC group. ($X = ,9212$).

Considering the reading times gathered from the RC area through the sentence types, the SRC/ORC asymmetry is not observed in the High Attachment sentences. There is not a significant difference in processing the RC area of the sentences that the participants were given to read. the RC is a central part of our investigation to trace such asymmetry. Although the ORC sentences all had higher reading times, they are not significant enough in the late processing. The findings imply that difficulty related to attachment preferences hinder the participants from being aware of asymmetry distinction between the RC types.

For the second part of this section, experimental sentences are handled as entire AoIs. The total fixation duration reading times are considered to discuss possible reading time differences between the SRC and ORC in the Low Attachment sentences.

Table 33 below presents the statistical information including mean, standard deviation for the Low Attachment sentences divided into the Subject and Object RC.

Table 33. Descriptive Statistics on RC Asymmetry Effect on Attachment Types Considering Total Fixation Duration

The Entire Sentence	N	Min.	Max.	Mean	Std. Deviation
SRC-Low Attachment	60	,08	8,72	3,3456	1,74757
ORC-Low Attachment	60	,54	11,17	3,7836	1,60791

Table 33 shows the total fixation duration reading times for the SRC and ORC sentences in the Low Attachment sentences. Mean values present that the ORC sentences ($X=3,7836$) are processed longer than the SRC sentences ($X=3,3456$).

Table 34 below presents the results of the t-test administered on the Low Attachment sentences and whether the RC types reveal a significant asymmetry.

Table 34. T-test Results on RC Asymmetry Effect on Low Attachment Sentences Considering Total Fixation Duration

The Entire Sentence	N	Mean	Std. Dev.	t	df	p
SRC-Low Attachment	60	3,3456	1,74757	2,601	59	,012
ORC-Low Attachment	60	3,7836	1,60791			

The t-test results in Table 34 above indicate that the two groups are considerably different from each other ($t_{0,05:59}= 2,601$). The Low Attachment sentences with ORC ($X= 3,7836$) seem to have significantly ($p>0,05$) higher reading times than that of the Low Attachment sentences with SRC sentences ($X= 3,3456$).

For the Low Attachment sentences, it could be concluded that the RC asymmetry is a significant factor that affects the duration of processing. It can be suggested that the

participants are sensitive to RC asymmetry in the processing of the Low Attachment sentences.

The second attachment type to be analyzed is the High Attachment with Ambiguity sentences. Table 35 below presents the descriptive statistics for reading times of these sentence types.

Table 35. Descriptive Statistics on RC Asymmetry Effect on Attachment Types Considering Total Fixation Duration

The Entire Sentence	N	Min.	Max.	Mean	Std. Dev.	Kurtosis	Std. Error
SRC-High Attachment with Ambiguity	60	,38	11,29	3,6732	2,41558	,459	,613
ORC-High Attachment with Ambiguity	60	,30	11,95	4,4215	2,24701	2,515	,613

In Table 35 similar to the previous findings, the reading times suggest that the ORC reading times ($X=4,4215$) are higher than that of the SRCs ($X=3,6732$).

Table 36 below presents the results of the t-test administered on the High Attachment with Ambiguity sentences and it is revealed whether the RC types possess a significant asymmetry.

Table 36. T-test Results on RC Asymmetry Effect on High Attachment with Ambiguity Sentences Considering Total Fixation Duration

The Entire Sentence	N	Mean	Std. Dev.	t	df	p
SRC-High Attachment with Ambiguity	60	3,6732	2,24701	3,052	59	,003
ORC-High Attachment with Ambiguity	60	4,4215	2,41558			

As can be seen in Table 36 above, a difference between the processing of the RCs is observed ($t_{0,05:59} = 3,052$). Considering the results, the ORC group reading times ($X = 4,4215$) are significantly ($p > 0,05$) higher than that of SRC group ($X = 3,6732$).

Considering the total fixation reading times, it is suggested that once initial processing is complete and the parser makes required reanalysis, it reaches the intended message of the given sentence. On this analysis, the operation is in line with *Adjust* proposed by Fodor and Inoue (1998, 2000). Upon realizing that the main verb requires a theme to fill the direct object position, NP2 (the second NP that follows the RC) is stolen from the node and attached to the RC in the initial processing. During this operation, the cognitive load for processing SRC and ORC are significantly different.

The last attachment type is High Attachment sentences. The descriptive statistics for the reading times in these sentence type divided into SRC and ORC are presented in Table 37 below.

Table 37. Descriptive Statistics on RC Asymmetry Effect on Attachment Types Considering Total Fixation Duration

The Entire Sentence	N	Min.	Max.	Mean	Std. Dev.	Kurtosis	Std. Error
SRC-High Attachment	60	,10	10,47	3,0349	1,68372	5,525	,613
ORC-High Attachment	60	,38	7,81	3,3920	1,43861	1,216	,613

Table 37 above suggests that the reading times belonging to ORCs are longer than that of the SRCs. This overall conclusion, judging by the means values, indicates that our data are in line with the SDH (O'Grady, 2003).

The High Attachment sentences in the study require the first NP to be attached to the RC that precedes it. The second NP is not a semantically or pragmatically potential

candidate for the action in the RC. Also, the main verb is a ditransitive verb which requires a direct object.

Table 38 below provides the t-test results on RC asymmetry on High Attachment sentences.

Table 38. T-test Results on RC Asymmetry Effect on High Attachment Sentences Considering Total Fixation Duration

The Entire Sentence	N	Mean	Std.Deviation	t	df	p
SRC-High Attachment	60	3,0349	1,68372	2,057	59	,044
ORC-High Attachment	60	3,3920	1,43861			

Table 38 shows that the RC types are divergent ($t_{0,05:59} = 2,057$) considering the High Attachment sentences in the total fixation duration. The ORC group ($X=3,3920$) has significantly ($p<0,05$) higher reading times than the SRC group ($X=3,0349$). However, the divergence is a marginal one ($p=,044$). The total processing in this section can still be said to display asymmetry. When the participants reanalyze the High Attachment sentences, they are sensitive to RC differences.

General Discussion of the Findings about RC Asymmetry Effect on Sentence Types

In Table 39, all SRC/ORC asymmetries found in the study are presented. Concerning the RC reading times in general, the ORC reading times are higher than the SRCs. Among the significant asymmetries presented in Table 39 below, Processing durations for the ORC sentences are significantly longer than the SRC sentences.

Table 39. Significant ORC/SRC Asymmetries Observed in Attachment Types

RC Asymmetry		
	RC Area	The Entire Sentence
Low Attachment	<i>Symmetrical</i>	<i>Asymmetrical</i>
High Attachment with Ambiguity	<i>Symmetrical</i>	<i>Asymmetrical</i>
High Attachment	<i>Symmetrical</i>	<i>Asymmetrical</i>

As can be seen in Table 39, for the RC area the reading times for the ORCs are not seen to be statistically longer than the SRC sentences although there is also an extra syllable (two letter) in the ORC area. In all sentence types, total fixation duration reading times suggest that for the participants the ORC AoI does not cause comparatively more cognitive load on processing the given sentence type. On the other hand, the reading times for the entire sentences illustrate significant divergences in the SRC/ORC sentences with the exception that there is a marginal significance for the High Attachment sentence type. For the Low Attachment sentence type, the participants are sensitive to the RC asymmetry. This result, however, cannot be attributed to the ease of processing of this sentence type. In the previous part of the analysis, it is stated that Low Attachment sentences are read in longer durations compared to High Attachment sentences. It is suggested that the Turkish parser processes the High Attachment sentences with less cognitive load than Low Attachment sentences. In this regard, although they do not involve a local ambiguity, the Low Attachment sentence configuration slows down the parser's reading time implying that it might go through a reanalysis. Because of this doubt, the parser somehow double-checks its syntactic parsing decisions. This deliberate operation also raises RC asymmetry awareness. The Late Closure (Fraizer and Fodor, 1978) is valid for explaining the High Attachment

preference for RCs in Turkish. Furthermore, for sentences with ambiguity, the *Attach Anyway* (Fodor and Inoue, 1998) accurately explains the course of reanalysis. Considering the initial processing durations, it could be observed that the sentences with this type are parsed considerably easily despite the embedded ambiguity in them. This observance proves that the parser tolerates the local ambiguity and attaches the incoming material as long as they are in line with the intended meaning of the given sentences. As for *Adjust* (Fodor and Inoue, 1998), the total processing reading times clearly indicates the adjust and repair operations carried out by the parser. As discussed earlier, the High Attachment sentences are processed shorter than the Low Attachment sentences, which forms the ground for a lack of RC asymmetry. As long as the parser does not encounter a licensing challenge, it does not focus on the details of structural properties for the given sentences. This is what provides symmetrical reading times for SRCs and ORCs in High Attachment sentences. Consequently, it is claimed that as the parsing and processing of Low and High with Ambiguity Attachment sentences are relatively more laborious, the RC asymmetry awareness is raised. Unlike these attachment types, the High Attachment sentences do not display such asymmetry as licensing problems are not experienced and the intended meaning of the given sentences are relatively easily gained. In this case, the parser is not preoccupied with the type of RC he/she is processing.

As an answer to the first part of the third research question, it is suggested that the Low Attachment sentences involve the Subject/Object Asymmetry while for the High Attachment sentences this asymmetry is observed although it is a marginal difference.

4.2.1. Analysis of the Answers to Comprehension Questions

In this part of the analysis, the answers to the comprehension questions are analyzed to present a possible RC asymmetry. A comparison between the results of the online and offline data is also presented here. As a reminder, a pair of comprehension questions is provided below.

(117)

[Şehr-in sevdiğ-i] takım kaptan-ı

The city-GEN love-PART-POSS team captain-POSS

çabucak ilgi-ye alıştı.

quickly interest-DAT adapt-PAST-3rd SG.

The team captain whom the city loves quickly adapted to attention.

Comprehension Question

- Takım çabucak ilgi-ye alıştı. False
Team-NOM quickly interest-DAT adapt-PAST-3rd SG.
The team quickly adapted to attention.

Table 40 below shows the descriptive statistics for answers to the comprehension questions and divided into the attachment and RC types.

