THE PROCESSING OF SUBJECT-VERB NUMBER AGREEMENT IN L2 ENGLISH BY NATIVE TURKISH SPEAKERS

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THE PROCESSING OF SUBJECT-VERB NUMBER AGREEMENT IN L2 ENGLISH BY NATIVE TURKISH SPEAKERS

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The Processing of Subject-Verb Number Agreement in L2 English

by Native Turkish Speakers

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Abstract

Gülay Öztürk, "The Processing of Subject-Verb Number Agreement in L2 English by Native Turkish Speakers "

The present study aims to investigate how end-state Turkish learners process subject-verb agreement in L2 English as a second language (L2). The constructions under investigation are embedded noun phrase (NP) constructions made up of a head NP and daughter NP. The numbers of the two nouns are manipulated (i.e., *the toy(s) for the kid(s)).* The processing routines of the end-state L2 English speakers are investigated in comparison to those of native English speakers.

Studies on first language (L1) sentence processing have revealed that adult native speakers of English tend to experience a processing difficulty in production and comprehension when the subject NP contains a singular head noun and a plural local noun (i.e., the (S)ingular-(P)lural condition) (e.g. *the toy for the kids*); but not when the head noun is plural and the local noun is singular (i.e., the PS condition) (e.g., *the toys for the kid*). This difference between the two conditions is called the *mismatch asymmetry* (Pearlmutter, Garnsey, & Bock, 1999, Vigliocco & Nicol, 1998).

Two sentence preamble completion tasks were administered. The first one required declarative sentence production and the second one required question formation. The aim was to test whether subject-verb agreement computation is based on syntactic or linear distance. In addition, a word-by-word moving window technique was used as a self-paced reading task to compare and contrast the processing behaviors of the L2 speakers and the native controls in sentence comprehension.

No difference was found between L2 speakers and the native controls either in the production tasks or in the comprehension task. The number of agreement errors and distributional trend across the experimental conditions in the declarative sentence production task was identical in both groups. The same mismatch effect was observed both in L2 speakers' and the native controls' agreement errors. In the question formation task, no mismatch effect was observed for either group and no difference was found between the L2 group and the native controls. The results of the comprehension task were parallel to those in the declarative sentence production task. That is, there was a mismatch effect in both groups. Yet, in sentence comprehension, the L2 group was slower than the native speakers with respect to their reaction times. These findings are in line with previous research not only in production but also in comprehension (Bock & Cutting, 1992; Bock & Eberhard, 1993; Pearlmutter et al. 1999).

Özet

Gülay Öztürk, "The Processing of Subject-Verb Number Agreement in L2 English by Native Turkish Speakers"

Bu çalışma son-seviye ikinci dili İngilizce olan Türklerin ikinci dil olarak İngilizce'deki özne-yüklem uyumunu nasıl işlediklerini araştırmayı amaçlamaktadır. Araştırılan yapılar bir tamlanan ve bir tamlayan öbeklerden oluşan içeyerleşik ad öbekleridir. Tamlayan ve tamlanan adların sayıları üzerinde değişiklikler yapılmıştır (*çocuk(lar) için oyuncak(lar)*). Son-seviye ikinci dil olarak İngilizce konuşanların işleme rutinleri anadili İngilizce olan konuşmacılarınkiyle karşılaştırmalı olarak araştırılmıştır.

Birinci dilde yapılan tümce işleme çalışmaları anadili İngilizce olan yetişkin konuşmacıların özne durumundaki ad öbeği tekil bir tamlanan isim ve çoğul bir tamlayan isim ((T)ekil-(Ç)oğul durumu) (*çocuklar için oyuncak*) içerdiği zaman üretimde ve kavramada işleme zorluğu çekmeye meyilli olduklarını; ancak tamlanan isim çoğul, tamlayan isim tekil (ÇT durumu) (*çocuk için oyuncaklar*) olduğu zaman böyle bir zorluk yaşamadıklarını göstermiştir. İki durum arasındaki bu farka *uyuşmama asimetrisi* adı verilir (Pearlmutter, Garnsey, & Bock, 1999, Vigliocco & Nicol, 1998).

Bu çalışmada katılımcılara iki cümle başlangıcını tamamlama görevi verilmiştir. İlki, bildiri tümcesi kurmayı, ikincisi ise soru tümcesi kurmayı gerektirmiştir. Amaç, özne-yüklem uyumu kurmanın sözdizimsel uzaklığa mı yoksa doğrusal uzaklığa mı bağlı olduğunu sınamaktı. Bunlara ek olarak, ikinci dil konuşmacılarının ve anadili İngilizce olanların dil işleme tümce kavramadaki davranışlarını karşılaştırmak amacıyla sıralı-kelime okuma tekniği kullanılmıştır.