Table 40. Descriptive Statistics on RC Effect on Attachment Types for Correct Answers to Comprehension Questions

Sentence Configuration	N Statistics	Minimum Statistics	Maximum Statistics	Mean Statistics	Std. Deviation Statistic
SRC-Low Attachment	60	,00	7,00	6,2000	1,85765
SRC-High Attachment with Ambiguity	60	,00	7,00	5,6333	2,32865
SRC-High Attachment	60	4,00	7,00	6,7667	,76727
ORC-Low Attachment	60	,00	7,00	5,8333	2,37335
ORC-High Attachment with Ambiguity	60	,00	7,00	4,5500	2,83097
ORC-High Attachment	60	,00	7,00	6,2000	1,91161

Table 40 shows that the accuracy rates for the comprehension questions for the ORC sentences are lower than those of the SRC sentences for each attachment and RC type. Also, another indication is that the High attachment sentence type with a potential ambiguity exhibits the lowest success of all. Central to the analysis of the present study, it is viewed that participants' success in the comprehension questions to the High Attachment sentences, regardless of being the SRC or ORC, is higher than sentences with Low Attachment configuration.

However, implications from Table 40 above require statistical tools to verify. Table 41 shows the t-test results about each sentence type in terms of the RC types across attachment types.

Table 41. T-test Results for RC Effect on Attachment Types for Correct Answers to Comprehension Questions

				95% Confidence Interval of the Difference		t	df	Significance (2-tailed)
Sentence Configuration	Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
SRC-Low Attachment	,36667	,82270	,10621	,57919	,15414	3,452	59	,001
ORC-Low Attachment								

As can be seen in Table 41 above, there is a clear difference ($t_{0,05;59}=3,452$) between the Low Attachment ($X=6,2000$) with SRC and the Low Attachment with ORC ($X=5,8333$) is proved to be significant ($p<0.05$). In conclusion, in terms of a sentence with the Low Attachment configuration, Turkish speakers adhere to the general RC asymmetry tendency toward SRC advantage.

For reading time analysis, it is indicated that the RC asymmetry is observed in the Low Attachment sentences. This result is also confirmed in the analysis of comprehension questions.

Table 42 below gives the correct answers given to comprehension questions for High Attachment with Ambiguity sentences grouped according to SRCs and ORCs.

Table 42. T-test Results for RC Effect on Attachment Types for Correct Answers to Comprehension Questions

Sentence Configuration	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Significance (2-tailed)
				Lower	Upper			
SRC-High Attachment with Ambiguity	1,08333	1,29263	,16688	1,41726	,74941	6,492	59	,001
ORC- High Attachment with Ambiguity								

The results of the independent t-test, as can be seen in Table 42, indicate that there is a clear difference ($t_{0,05;59}=6,492$) between the High Attachment with Ambiguity sentences with SRC ($X=5,6333$) and with the ORC ($X=4,5500$). This difference is statistically significant ($p=,001$). To briefly state, even though the sentences mentioned above involve a local ambiguity, the parser displays an inclination to be more successful at the SRC sentences.

For reading time analysis, it is stated that the RC asymmetry is not observed during the total processing. It is observed that a significant asymmetry is monitored after required

reanalysis, which is heavily implemented for this sentence type. The RC asymmetry in the total processing is reflected on the comprehension analysis in this part as seen above.

The High Attachment sentences manipulated and grouped by the two RC types are presented below. The correct answers to the comprehension questions are compared and evaluated. Table 43 below compares SRC and ORC High Attachment sentences by means of the t-test.

Table 43. T-test Results for RC Effect on Attachment Types for Correct Answers to Comprehension Questions

				95% Confidence Interval of the Difference		t	df	Significance (2-tailed)
Sentence Configuration	Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
SRC- High Attachment	,56667	1,22636	,15832	,88347	,24986	3,579	59	,001
ORC- High Attachment								

In this comparison given in Table 43 above indicates a difference ($t_{0,05:59}=3,579$) in the correct answers given to the comprehension questions. The participants' success in the High Attachment sentences with SRC manipulation is significantly higher than the High Attachment sentences manipulated by the ORC. The High Attachment sentences, unlike the Low Attachment sentences, require NP1 to be added into the argument structure of the action in RC. On the other hand, NP2 is left outside this operation and is licensed as the direct object of the main verb. Despite these differences to the Low Attachment

sentence configuration, the parser can process the High Attachment sentences with SRC manipulation more successfully.

In the previous section, it is stated that for the total processing reading, a significant asymmetry exists although it is marginal. in the comprehension analysis, a significance value of ,001 suggests that the participants are statistically more successful for comprehension questions about the High Attachment sentences with SRC manipulation.

The conclusion for the RC asymmetry effect on the attachment preferences is that the participants answer the comprehension questions about the SRCs more accurately than the ORCs regardless of the attachment preferences. The asymmetry is detected in all the three attachment preferences, which are to the advantage for the SRCs. Another conclusion is that for the High Attachment sentences, the total fixation duration reading times yield a marginal significance. However, the participants seem to make their final decisions and answer question with the SRCs more accurately than the ORCs.

4.2.2 Analysis of Subject and Object RC Asymmetry

For the second part of the third research question "...If so, is there a processing asymmetry between Subject Relative Clauses and Object Relative Clauses in the context of attachment preferences?", the experimental sentences are categorized into two chunks as SRC and ORCs. The rearranged data includes normal distribution. With the result in hand, independent t-test is administered to the pair and the results are discussed. the SRC and ORC sentences below are given for reference.

(118) SRC

[Zabıta-yı gör-en] bakkal çırağ-ı
 [Police-ACC see-RC] grocery assistant-POSS
 hemen içeri girdi.
 immediately inside enter-PAST-3rd SG.

The grocery (owner) assistant who saw the police went inside immediately.

(119) ORC

[Şehr-in sev-diği] takım kapta-nı
 [city-GEN love-RC] team captain-POSS
 çabucak ilgi-ye alış-tı.
 quickly interest adapt-PAST-3rd SG.

The team captain whom the city loves quickly adapted to attention.

Table 44 below presents the descriptive statistics on the SRC and ORC sentences and the normality test results for the reading times of the participants in the first fixation duration. Similar to the findings in the previous parts, it is observed that parsing the ORCs lasts longer than the SRCs.

Table 44. Descriptive Statistics on RC Asymmetry Considering First Fixation Duration

Types of RCs	N	Min.	Max.	Mean	Std. Deviation	Kurtosis	Std. Error
SRC	60	,09	,17	,1248	,02143	-,936	,608
ORC	60	,09	,29	,1348	,02931	12,601	,608

Table 44 indicates that an overview of the mean values pertaining to RC types presents rough but relevant information for discussion. Similar to previous reading time analyses, it is revealed that the participants have more difficulty in parsing ORCs, which suggests a SRC/ORC asymmetry. In order to statistically display whether this difference is significant, Table 45 below is provided.

Table 45. T-test Results on RC Asymmetry Considering First Fixation Duration

Types of RCs	Paired Differences					t	df	Significance
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
SRC	,01000	,02429	,00314	,01627	,00373	3,189	59	,002
ORC								

Table 45 above indicates that there are significant differences between the ORC and SRC groups considering the first fixation duration reading times. The difference ($t_{0,05:59} = 3,189$) between the ORC ($X = 1,1348$) and the SRC ($X = 1,1248$) group reading times are found to be significant ($p = ,002$).

In order to obtain a broader perspective into the RC asymmetry processing, the total fixation duration reading times for the two RC types are presented below.

Table 46. Descriptive Statistics on RC Asymmetry Considering Total Fixation Duration

Types of RCs	N	Min.	Max.	Mean	Std. Deviation	Kurtosis Statistic	Std. Error
SRC	60	,28	9,02	3,3422	1,72190	,968	,608
ORC	60	,43	9,81	3,9170	1,67210	1,978	,608

As seen in Table 46 above, for the total processing durations, participants are observed to parse the ORC sentences longer than the SRC sentences once again. An RC asymmetry is observed however, this conclusion requires further statistical analysis. For the t-test results, Table 47 below is presented.

Table 47. T-test Results on RC Asymmetry Considering Total Fixation Duration

Types of RCs	Paired Differences					t	df	Significance
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
SRC	,57483	1,05835	,13663	,30143	,84823	4,207	59	,001
ORC								

Table 47 above displays that there is a certain difference ($t_{0,05:59} = 4,207$) between the two RC types. In addition, it is observed that for the total processing durations, ORCs ($X=3,9170$) are processed significantly longer than SRCs ($X=3,3422$).

From both reading time analyses, it is accounted that the Turkish parser goes through a heavier cognitive operation analyzing and understanding ORC compared to SRCs. Structurally, it can be ascribed to the fact that Turkish ORCs are embedded deeper than SRCs. This situation is also best explained by Structural Distance Hypothesis (SDH) by O’Grady (2003). As O’Grady (2003) states in SDH, interfering maximal projections between the head and gap in ORCs are more in Turkish, which is a determining factor in statistically higher reading times for sentences involving ORC. As noted below, in the sentences provided, structural distances display clear view. In SRC sentences, the distance is only one node on the other hand, ORC sentence involves two nodes.

(120)
SRC

[_{CP} [_{e_i} Zabıta-(y) ₁ gör-en]	bakkal	çırağ-ı _i]
[Police-ACC see-PART]	grocery	apprentice-POSS

hemen içeri girdi.
immediately inside enter-PAST-3rd SG.
The grocery owner apprentice who saw the police went inside immediate

Structural distance = 1 node (CP)

(121)

ORC

[_{CP}[Zabıta-(n)ın [_{VP}e_i gör-düğ-ü]] bakkal çırağı]
 [Police-GEN see-PART] grocery owner apprentice-ACC
 hemen içeri girdi.
 immediately inside-DAT enter-PAST-3rd SG.
 The grocery owner who the police saw went inside immediately.

Structural distance = 2 nodes (VP, CP)

Furthermore, as a specific linguistic property of Turkish RCs, the ORCs involve person agreement unlike the SRCs, which also contributes to the statistically significant longer durations for processing them.

The result of ORC disadvantage also supports the findings of previous studies. In Bulut (2012), the participants were made to read sentence with RCs where only one NP was attached. Despite the fact that the sentences were not manipulated to include high or low attachment, a similar conclusion was reached. In Kahraman (2015), it was claimed that inclusion of context would ease difficulty of processing ORC structures. However, context was not a factor, and RC asymmetry was observed anyway.

As an answer to the research question, briefly, it can be confidently stated that processing of ORCs in Turkish lasts longer than SRCs in the context of attachment preferences in the present study.

4.2.3. Analysis of the Answers to Comprehension Questions

For the second part of the analysis for this section, correct answers to comprehension questions for the ORC and SRCs are considered. The target sentences are rearranged into two categories as SRC and ORC.

In this part of the analysis, the participants' scores for the comprehension questions are also categorized into two sections as SRC and ORC. The descriptive statistics along with Kurtosis normality test results are presented in Table 48 below.

Table 48. Descriptive Statistics and Normality Distribution of RC Asymmetry for Correct Answers to Comprehension Questions

Types of RCs	N	Min.	Max.	Mean	Std. Deviation	Kurtosis	Std. Error
SRC	60	4,00	21,00	18,6333	4,73704	3,311	,608
ORC	60	,00	21,00	16,5833	6,59556	1,023	,608

Table 48 shows the results of the Kurtosis normality test and exhibits that the data are distributed normally. Therefore, an independent t-test is administered for paired tests (SRC/ORC comparisons). An overview of mean values pertaining to the RC types presents rough but relevant information for discussion. Similar to the reading time analysis, correct answers to the comprehension questions reveal that the participants have more difficulty in correctly answering the ORC comprehension question, which suggests the SRC/ORC asymmetry. Table 49 below gives the results of the t-test.

Table 49. T-test Results on RC Asymmetry for Correct Answers to Comprehension Questions

Types of RCs	N	Mean	Std.Deviation	t	df	Significance (2-tailed)
SRC	60	18,6333	4,73404	-6,549	59	,001
ORC	60	16,5833	6,59556			

Table 49 above displays the t-test results on the RC asymmetry for correct answers to the comprehension questions. There seems to be a certain difference ($t_{0,05;59} = -6,549$)

between SRC ($X=18,6333$) and ORC ($X=16,5833$) figures. According to the results of the t-test conducted on the RC types, a significant ($p=,001$) difference is observed.

In parallel with the data gathered in reading time analysis, the means of correct answers to the comprehension questions confirms the interpretations suggested before. The interpretation that the participants bear less cognitive load in processing SRCs compared to ORC sentences in reading analysis part is confirmed with the findings presented here. Fewer correct answers given for the ORC sentences validate this argument.



CHAPTER 5

CONCLUSION

The purpose of this thesis is to investigate Turkish native speakers' attachment preferences to RCs under certain conditions and describe the factors and reasons for processing differences in two RC types as SRCs and ORCs. Within this scope, it is specifically aimed at presenting processing differences between the High and Low Attachment to the RCs considering online reading times and offline answers to the comprehension questions following the given experimental sentences. By manipulating certain experimental sentences that contain deliberately implanted ambiguities, the parser's reanalysis and disambiguating strategies are described when it is confronted with garden-path sentences. Another purpose of the study is to observe whether there is a possible RC asymmetry effect on two divergent attachment types and whether asymmetry is observed in itself within the context of attachment types.

Research on the RC acquisition and processing has produced a number of hypotheses such as The Noun Phrase Accessibility Hierarchy (Keenan and Comrie, 1977; Keenan and Hawkins, 1987), Perspective Shifting (MacWhinney, 1977, 1982; MacWhinney and Pleh, 1988), Memory-Based Accounts (Ford, 1983; Frazier and Fodor, 1978; MacWhinney, 1987; Wanner and Maratsos, 1978), Word-order Canonicity (MacDonald and Christiansen, 2002; Bever, 1970; Mitchell, Cuetos, Corley, and Brysbaert, 1995; Tabor, Juliano, and Tanenhaus, 1997), Constraint-Based Approaches (Boland, 1997; Gennari and MacDonald, 2008; MacDonald, 1994; MacDonald, Pearlmutter and

Seidenberg, 1994; McRae, Spivey-Knowlton, and Tanenhaus, 1998; Spivey-Knowlton and Sedivy, 1995; Trueswell, Tanenhaus, and Garnsey, 1994) are observed for characterizing the RC asymmetries. Although their explanatory power is not ignored, the distance hypotheses; Structural Distance Hypothesis and Linear Distance Hypothesis (O'Grady, Miseon, and Miho, 2003) are much more central to explaining processing asymmetry of SRCs and ORCs in the present study. Besides the distance hypotheses for explaining structural and syntactic discrepancies for the processing RCs in Turkish, the properties pertaining to inflectional suffixes such as person and number are also taken into account while analyzing the case. As a basis for the sentence processing models, three main trends dominate the field, namely the Universal Sentence Processing Models, the Parameterized Models of Parsing and the Experience-based Models of Sentence Processing (Papadopoulou, 2006). As a Universalist account of sentence processing, Garden Path Model (Frazier, 1978, 1987; Frazier and Fodor, 1978; Frazier and Rayner, 1982) is considered in the present study analyzing and explaining the course of attachment preferences and ambiguity resolution. In the model, the Late Closure (Frazier and Fodor, 1978), *Attach (Anyway)* and *Adjust* (Fodor and Inoue, 1998, 2000) are interrelated accounts that are used to explain the nature of attachment preferences to the RCs in Turkish.

Research on attachment preferences to RCs in Turkish has so far replicated certain structures that have been tested in English and head-initial languages such as genitive possessive constructions ([NP1_{GEN}+NP2] and prepositional phrases [[NP1 P]_{PP}+NP2]). The significance of the study is to investigate possessive compounds [NP1+NP2_{POSS}] and [NP1+NP2_{ACC}] which have not been studied in the field.

The study involves certain limitation to mention. -(y)An, -DIK are the only two RC markers for SRCs and ORCs respectively. Despite the fact that Turkish allows a number of other markers for relativization such as -(y)An, -DIK, -(y)AcAK (olan/olduK), -mİş (olan/olduK/olacaK) and ki, the two markers were included into the study to control the boundaries of the gathered data and it is due to the fact that -(y)An, -DIK are major Turkish RC markers (Göksel and Kerslake, 2005).

In order to obtain a correct amount of data to analyze, 84 sentences, followed by the comprehension questions, were presented to the participants to read. To prevent unbalanced reading times between the first and the last sentences, two sets of sentences were used. On set 1, even number of participants read the sentences and answered the questions in the normal order. For set 2, participants with odd number read and answered from the last to the first sentence. Out of the eighty-four sentences that are included in the experiment, forty-two sentences are target sentences while the other half is filler sentences. 3 attachment types (Low, High, High with Ambiguity) X 2 RC types (Subject, Object) in total six conditions were tested and taken into consideration for the analysis. As a reminder of the target sentences, the ones below could be viewed.

(122) SRC/Low Attachment

[Zabıta-yı gör-en] bakkal çırağ-ı

SRC

LOW

[Police-ACC see-RC] grocery assistant-POSS

SRC

LOW

hemen içeri girdi.

immediately inside enter-PAST-3rd SG.

The grocery (owner) assistant who saw the police went inside immediately.

(123) SRC/High Attachment with Ambiguity

[Zabıta-yı gören] bakkal çırağ-ı

SRC

HIGH (with Ambiguity)

[Police-ACC see-RC] grocery owner assistant-ACC

SRC

HIGH (with Ambiguity)

hemen ev-e gönderdi.
 immediately home-DAT send-PAST- 3rd SG.
 The grocery owner who saw the police sent the assistant home immediately.

(124) SRC/High Attachment

[Zabıta-yı gören] bakkal telefon-u
 SRC HIGH
 [Police-ACC see-RC] grocery owner telephone-ACC
 SRC HIGH
 hemen el-in-e aldı.
 immediately hand-POSS-DAT take-PAST-3rd SG.
 The grocery owner who saw the police took the telephone in his hand immediately.

(125) ORC/Low Attachment

[Şehr-in sevdiğ-i] takım kaptan-ı
 ORC LOW
 [City-GEN love-RC-POSS] team captain-POSS
 ORC LOW
 çabucak ilgi-ye alıştı.
 quickly interest-DAT adapt-PAST-3rd SG.
 The team captain whom the city loves quickly adapted to attention.

(126) ORC/High Attachment with Ambiguity

[Şehr-in sevdiğ-i] takım kaptan-ı
 ORC HIGH (with Ambiguity)
 [city-GEN love-RC-POSS] team captain-ACC
 ORC HIGH (with Ambiguity)
 çabucak yönetim-e gönderdi.
 quickly administration-DAT send-PAST-3rd SG.
 The team which the city loves quickly sent to the administration.

(127) ORC/High Attachment

[Şehr-in sevdiğ-i] takım baklava-yı
 ORC HIGH
 [City-GEN love-RC-POSS] team baklava-ACC
 ORC HIGH
 çabucak eller-i-ne aldı.
 quickly hand-POSS-PL-DAT hold-PAST-3rd SG.
 The team which the city loves quickly held the baklava in their hands.

The argument structures of the main verbs differ in each attachment type. In Low Attachment sentences, main verbs (transitive) allow only one argument.

[DP__] V– girmek (to enter), - alışmak (adopt)

In the High Attachment and High Attachment with Ambiguity sentences, the main verbs (ditransitive) have two arguments.

[DP ____ DP {DP/PP}] V – göndermek (send), - almak (hold)

Following each experimental sentence being read, a true/false comprehension question was asked to the participants for checking if they have attentively read and comprehended the given sentences and also to gather data to comparatively analyze the online and offline performance of the participants.

For the analysis of the gathered data, two crucial reading time measures were obtained from the eye-tracking device; the first fixation duration and the total fixation duration. The first refers to the reading time, in which a participant sees the given sentence for the first time. It measures the initial processing of the given AoIs or sentences in total. The total fixation duration reading times provide processing information of the participants regarding their reanalysis patterns and repair strategies. It is also possible to gather information concerning what elements of the sentence possess more importance in a given ambiguous sentence.

For the following parts of the chapter, research questions are reviewed and answered, and suggestions for further studies are given.