Ne üretim görevlerinde ne de kavrama görevinde ikinci dil konuşanlarla anadili İngilizce olanlar arasında bir fark bulunmuştur. Bildiri tümcesi üretme görevindeki özne-yüklem uyumu hatalarının sayısı ve bu hataların deneysel durumlar arasındaki dağılım eğilimleri her iki grup için de aynıydı. Benzer bir uyuşmama asimetrisi hem ikinci dil konuşmacılarında hem de anadili İngilizce olan konuşmacıların özne-yüklem uyumu hatalarında görülmüştür. Soru tümcesi kurma görevinde her iki grupta da uyuşmama asimetrisi görülmemiş ve ikinci dil grubuyla anadil grubu arasında hiçbir fark bulunamamıştır. Kavrama görevinin sonuçları üretim görevinin sonuçlarına paralel çıkmıştır. Her iki grupta da uyuşmama asimetrisi görülmüştür. Ancak tümce kavramada, tepki süreleri göz önünde bulundurulduğunda, ikinci dil konuşmacıları grubunun anadil konuşmacıları grubundan daha yavaş olduğu ortaya çıkmıştır.

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CONTENTS

CHAPTER 1: INTRODUCTION ……1

CHAPTER 2: REVIEW OF LITERATURE ……12
First Language Sentence Processing ……12
Research on Subject-verb Agreement in L1Comprehension ……25
Second Language Sentence Processing ……43
Research on Subject-verb Agreement in L2 Production and Comprehension….56

CHAPTER 3: METHODOLOGY ……61
Research Questions ……68
Variables ……69
Participants ……70
Production Task ……71
Comprehension Task ……77
Offline Task ……80

CHAPTER 4: RESULTS ……83
Results of the Declarative Sentence Production Task ……83
The Results of the Question Formation Task ……88
Results of the Comprehension Task ……94

CHAPTER 5: DISCUSSION AND CONCLUSION ……102
Discussion ……103
Pedagogical Implications ……108
Limitations and Suggestions for Further Research ……111

APPENDICES
A. Experimental Items in the Comprehension Test ……114
B. Filler Sentences in the Comprehension Test ……120
C. Trial Sentences in the Comprehension Test ……122
D. Background Questionnaire for L2 Speakers ……123
E. Background Questionnaire for Native Speaker Participants ……125
F. Items in the Declarative Sentence Production Task ……127
G. Items in the Question Formation Task ……128
H. Transcriptions ……129
I. Experimental Items in the Offline Grammar Task ……136

REFERENCES ……138

FIGURES

1. Agreement through feature-copying
2. Erroneous feature-copying process
3. Agreement through feature-unification
4. Levels of sentence production in top-down serial model
5. Levels of sentence production in Bock & Levelt's model
6. The phrase structure of the double-modification preambles
7. The syntactic tree structures of the two Dutch subordinate clauses in the subject-modifier condition and the direct object condition
8. Illustration of the maze technique from Nicol, Forster & Veres (1997)
9. The distribution of RTs in Pearlmutter, Garnsey and Bock (1999)
10. Number of agreement errors in the declarative sentence production task
11. Number of repetition errors in the declarative sentence production task
12. Number of agreement errors in the question formation task
13. The number of repetition errors in the question formation task
14. Native speakers' reading times in all segments
15. L2 speakers' reading times in all segments
16. Normal Q-Q plots: RTs on the 3rd segment
17. Estimated marginal means

TABLES

1. Language Background of L2 Speakers
2. Scoring Procedure: Categories of the Oral Responses
3. Distribution of Responses in the Declarative Sentence Production Task
4. Distribution of Responses in the Question Formation Task
5. Means and Standard Deviations of the RTs on the 3rd Segment

CHAPTER 1

INTRODUCTION

Extensive research that has been conducted on first language (L1) processing over the last two decades finally paved the way for many psycholinguistic studies in the field of second language acquisition (SLA). Consequently, recent SLA research studies have an increasing emphasis on processing issues. Language processing refers to the mental processes involved in decoding written or spoken data in real time (Marinis, 2003). The mental processes involved in SLA investigated through on-line measures of language processing such as reaction time (RT) data and real time error production data. In the field of SLA, psychometric measures such as RT analysis give insights into the functioning of L1 and L2 processes in the bilingual mind and also reveal difficulties in second language (L2) sentence processing. Online techniques provide SLA researchers with opportunities to study aspects of L2 performance that are not otherwise open to direct observation (Juffs, 2001; Felser, 2005). That is, compared to offline data, data obtained via online measures provide a more accurate picture of the mental representation of language.