5.1. ANSWERS OF THE RESEARCH QUESTIONS

Before dealing with the answers to the research question “What are the processing differences between the High and Low Attachment to RCs in Turkish?”, it can be stated that even in initial processing, the Turkish speakers are observed to present a high

degree of lexical semantic awareness when it comes to adding new words into the phrase that is being processed along with utilizing syntactic information. When processing is considered in terms of reading times, a further conclusion to point out is that the High Attachment sentences take the parser shorter to process compared to the Low Attachment sentences, which is supported by Kırkıcı (2004) and Dinctopal-Deniz (2010). Therefore, it is suggested that Turkish is a High Attachment language. In the High Attachment sentences, a new node for NP2 (AoI 3, namely the second NP that follows the RC) is created unlike the Low Attachment and this results in higher fixation times during the initial processing (first fixation duration) when the parser is exposed to the incoming flow of information. However, observed lower reading times in main verb (both in first and total fixation durations) is an indication that this online decision embracing both syntactic and more importantly semantic information is checked when reaching the main verb (lower fixation durations for the High Attachment sentence type).

Another processing difference between the two attachment types is how central and crucial the role of the main verb is. It is indicated that the Low Attachment AoIs are comparatively processed slower than the High Attachment AoIs. However, the difference is more significant in the observance of the main verbs. It is speculated that in processing of the Low Attachment sentences, the parser is not confident about the final parsing of a given sentence. The features and properties of the main verb are scrutinized extensively in order to reach the intended message of the sentence by the parser. The High Attachment main verbs, on the other hand, significantly possess lower reading times. As it is indicated before, longer fixation durations on NP2 due to creating a new node is made so confidently that the main verb is not an area for confirmation

anymore. To sum up, in the present study, the High Attachment preference is supported as observed in the related studies by Kırkıcı (2004) and Dinctopal-Deniz (2010). Furthermore, due to the eye-tracker device used in the experiment, more fine-grained analyses were performed. For the Low Attachment sentences, the main verb is an indispensable part for confirming syntactic operations and attachment preferences; thus, decoding the intended meaning of a given sentence. For Low Attachment configuration, early processing is completed with relatively smoothly as the incoming materials do not interfere with the Late Closure. On the other hand, for the High Attachment sentences it is not the case. NP2 (AoI3) does not meet lexical semantic requirements of the action in RC and thus is not added into the node as the agent/patient even in early processing. Although this AoI requires relatively longer fixation duration, the parsing operation shortens the overall processing durations. Therefore, the parser does not rely on the argument structure of the main verb for checking.

For the second research question “What strategies are used by the Turkish parser when confronted with a potential local ambiguity?”, it was observed that in case of potential local ambiguity (as discussed in High Attachment with Ambiguity sentences), using argument structure and licensing information of the main verb is the strongest strategy. Although reading times for other AoIs show the High Attachment with Ambiguity as the lowest or second lowest sentence type in processing, MV (AoI5) reading time completely changes the direction of reading times. This area lies at the center of discussion in parsing preferences. Supposing it as a Low Attachment sentence until the end of the sentence, the parser realizes that her/his initial processing collapses especially when reaching a ditransitive verb. In the parsing draft, there is no node opened for a second argument. That is when, the parser struggles for reaching intended meaning by

the sentence and a need for revision arises. The proposed direction of parsing in this locally ambiguous sentence type follows Garden Path Theory. The already opened node captures the incoming materials as long as they are consistent with the semantic features of the elements in the node. However, the ambiguity is realized and it is resolved when only the end of the sentence is reached. As seen in the model of Fodor and Inoue (1998), Garden-path effect is resolved after reaching the essential information presented by the main verb. In the present study, the main verb acts as “the error signal” as illustrated by Ferreira and Henderson (1991, 1998). This is the location where the parser *Attaches Anyway* what is already postulated at initial syntactic analysis. The main verbs of the sentences possess a central role in disambiguation due to two reasons. The first is that in Turkish, the main verb licenses roles to arguments. The second is that this is the final incoming element of the sentence and the parser completes and finalizes processing of the given sentence. Upon realizing that the parsing draft of the Low Attachment configuration is ill-formed both semantically and more importantly syntactically, the reanalysis of this sentence type later involves heavy cognitive load. Regarding AoI reading times for the main verb, this sentence type has the highest reading times. In an attempt to repair the misanalysed NP, the parser *Adjusts* the first draft of processing and this time attach NP1 low to the RC. To conclude, in order to reanalyze and repair a given ambiguous sentence the main verb has the central role due to its licensing role. For Turkish parser, the early processing is dominated by syntactic operations (Late Closure). However, it is overridden by lexical-semantic information of the main verb when it is led into a Garden-path situation.

In order to answer the first part of the third question, which is “Does Subject/Object Relative Clause asymmetry affect Low and High Attachment preferences? If so, is there

a processing asymmetry between SRCs and Object Relative Clauses in the context of attachment preferences? ”, the processing of RC AoI and the entire sentences as an AoI are observed for their total processing reading times. For all attachment types (Low, High and High with Ambiguity Attachment), the ORCs are found to have been read in longer durations than the SRCs. The statistical tools which were employed to search for significance, however, yield a different result. In terms of RC area, ORCs are not read significantly longer than that of SRCs considering all attachment types. The result suggests two remarkable points. The first one is that one-syllable difference between SRC and ORC does not pose a problem in processing asymmetry. The second is that processing of RC area is not an issue in asymmetry effect on attachment types. The asymmetry displays itself on reading the rest of the sentence, in which participants carry the cognitive load of ORC processing.

For the second part of the third research question, in the context of two different attachment configurations, participants’ processing trends are also observed whether there is a significant difference between SRC and ORCs. Experimental sentences are divided into two regarding the RC types. The conclusion is that an RC asymmetry is clearly observed. A heavier cognitive load is the case for the ORCs compared to the SRCs. Predictions of Structural Distance Hypothesis (SDH) (O’Grady, 2003) for Turkish RCs hold true in the present study. Interfering maximal projections between heads and gaps in ORCs are further than SRCs, which results in longer reading times. Besides the structurally further distance between the two RC types, the fact that ORCs possess person suffix is a language-specific factor that adds to the difficulty of processing.

5.2. SUGGESTIONS FOR FURTHER RESEARCH

It is possible to improve certain aspects of the present study, and points that are related but not considered here can be tested in further research in the future. In the present study, The Low/High Attachment configurations were not manipulated regarding animacy. Animate/Inanimate or Inanimate/Animate NP pairs as possible sites to be attached to RCs will be prepared in further research and tested whether animacy is a deciding factor in the attachment preferences to RCs. The experimental sentences presented in this study are context-free. For further research, the same sentences could be presented with appropriate contexts and the role of the context could be tested as a factor influencing the processing of the attachment preferences, the RC attachment and the ambiguity resolution.

Pupil calibrations were performed for each participant prior to implementation of the experiment however, during the time a participant reads given sentences it is not detected if he/she spends an acceptable span of time on a certain component (AoI) of the sentence. Specialized software such as *em2* (Logacev and Vasishth, 2013) will be used in further studies for excluding fixations shorter than 50 ms and longer than 1200 ms as they are not acceptable durations for reading a given word.

The findings from the experiment in this study can be investigated in teaching Turkish as a foreign language. Other compounds (genitive compounds, prepositional phrases) and the possessive compound that is analyzed in the experiment of the study can be compared to find which compound is easier to process. In this way, an order of difficulty of these structures can be revealed and taught in classes accordingly. Therefore, developments to curriculum design for programs that teach Turkish as a foreign language will be provided.

The findings can also be used in the improvement of artificial intelligence algorithms for translation. High attachment preference in Turkish can be prioritized in translations of similar structures from Turkish.

Discourse Analysis is another area to investigate the implications of the structures in this study. An analysis on the use of possessive constructions compared to genitive constructions in terms of RC attachment will yield considerable data to discuss on.

In the field of psycholinguistics today, researches carried out in language processing mainly focus on certain linguistic structures and compare one or two factors that affect the nature of processing. As discussed in the present study, individual factors such as structural or linear distance, main verb licensing role and incremental processing nature of language processing are thought to be largely responsible for the findings. However, for a better appreciation of language processing, a wholistic approach to language processing is required to come up with a system that embraces all factors such as frequency, word order, etc. that contribute to it. On this point, Connectionism has the potential to produce flexible and inclusive models that will account for the processing attachment preferences to RCs.

The computational models are likely to be used more commonly in the field of language processing in the future. They are effective tools to test psycholinguistic hypotheses considering a number of factors including frequency. In line with the development in computer modelling techniques, computational models could be used to test factors that play a role in attachment preferences and RC processing in the future.

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APPENDIX 1

Target Sentences

1. Zabıtayı gören bakkal çırağı hemen içeri girdi.

The grocery apprentice who saw the police immediately went inside

- a. Bakkal çırağı hemen içeri girdi.

Doğru

Grocery apprentice immediately went inside.

True

2. Zabıtayı gören bakkal çırağı hemen eve gönderdi.

The grocery owner who saw the police immediately sent the apprentice home.

- a. Bakkal çırağı zabıtayı gördü.

Yanlış

The grocery apprentice saw the police.

False

3. Zabıtayı gören bakkal telefonu hemen eline aldı.

The grocery owner who saw the police took the telephone in his hand immediately.

- a. Bakkal telefonu eline aldı.

Doğru

The grocery owner took the telephone in his hand.

True

4. Zabıtanın gördüğü bakkal çırağı hemen içeri girdi.

The grocery apprentice whom the police saw immediately went inside.

- a. Bakkal içeri girdi.

Yanlış

The grocery owner went inside.

False

5. Zabıtanın gördüğü bakkal çırağı hemen eve gönderdi.

The grocery owner whom the police saw immediately sent the apprentice home.

- a. Bakkal zabıtayı gördü.

Yanlış

The grocery owner saw the police

False

6. Zabıtanın gördüğü bakkal telefonu hemen eline aldı.

The grocery owner whom the police saw immediately took the telephone in his hand.

- a. Bakkal zabıtayı gördü.

Yanlış

The grocery owner saw the police

False

7. Şehri seven takım kaptanı çabucak ilgiye alıştı.

The team leader who loved the city quickly adapted to attention.

- a. Takım çabucak ilgiye alıştı. Yanlış
The team quickly adapted to attention. False
8. Şehri seven takım kaptanı çabucak yönetime gönderdi.
The team who loved the city quickly sent the leader to the administration.
a. Takım kaptanı şehri sevdi. Yanlış
The team leader loved the city. False
9. Şehri seven takım baklayı çabucak ellerine aldı.
The team who loved the city took the baklava into their hands.
a. Takım şehri sevdi. Doğru
The team loved the city True
10. Şehrin sevdiği takım kaptanı çabucak uyum gösterdi.
The team leader whom the city loved quickly adapted.
a. Şehir takımı sevdi. Yanlış
The city loved the team. False
11. Şehrin sevdiği takım kaptanı çabucak yönetime gönderdi.
The team who the city loved quickly sent the leader to the administration.
a. Takım yönetimle görüştü. Yanlış
The team met the administration. False
12. Şehrin sevdiği takım baklayı çabucak mideye indirdi.
The team who the city loved quickly ate the baklava.
a. Şehir takımı sevdi. Doğru
The city loved the team. True
13. Ailesine kızan köylü çocuğu aniden evden ayrıldı.
The village child who got mad at his family suddenly left the house.
a. Köylü aniden eve geldi. Yanlış
The villager suddenly came home. False
14. Ailesine kızan köylü çocuğu aniden evden kovdu.
The villager who got mad at his family expelled the child from the house.
a. Köylü çocuğu evden kovuldu. Doğru
The villager expelled the boy from home. True
15. Ailesine kızan köylü çapayı aniden elinden attı.
The villager who got mad at his family threw the hoe out of his hand.

- a. Köylü çapayı elinden attı. Doğru
The villager threw the hoe out of his hand. True
16. Ailesinin kızdığı köylü çocuğu aniden evden ayrıldı.
The villager who his family got mad quickly at left the house.
- a. Ailesi köylü çocuğuna kızdı. Doğru
His family got mad at the villager. True
17. Ailesinin kızdığı köylü çocuğu aniden evden kovdu.
The villager who his family got mad at expelled the child from the house.
- a. Köylü çocuğu evine aldı. Yanlış
The villager admitted the child to his house False
18. Ailesinin kızdığı köylü çapayı aniden elinden attı.
The villager who his family got mad at threw the hoe out of his hand.
- a. Ailesi köylüye kızdı. Doğru
His family got mad at the villager. True
19. Müşterileri tanıyan yönetici asistanı itinayla görüşmeler yaptı.
The manager assistant who knew the customers held meetings carefully.
- a. Yönetici müşterileri tanıdı. Yanlış
The administrator knew the customers. False
20. Müşterileri tanıyan yönetici asistanı itinayla toplantıya hazırladı.
The manager who knew the customers carefully prepared the assistant to the meeting.
- a. Müşteriler yöneticiyi tanıdı. Yanlış
The customers knew the administrator. False
21. Müşterileri tanıyan yönetici anlaşmaları itinayla gözden geçirdi.
The manager who knew the customers carefully reviewed the agreements.
- a. Müşteriler anlaşmayı gözden geçirdi. Yanlış
The customers reviewed the agreements. False
22. Müşterilerin tanıdığı yönetici asistanı itinayla hepsini aradı.
The manager assistant who the customers knew held meetings carefully.
- a. Yönetici itinayla görüşmeler yaptı. Doğru
The manager held meetings carefully. True

23. Müşterilerin tanıdığı yönetici asistanı itinayla toplantıya hazırladı.

The manager who the customers knew carefully prepared the assistant to the meeting.

a. Müşteriler yöneticiyi tanıdı.

Doğru

The customers knew the manager.

True

24. Müşterilerin tanıdığı yönetici anlaşmaları itinayla gözden geçirdi.

The manager who the customers knew carefully reviewed the agreements.

a. Yönetici müşterileri tanıdı.

Yanlış

The manager knew the customers.

False

25. Medyayı seven şirket patronu memnuniyetle soruları cevapladı.

The company boss who likes the media gladly answered the questions.

a. Şirket patronu medyayı sever.

Doğru

The company boss likes the media.

True

26. Medyayı seven şirket patronu memnuniyetle programa gönderdi.

The company which likes the media gladly sent the boss to the event.

a. Şirket patronu programa gönderdi.

Doğru

The company sent the boss to the event.

True

27. Medyayı seven şirket kapıları memnuniyetle ziyaretçilere açtı.

The company which likes the media gladly opened the doors to guests.

a. Medya şirketi sevdi.

Yanlış

The media loved the company

False

28. Medyanın sevdiği şirket patronu memnuniyetle soruları cevapladı.

The company boss whom the media likes gladly answered the questions.

a. Medya şirket patronunu sever.

Doğru

The media likes the company boss.

True

29. Medyanın sevdiği şirket patronu memnuniyetle programa gönderdi.

The company which the media likes gladly sent the boss to the event.

a. Medya şirket patronunu sevdi.

Yanlış

The media liked the company boss.

False

30. Medyanın sevdiği şirket kapıları memnuniyetle ziyarete açtı.

The company which the media likes gladly opened the doors to guests.

a. Medya şirketi sevdi.

Doğru

The media likes the company.

True

31. Doktoru bekleyen hasta yakınları üzüntüyle kapıya baktı.

The patient relatives who were waiting for the doctor sadly looked at the door.

a. Hasta doktoru bekledi.

Yanlış

The patient waited for the doctor.

False

32. Doktoru bekleyen hasta yakınları üzüntüyle dışarı gönderdi.

The patient who was waiting for the doctor sadly sent the relatives out.

a. Hasta yakınlarını dışarı gönderdi.

Doğru

The patient sent the relatives out.

True

33. Doktoru bekleyen hasta resmi üzüntüyle masaya bıraktı.

The patient who was waiting for the doctor sadly left the photo on the table.

a. Hasta doktoru bekledi.

Doğru

The patient waited for the doctor.

True

34. Doktorun beklediği hasta yakınları üzüntüyle kapıya baktı.

The patient relatives who the doctor was waiting sadly looked at the door.

a. Doktor hastayı bekledi.

Yanlış

The doctor waited for the patient.

False

35. Doktorun beklediği hasta yakınları üzüntüyle dışarı gönderdi.

The patient who the doctor was waiting sadly sent the relatives out.

a. Doktor hastayı bekledi.

Doğru

The doctor waited for the patient.

True

36. Doktorun beklediği hasta resmi üzüntüyle masaya bıraktı.

The patient who the doctor was waiting sadly left the photo on the table.

a. Doktor hasta resmini bekledi.

Yanlış

The doctor waited for the patient photo.

False

37. Çocuğa bakan polis köpeği birden ayağa kalktı.

The police dog which was looking at the child suddenly stood.

a. Polis birden ayağa kalktı.

Yanlış

The policeman suddenly stood

False

38. Çocuğa bakan polis köpeği birden içeri gönderdi.

The policeman who was looking at the child suddenly sent the dog inside.

a. Polis köpeğini içeri gönderdi.

Doğru

The policeman sent his dog inside

True

39. Çocuğa bakan polis sigarayı birden elinden attı.

The policeman who was looking at the child suddenly threw the cigarette out of his hand.

a. Çocuk polise baktı.

Yanlış

The child looked at the police.

False

40. Çocuğun baktığı polis köpeği birden ayağa kalktı.

The police dog which the child was looking at suddenly stood.

a. Çocuk polis köpeğine baktı.

Doğru

The child looked at the police dog.

True

41. Çocuğun baktığı polis köpeği birden içeri gönderdi.

The policeman who the child was looking at suddenly sent the dog inside.

a. Polis köpeği çocuğa baktı.

Yanlış

The police dog looked at the child.

False

42. Çocuğun baktığı polis sigarayı birden elinden attı.

The policeman who was looking at the child suddenly threw the cigarette out of his hand.

a. Polis sigarayı elinden attı.

Doğru

The policeman threw the cigarette out of his hand.

True

Filler Sentences

1. Eve gelen küçük kız annesini göremedi.
The little girl who came home could not see her mother.
 - Küçük kız eve geldi. Doğru
 - The little girl came home. True
2. Tanıdığım diş doktoru işini çok iyi yapar.
The dentist whom I know does his job very well.
 - Diş doktoru işinde iyi değil. Yanlış
 - The dentist is not good at his job. False
3. Yarın Ankara'ya gönderecekleri büyükelçi iyi derecede Türkçe biliyor.
The ambassador who they will send to Ankara tomorrow speaks Turkish to a good degree.
 - Büyükelçi iyi derecede Türkçe biliyor. Doğru
 - The ambassador speaks Turkish to a good degree. True
4. Hakkında konuştuğumuz adam birden geldi.
The man whom we were talking about suddenly came in.
 - Bir adam hakkında konuşmadık. Yanlış
 - We did not talk about a man. False
5. Köpeği ölen arkadaşımı dün gördüm.
I saw my friend whose dog died yesterday.
 - Arkadaşımın köpeği doğurdu. Yanlış
 - My friend's dog gave birth. False
6. Gaza basan şoför aniden kaza yaptı.
The driver who suddenly accelerated had an accident.
 - Şoför gaza bastı. Doğru
 - The driver accelerated. True
7. Ödevi biten öğrenci çıktı almayı unuttu.
The student who finished his homework forgot to print it out.
 - Öğrenci ödevini unuttu. Yanlış
 - The student forgot the homework. False
8. Cüzdanını unutan kız eve dönmek zorunda kaldı.

- The girl who forgot her purse had to go back home.
- Kız eve dönmek zorunda kaldı. Doğru
 - The girl had to go back home. True
9. Pırasadan nefret edenler çoğunluktadır.
- The ones who hate leek are the majority.
- Çoğunluk pırasaya bayılır. Yanlış
 - The majority love leek. False
10. Kardeşini seven abi fedakarlık yapar.
- The brother who loves his younger brother makes sacrifices.
- Abiler kardeşlerini sever. Doğru
 - Brothers love their young brothers. True
11. Yüksek not alan öğrenci tebrik edildi.
- The student who got a high grade was congratulated.
- Öğrenci yüksek not aldı. Doğru
 - The student got a high grade. True
12. Dövülen zavallı kanlar içindeydi.
- The poor man who was beaten was drenched in blood.
- Zavallı bayıldı. Yanlış
 - The poor man fainted. False
13. Çalışanın sağlık sigortası ödenerek kar etmek mümkündür.
- It is possible to make profit by paying for an employee's health insurance.
- İşverenin sigorta ödemesi kazançlı olabilir. Doğru
 - It could be profitable for an employer to pay health insurance. True
14. Denetlemeden önce futbol federasyonu yorumdan kaçındı.
- The football federation abstained from comments before inspections.
- Futbol federasyonundan açıklama henüz gelmedi. Doğru
 - Clarifications from the football federation have not been released. True
15. Şirket kızılötesi detektörlerin ihracatına başladı.
- The company started export of the infrared detectors.
- Detektörler Türkiye'de satıldı. Yanlış
 - The detectors were sold in Turkey. False
16. Şirket piyasayı inceleyince ürün fiyatını yükseltti.

The company raised the price of the product when they reconsidered the market.

- Ürün fiyatları düştü. Yanlış

The price of the product dropped. False

17. Bilim adamları yıllarca çalıştıktan sonra prototipi geliştirdiler.

The scientists developed the prototype after working on it for years.

- Prototip henüz tamamlanmadı. Yanlış

The prototype has not been completed. False

18. Emisyon skandalı sonrasında şirketten istifalar geldi.

Resignations were announced from the company following the emission scandals.

- Emisyon skandalı sebebiyle istifa edenler oldu. Doğru

Some people resigned due to the emission scandal. True

19. Otomotiv sanayi verileri açıklandı.

Data from automotive industry were released.

- İşsizlik verileri açıklandı. Yanlış

Unemployment data were released. False

20. Otelde ayrılacağı sırada aşçı kalfasını tanıdığını fark etti.

While departing from the hotel, he realized that he knew the chief's assistant.

- Oteldeyken aşçı kalfasından haberi yoktu. Doğru

He was not aware of the chief's assistant when he was at the hotel. True

21. Genç adamın hayali devlet adamı olmağı.

The dream of the young man was to be a statesman.

- Genç adam kendi işini kurmayı düşünmedi. Doğru

The young man did not think about setting up his own company. True

22. Holding patronu iddiaları yalanladı.

The boss of the company denied the claims.

- Holding patronu iddiaları yalanladı. Doğru

The boss of the company denied the claims. True

23. Ünlü bilişim şirketi holding haline geldi.

The famous tech company turned into a holding company.

- Şirket önceden küçüktü. Doğru

The company was small. True

24. İşe geç geleceğini şantiye müdürüne haber vermedi.

He did not inform the site manager that he would be late.

- Müdüre haber verildi.

Yanlış

The manager was informed.

False

25. Otomotiv firması denemeleri bitirip seri üretime geçmek istiyor.

The automotive company desires to finish inspections and start mass production.

- Firma seri üretime geçti.

Yanlış

The company started mass production.

False

26. Öğrenci velisi şikayetleri sakince dinleyip başını salladı.

The student's parent calmly listened to the complaints and nodded.

- Öğrenci velisi çılgına döndü.

Yanlış

The student's parent went mad.

False

27. Türk asıllı ABD vatandaşı kimya alanında Nobel ödülü aldı.

Turkish-originated US citizen received the Nobel Prize for Chemistry.

- Bilim adamı tıp alanında Nobel aldı.

Yanlış

The scientist received the Nobel Prize in Medicine.

False

28. Otobüs kaptanı koşarak otobüsten aşağı indi.

The captain of the bus rushed out of the bus.

- Kaptan evden aşağı indi.

Yanlış

The captain got out of the house.

False

29. Vatandaşlar miting alanına gelip parti başkanını dinlediler.

The citizens came to the rally point and listened to the party leader.

- Vatandaşlar konsere geldiler.

Yanlış

The citizens came to a concert.

False

30. Yüksek lisans öğrencisi tatil hazırlıklarına başladı.

The post-graduate student started holiday preparations.

- Öğrenci hala lisans programındadır.

Yanlış

The student is still studying in the undergraduate program.

False

31. Ünlü siyasetçinin dünürü kalp krizi geçirdi.

The father-in-law of the famous politician's son had a heart attack.

- Ünlü siyasetçinin dünürü midesinden rahatsızdı.

Yanlış

The father-in-law of the famous politician's son had a stomachache.

False

32. Haberi alan acil servise akın etti.

People who got the news rushed to the hospital.

- Acil servis haberi alanlarla doldu.

Doğru

The emergency was filled with the ones who got the news.

True

33. 150. kez soyulan ev sonunda yıkıldı.

The house which was robbed for a 150th time was eventually demolished.

- Ev 150 kez soyuldu.

Doğru

The house was robbed for 150 times.

True

34. Sıkı çalışarak sınavdan tam puan aldı.

He aced the exam by studying hard.

- Hiçbir şey yapmadan sınavdan tam puan aldı.

Yanlış

He aced the exam without doing anything.

False

35. Koalisyon havadan bombaladı.

The coalition bombarded from the sky.

- Koalisyon havadan yardım gönderdi.

Yanlış

The coalition sent help from the sky.

False

36. Bombalar şehir merkezine düşmesine rağmen can almadı.

Although the bombs fell into the city center, it did not kill anyone.

- Bombalama sonunda ölenler olmadı.

Doğru

Nobody was killed following the bombardment.

True

37. Bakan yeni operasyon tarihini verdi.

The minister announced the date of the new operation.

- Bakanın yeni operasyondan haberi var.

Doğru

The minister is informed of the new operation.

True

38. Dünyayı haberdar etmeden hareket başladı.

Without informing the world, the operation started.

- Harekatın başlangıcından dünyanın haberi yoktu.

Doğru

The world was not informed of the start of the operation.

True

39. Konut fiyatları %28 artarak dünyada birinci olduk.

We became the first in the world as the house prices rose by 28%.

- ABD’de konut fiyatları daha fazla yükseldi.

Yanlış

House prices in the USA rose higher.

False

40. Uçaktan iner inmez önemli açıklamalar yaptı.

He made important statements as soon as he got out of the plane.

- Açıklamalar uçaktan inince yapıldı.

Doğru

Statements were made after getting off the plane.

True

41. Mahkemede sanığın takım elbise giymesi yararınaymış.

It is said that it is to the alleged criminal's advantage to wear a suit to the court.

- Sanığın takım elbise giymesinin faydası yoktur.

Yanlış

There is no benefit for the alleged criminal to wear a suit.

False

42. Misilleme yapmak için hemen bir tatbikat düzenlendi.

To retaliate, a military exercise was organized.

- Tatbikatın amacı misillemeydi.

Doğru

The aim of the military exercise was retaliation.

False

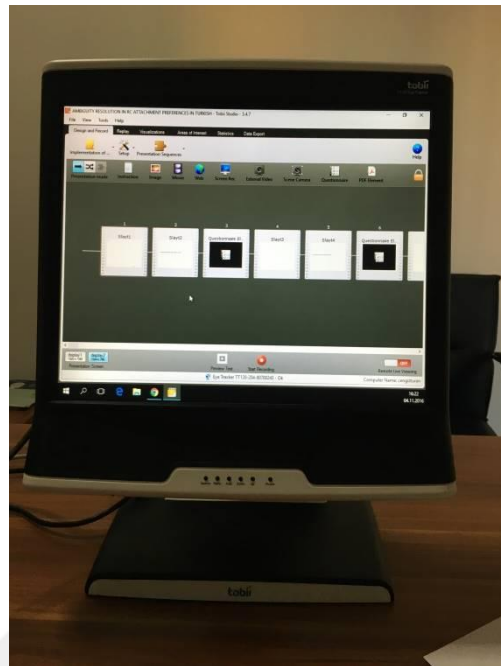
APPENDIX 2

Images from Implementation

1. Tobii Eye-Tracker Case



2. Tobii Eye-Tracker



3. A participant ready to start the experiment

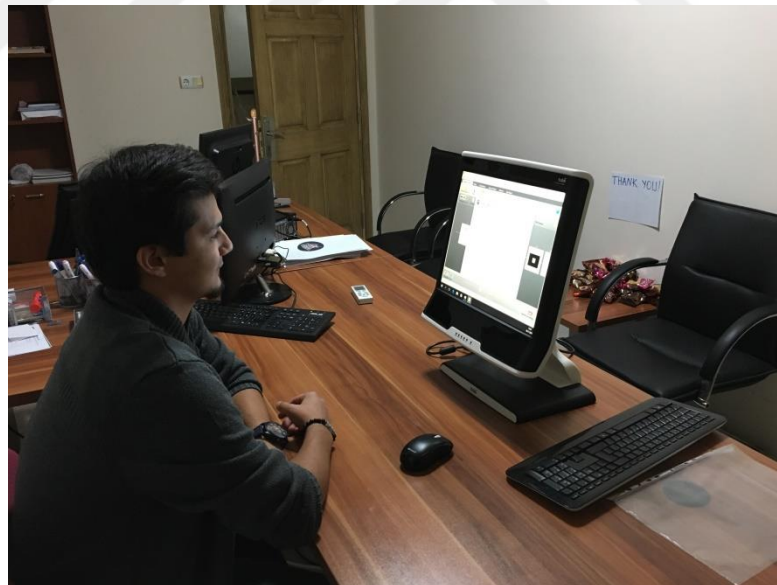


Table 50. Descriptive Statistics and Normality Distribution of Sentences Manipulated with RC and Attachment Types in terms of First Fixation Duration

Descriptive Statistics						Tests of Normality		
	N	Minimum	Maximum	Mean	Std. Deviation	Kolmogorov-Smirnov		
						Statistic	df	Significance
FF_SRC_LowA_Rel	60	,09	,20	,1422	,02731	,105	60	,095
FF_SRC_LowA_NP1	60	,09	,25	,1738	,03966	,095	60	,200*
FF_SRC_LowA_NP2	60	,10	,30	,2068	,04192	,110	60	,070
FF_SRC_LowA_MV	60	,08	,30	,1867	,05532	,102	60	,195
FF_SRC_LowA_SO	60	,14	,31	,2172	,04592	,112	60	,057
FF_SRC_AmbgL_Rel	60	,09	,20	,1423	,02445	,110	60	,067
FF_SRC_AmbgL_NP1	60	,09	,27	,1673	,04426	,093	60	,200*
FF_SRC_AmbgL_NP2	60	,10	,26	,1833	,03999	,081	60	,200*
FF_SRC_AmbgL_MV	60	,10	,30	,1878	,05083	,089	60	,200*
FF_SRC_AmbgL_SO	60	,13	,33	,2072	,04361	,101	60	,200*
FF_SRC_High_Rel	60	,11	,19	,1538	,02018	,109	60	,075
FF_SRC_High_NP1	60	,09	,23	,1597	,03167	,112	60	,057
FF_SRC_High_NP2	60	,11	,34	,2165	,05695	,073	60	,200*
FF_SRC_High_MV	60	,07	,27	,1613	,05150	,100	60	,200*
FF_SRC_High_SO	60	,11	,30	,2017	,04279	,077	60	,200*
FF_ORC_LowA_Rel	60	,07	,20	,1270	,02970	,110	60	,069
FF_ORC_LowA_NP1	60	,09	,25	,1758	,03872	,064	60	,200*
FF_ORC_LowA_NP2	60	,07	,33	,2012	,05434	,102	60	,197
FF_ORC_LowA_MV	60	,10	,22	,1540	,03335	,098	60	,200*
FF_ORC_LowA_SO	60	,08	,31	,2057	,05010	,097	60	,200*
FF_ORC_AmbgL_Rel	60	,08	,20	,1387	,02639	,095	60	,200*
FF_ORC_AmbgL_NP1	60	,08	,30	,1682	,05107	,114	60	,052
FF_ORC_AmbgL_NP2	60	,10	,28	,1840	,04393	,077	60	,200*
FF_ORC_AmbgL_MV	60	,10	,27	,1722	,04518	,078	60	,200*
FF_ORC_AmbgL_SO	60	,07	,37	,1932	,05786	,078	60	,200*
FF_ORC_High_Rel	60	,08	,19	,1355	,02683	,098	60	,200*
FF_ORC_High_NP1	60	,10	,25	,1702	,03505	,102	60	,187
FF_ORC_High_NP2	60	,10	,33	,2145	,06416	,086	60	,200*
FF_ORC_High_MV	60	,06	,27	,1502	,04799	,113	60	,055
FF_ORC_High_SO	60	,11	,29	,2045	,04428	,101	60	,200*
Valid N (listwise)	60							

Table 51. Descriptive Statistics and Normality Distribution of Sentences Manipulated with RC and Attachment Types in terms of Total Fixation Duration

Descriptive Statistics						Tests of Normality		
	N	Minimum	Maximum	Mean	Std. Deviation	Kolmogorov-Smirnov		
						Statistic	df	Significance
TF_SRC_LowA_Rel	60	,48	1,93	1,1517	,39453	,102	60	,196
TF_SRC_LowA_NP1	60	,27	,85	,4960	,15268	,110	60	,069
TF_SRC_LowA_NP2	60	,10	1,10	,5855	,25487	,113	60	,055
TF_SRC_LowA_MV	60	,13	,63	,3555	,13266	,114	60	,050
TF_SRC_LowA_SO	60	,28	1,19	,6205	,22697	,100	60	,200*
TF_SRC_AmbgL_Rel	60	,43	2,66	1,1550	,59131	,113	60	,057
TF_SRC_AmbgL_NP1	60	,23	1,35	,6462	,26593	,108	60	,080
TF_SRC_AmbgL_NP2	60	,19	1,35	,7405	,28372	,107	60	,086
TF_SRC_AmbgL_MV	60	,10	1,31	,5510	,27629	,103	60	,185
TF_SRC_AmbgL_SO	60	,15	1,38	,6878	,28281	,106	60	,092
TF_SRC_High_Rel	60	,30	2,28	,9888	,45542	,109	60	,076
TF_SRC_High_NP1	60	,13	1,10	,5067	,24806	,113	60	,057
TF_SRC_High_NP2	60	,17	1,58	,7415	,35268	,092	60	,200*
TF_SRC_High_MV	60	,10	,50	,2638	,09548	,114	60	,052
TF_SRC_High_SO	60	,16	1,06	,5830	,21900	,081	60	,200*
TF_ORC_LowA_Rel	60	,24	2,40	1,1200	,54274	,107	60	,083
TF_ORC_LowA_NP1	60	,18	1,20	,6098	,25188	,109	60	,072
TF_ORC_LowA_NP2	60	,18	1,25	,5753	,27486	,114	60	,051
TF_ORC_LowA_MV	60	,09	,53	,2535	,11205	,112	60	,057
TF_ORC_LowA_SO	60	,14	1,34	,5363	,26107	,096	60	,200*
TF_ORC_AmbgL_Rel	60	,14	2,38	1,0892	,56184	,103	60	,183
TF_ORC_AmbgL_NP1	60	,19	,90	,4738	,19714	,101	60	,200*
TF_ORC_AmbgL_NP2	60	,10	1,32	,5967	,29469	,112	60	,059
TF_ORC_AmbgL_MV	60	,12	,63	,3367	,11599	,107	60	,082
TF_ORC_AmbgL_SO	60	,16	1,46	,6157	,30017	,104	60	,166
TF_ORC_High_Rel	60	,28	1,96	,9212	,42298	,109	60	,071
TF_ORC_High_NP1	60	,10	,75	,3968	,16431	,105	60	,095
TF_ORC_High_NP2	60	,20	1,10	,6090	,24078	,092	60	,200*
TF_ORC_High_MV	60	,11	,46	,2727	,09508	,086	60	,200*
TF_ORC_High_SO	60	,19	1,19	,5612	,25510	,100	60	,200*
Valid N (listwise)	60							

Table 52. Descriptive Statistics and Normality distribution of sentences manipulated with RC in terms of First Fixation Duration

Descriptive Statistics						Tests of Normality		
	N	Minimum	Maximum	Mean	Std. Deviation	Kolmogorov-Smirnov ^a		
						Statistic	df	Significance
FF_LowA_Rel	60	,09	,18	,1346	,02255	,086	60	,764
FF_LowA_NP1	60	,11	,24	,1748	,03405	,082	60	,809
FF_LowA_NP2	60	,09	,28	,2040	,04026	,094	60	,667
FF_LowA_MV	60	,11	,26	,1703	,03618	,069	60	,938
FF_LowA_SO	60	,13	,31	,2114	,04213	,107	60	,499
FF_Ambgl_Rel	60	,11	,20	,1405	,02170	,129	60	,270
FF_Ambgl_NP1	60	,10	,29	,1677	,03997	,127	60	,289
FF_Ambgl_NP2	60	,12	,26	,1837	,03742	,103	60	,546
FF_Ambgl_MV	60	,12	,27	,1800	,03993	,093	60	,677
FF_Ambgl_SO	60	,11	,35	,2002	,04544	,072	60	,911
FF_High_Rel	60	,10	,19	,1447	,01895	,094	60	,662
FF_High_NP1	60	,11	,23	,1649	,02831	,074	60	,896
FF_High_NP2	60	,11	,32	,2155	,05466	,087	60	,754
FF_High_MV	60	,08	,26	,1558	,04036	,092	60	,691
FF_High_SO	60	,11	,30	,2031	,03652	,092	60	,693

Table 53. Descriptive Statistics and Normality distribution of sentences manipulated with Attachment types in terms of First Fixation Duration

Descriptive Statistics						Tests of Normality		
	N	Minimum	Maximum	Mean	Std. Deviation	Kolmogorov-Smirnov ^a		
						Statistic	df	Significance
TF_LowA_Rel	60	,54	2,09	1,1358	,40111	,142	60	,178
TF_LowA_NP1	60	,30	,93	,5529	,16692	,102	60	,556
TF_LowA_NP2	60	,17	1,13	,5804	,23207	,114	60	,414
TF_LowA_MV	60	,14	,52	,3045	,09698	,124	60	,319
TF_LowA_SO	60	,21	1,23	,5784	,21438	,101	60	,570
TF_Ambgl_Rel	60	,38	2,38	1,1221	,53472	,108	60	,482
TF_Ambgl_NP1	60	,27	1,06	,5600	,20834	,113	60	,424
TF_Ambgl_NP2	60	,29	1,20	,6686	,24727	,144	60	,168
TF_Ambgl_Mv	60	,20	,90	,4438	,16815	,109	60	,476
TF_Ambgl_SO	60	,22	1,32	,6517	,26606	,129	60	,267
TF_High_Rel	60	,33	1,98	,9550	,38577	,090	60	,716
TF_High_NP1	60	,16	,93	,4517	,17390	,101	60	,572
TF_High_NP2	60	,24	1,34	,6752	,27265	,136	60	,215
TF_High_Mv	60	,13	,48	,2683	,07976	,106	60	,508
TF_High_SO	60	,21	1,05	,5721	,20425	,074	60	,894

Table 54: Descriptive Statistics and Normality distribution of correct answers to comprehension questions

	N	Min.	Max.	Mean	Std. Dev.	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
ORC-Low Attachment	60	,00	7,00	5,8333	2,37335	1,468	,608
ORC-High Attachment with Ambiguity	60	,00	7,00	4,5500	2,83097	-1,247	,608
ORC-High Attachment	60	,00	7,00	6,2000	1,91161	5,709	,608
SRC-Low Attachment	60	,00	7,00	6,2000	1,85765	3,513	,608
SRC-High Attachment with Ambiguity	60	,00	7,00	5,6333	2,32865	1,191	,608
SRC-High Attachment	60	4,00	7,00	6,7667	,76727	9,576	,608
ORC	60	,00	21,00	16,5833	6,59556	1,023	,608
SRC	60	4,00	21,00	18,6333	4,73704	3,311	,608
Low Attachment	60	,00	14,00	12,0333	4,18215	2,262	,608
High Attachment with Ambiguity	60	,00	14,00	10,1833	5,02027	-,507	,608
High Attachment	60	4,00	14,00	12,9667	2,64233	7,090	,608

Table 55: Descriptive Statistics on RC Asymmetry Considering First Fixation Duration

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
FF_SRC	60	,09	,17	,1248	,02143	-,936	,608
FF_ORC	60	,09	,29	,1348	,02931	12,601	,608
Valid N (listwise)	60						

Table 56: T-test Results on RC Asymmetry Considering First Fixation Duration

	Paired Differences					t	df	Significance (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair FF_ORC - 1 FF_SRC	-,01000	,02429	,00314	-,01627	-,00373	- 3,189	59	,002

Table 57: Descriptive Statistics on RC Asymmetry Considering Total Fixation Duration

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
TF_ORC	60	,28	9,02	3,3422	1,72190	,968	,608
TF_SRC	60	,43	9,81	3,9170	1,67210	1,978	,608
Valid N (listwise)	60						

Table 58: T-test Results on RC Asymmetry Considering First Fixation Duration

	Paired Differences					t	df	Significance (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair TF_ORC - 1 TF_SRC	,57483	1,05835	,13663	,30143	,84823	4,207	59	,001

Table 59: T-test Results on RC Asymmetry Effect on Low Attachment Sentences Considering First Fixation Duration

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
FF_SRC_Low	59	,07	,20	,1212	,03074	-,307	,613
FF_ORC_LowA	59	,07	,50	,1356	,05347	38,201	,613
Valid N (listwise)	59						

Table 60: T-test Results on RC Asymmetry Effect on Low Attachment Sentences Considering First Fixation Duration

	Paired Differences					t	df	Significance (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair FF_SRC_Low - 1 FF_ORC_LowA	,01441	,04928	,00642	,00156	,02725	2,246	58	,029

Table 61: Descriptive Statistics and Normality distribution of RC Asymmetry Effect on Low Attachment Sentences Considering Total Fixation Duration

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
TF_SRC_Low	59	,08	8,72	3,3456	1,74757	,772	,613
TF_ORC_LowA	59	,54	11,17	3,7836	1,60791	6,596	,613
Valid N (listwise)	59						

Table 62: T-test Results on RC Asymmetry Effect on Low Attachment Sentences Considering Total Fixation Duration

	Paired Differences					t	df	Significance (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 TF_SRC_Low - TF_ORC_LowA	,43797	1,29316	,16835	,10097	,77496	2,601	58	,012

Table 63: Descriptive Statistics and Normality distribution of RC Asymmetry Effect on High Attachment with Ambiguity Sentences Considering Total Fixation Duration

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
TF_SRC_HighAw_Ambg	59	,30	11,95	3,6732	2,24701	2,515	,613
TF_ORC_HighAw_Ambg	59	,38	11,29	4,4215	2,41558	,459	,613
Valid N (listwise)	59						

Table 64: T-test Results on RC Asymmetry Effect on High Attachment with Ambiguity Sentences Considering Total Fixation Duration

	Paired Differences					t	df	Significance (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 TF_SRC_HighAw_Ambg - TF_ORC_HighAw_Ambg	,74831	1,88358	,24522	,25744	1,23917	3,052	58	,003

Table 65: Descriptive Statistics and Normality distribution of RC Asymmetry Effect on High Attachment with Ambiguity Sentences Considering First Fixation Duration

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
FF_SRC_HighA	59	,06	,18	,1249	,02873	-,567	,613
FF_ORC_HighA	59	,08	,21	,1322	,02835	-,132	,613
Valid N (listwise)	59						

Table 66: T-test Results on RC Asymmetry Effect on High Attachment with Ambiguity Sentences Considering First Fixation Duration

	Paired Differences					t	df	Significance (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 FF_SRC_HighA - FF_ORC_HighA	,00729	,03352	,00436	-,00145	,01602	1,670	58	,100

Table 67: Descriptive Statistics and Normality distribution of RC Asymmetry Effect on High Attachment Sentences Considering First Fixation Duration

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
TF_SRC_HighA	59	,10	10,47	3,0349	1,68372	5,525	,613
TF_ORC_HighA	59	,38	7,81	3,3920	1,43861	1,216	,613
Valid N (listwise)	59						

Table 68: T-test Results on RC Asymmetry Effect on High Attachment with Ambiguity Sentences Considering Total Fixation Duration

	Paired Differences					t	df	Significance (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 TF_SRC_HighA - TF_ORC_HighA	,35712	1,33371	,17363	,00955	,70469	2,057	58	,044

APPENDIX 3



T.C.
HACETTEPE ÜNİVERSİTESİ
Rektörlük

24 Nisan 2017

Sayı : 35853172/433-1541

SOSYAL BİLİMLER ENSTİTÜSÜ MÜDÜRLÜĞÜNE

Hatun-

İlgi: 04.04.2017 tarih ve 2238 sayılı yazınız.

Enstitünüz İngiliz Dilbilimi Anabilim Dalı doktora programı öğrencilerinden **Cengiz TURAN**'ın **Doç. Dr. Emine YARAR** danışmanlığında yürüttüğü "**Türkçede Ortaç Yapısına Bağlama Tercihlerinde Anlam Karmaşası Çözümü**" başlıklı tez çalışması, Üniversitemiz Senatosu Etik Komisyonunun **11 Nisan 2017** tarihinde yapmış olduğu toplantıda incelenmiş olup, etik açıdan uygun bulunmuştur.

Bilgilerinizi ve gereğini rica ederim.

Prof. Dr. Rahime M. NOHUTCU
Rektör a.
Rektör Yardımcısı



T.C.
HACETTEPE ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ MÜDÜRLÜĞÜ

Sayı: 12908312-010.99/2870
Konu: Cengiz TURAN Hk.

02/05/2017

İngiliz Dilbilimi
Anabilim Dalı Başkanlığı'na,

Hütn-

Anabilim Dalımız doktora programı öğrencilerinden Cengiz TURAN'ın Doç.Dr. Emine YARAR danışmanlığında hazırladığı ; " Türkçede Ortaç Yapısına Bağlama Tercihlerinde Anlam Karmaşası Çözümü " başlıklı tez çalışma izni isteğine ilişkin Yazı İşleri Müdürlüğünden alınan 24.04.2017 tarih 433-1541 sayılı yazı ilişikte gönderilmiştir.

Bilgilerinizi ve adı geçen öğrenciye tebliğini rica ederim.

Saygılarımla,

Prof.Dr. SİBEL BOZBEYOĞLU
Enstitü Müdürü

EKLER :
Belge

Enstitü Sekreteri : Ş. KOÇOĞLU (Paraf)

Sayın Doç. Dr. Emine Yarar'ın
ve tez öğrencisi Cengiz Turan'ın
bilgileriniz.

Bilgi edindim.

4/5/2017

315/2017

99/40

H.S.

Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü 06060 Hacettepe-ANKARA E-şğı: www.sosyalbilimler.hacettepe.edu.tr
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6780420956

**APPENDIX 4****HACETTEPE ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ
DOKTORA TEZ ÇALIŞMASI ORJİNALLİK RAPORU****HACETTEPE ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ
İNGİLİZ DİLBİLİMİ ANABİLİM DALI BAŞKANLIĞI'NA**

Tarih: 20/06/2017

Tez Başlığı: Türkçede Ortaç Yapılarına Yönelik Ekleme Tercihlerinin Göz İzleme Tekniği İncelenmesi

Yukarıda başlığı gösterilen tez çalışmamın a) Kapak sayfası, b) Giriş, c) Ana bölümler ve d) Sonuç kısımlarından oluşan toplam 135 sayfalık kısmına ilişkin, 18/06/2018 tarihinde şahsım tarafından Turnitin adlı intihal tespit programından aşağıda işaretlenmiş filtrelemeler uygulanarak alınmış olan orijinallik raporuna göre, tezimin benzerlik oranı % 11'dur.

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- 3- ☐ Alıntılar hariç
- 4- ☒ Alıntılar dâhil
- 5- ☐ 5 kelimedenden daha az örtüşme içeren metin kısımları hariç

Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü Tez Çalışması Orijinallik Raporu Alınması ve Kullanılması Uygulama Esasları'nı inceledim ve bu Uygulama Esasları'nda belirtilen azami benzerlik oranlarına göre tez çalışmamın herhangi bir intihal içermediğini; aksinin tespit edileceği muhtemel durumda doğabilecek her türlü hukuki sorumluluğu kabul ettiğimi ve yukarıda vermiş olduğum bilgilerin doğru olduğunu beyan ederim.

Gereğini saygılarımla arz ederim.

Tarih ve İmza

20/06/2018

Adı Soyadı: Cengiz Turan
Öğrenci No: N11248264
Anabilim Dalı: İngiliz Dilbilimi
Programı: İngiliz Dilbilimi
Statüsü: ☒ Doktora ☐ Bütünleşik Dr.

DANIŞMAN ONAYI

UYGUNDUR.

DOÇ. DR. ENİNE YARAR

(Unvan, Ad Soyad, İmza)



HACETTEPE UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
Ph.D. DISSERTATION ORIGINALITY REPORT

HACETTEPE UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
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Student No: N11248264

Department: English Linguistics

Program: English Linguistics

Status: ☒ Ph.D. ☐ Combined MA/ Ph.D.

20/06/2018

ADVISOR APPROVAL

APPROVED.

ASSOC. PROF. DR. EMINE YARAR
(Title, Name Surname, Signature)

ÖZGEÇMİŞ

Kişisel Bilgiler

Adı Soyadı : Cengiz Turan

Doğum Yeri ve Tarihi : Siirt – 31.08.1985

Eğitim Durumu

Lisans Öğrenimi :Çukurova Üniversitesi, İngilizce Öğretmenliği Bölümü

Yüksek Lisans Öğrenimi :Hacettepe Üniversitesi, İngiliz Dilbilimi Anabilim Dalı

Bildiği Yabancı Diller :İngilizce, Almanca

Bilimsel Faaliyetleri :Turan, C. (2013). Access to UG and Transfers from L1 in the Acquisition of Relative Clauses by Turkish Learners of English. (ISLC), Izmir, 17-19 June 2013, 203-220

Turan, C. (2013). İngilizceyi İkinci Dil Olarak Öğrenen Türk Öğrencilerin Ortaç Yapısını Öğreniminde Evrensel Dilbilgisine Erişimi/Birinci Dilden Aktarımların Derecesi. 27. Ulusal Dilbilim Kurultayı, 02-04 Mayıs 2013, Kemer – Antalya.

Turan, C. (2015) Access to UG and Transfers from L1 in the Acquisition of Relative Clauses by Turkish Learners of English (CUELT), Adana, 21-22 May.

İş Deneyimi**Stajlar** :**Projeler** :**Çalıştığı Kurumlar** :Adana Bilim ve Teknoloji Üniversitesi -
Yabancı Diller Yüksekokulu**İletişim****E-Posta Adresi** :cturan@adanabtu.edu.tr**Tarih** :05.06.2018