The present study investigates the processing performance of end-state L2 English learners. The term *end-state* refers to the final product of L2 acquisition whether it is native-like attainment or any other outcome (Birdsong, 2006:11). Our criteria to operationalize the term *end state* are prolonged and require frequent exposure to L2 and some period of residence in the L2 country where the L2 was used as the dominant language. In other words, we assumed that late L2 learners who have been exposed to

L2 English continuously for an extended period of time and lived in an L2 country for some time and continued to use the L2 dominantly there can be considered end-state L2 speakers, who reached the ultimate grammar and after that point, are believed to make no further progress in L2, thus, in some sense completed the L2 acquisition process (Gürel, 2002, White, 2000). The terms L2 *end state, final state, steady state* as well as *ultimate attainment in L2* are used interchangeably in the literature.

The present study investigates the processing performance of end-state L2 English speakers concentrating on an issue that has long been studied in the area of L1 sentence processing. We investigate the processing of subject-verb agreement in complex noun phrases (NP). These are forms that include a head noun and a postmodifying/local noun embedded in a prepositional phrase (PP) as shown in (1) below.

(1) The toy(s) for the kid(s)

The number feature of the head noun (i.e. *toy*) and the local noun (i.e. *kid*) are manipulated to identify the effects of singularity and plurality on agreement computations. Previous studies that investigate mechanisms that govern subject-verb agreement in L1 have obtained a common finding that in constructions such as (1) above native speakers of English have problems with subject-verb agreement when the head noun is singular and the local noun is plural (i.e. the SP condition) but not when the local noun is plural and the head noun is singular (i.e. the PS condition). In other words, in the SP condition, native speakers were observed to make subject-verb agreement errors in production (e.g. *the toy for the kids are…) and they have difficulty in processing the verb in comprehension (Bock & Miller, 1991; Bock & Eberhard, 1993, Pearlmutter, Garnsey & Bock, 1999; Vigliocco & Nicol, 1998).

The phenomenon was observed not only in L1 English but also in other languages such as French, Spanish, Italian, Dutch (Franck, Vigliocco & Nicol, 2002; Vigliocco, Butterworth & Garrett, 1996; Vigliocco, Butterworth & Semenza, 1995; Hartsuiker, Anton-Méndez & van Zee, 2001, respectively). However, whether or not L2 speakers of English go through the same processing routines as native speakers has rarely been investigated. That is, there are only a few studies on the processing of subject-verb agreement in L2 and the results are not conclusive (Jiang, 2004; Nicol, Teller & Greth, 2001).

The present study aims at exploring the processing behaviors of L1 Turkish speakers of L2 English in subject-verb agreement in the beforementioned embedded NP constructions. We compare and contrast L2 speakers' processing patterns to those of native speakers in production and comprehension. The ultimate aim of this investigation is to identify whether or not adult L2 learners can accomplish native-like processing in the L2 end-state.

This thesis is organized as follows; the following chapter summarizes the related L1 and L2 literature. The participant groups, the tasks and procedures are described in Chapter 3. The results of the tasks are presented in Chapter 4. Finally, in Chapter 5, we discuss our results in relation to our predictions and in comparison to the findings of previous studies.

Before moving on to the review of the literature, it is necessary to discuss the linguistic background of the phenomenon under investigation. In the following section, the descriptive rules of subject verb-agreement in English and in Turkish are presented.

Subject-verb agreement in English

Subject-verb agreement appears in almost all natural languages within such categories as person, gender and number. Number agreement is one of the basic descriptive rules of the English language in that singular subjects require singular verbs, and plural subjects require plural verbs (Quirk, Greenbaum, Leech, & Svartvik, 1972:756). In other words, if the subject refers to one thing or entity, then the verb must be singular; and if the subject refers to more than one thing, then the verb must be plural. Even when there are some intervening syntactic constituents between the head noun and the agreeing verb, as in (2a-2c) below, the verb still has to agree with the head noun (i.e. *the key* below). Since English is a head-initial language, the modifying PP construction (i.e. *to the cabinet*) follows the head noun. The letters S and P below indicate the singularity or plurality of the head noun and the local noun, respectively.

(2) a. The key to the cabinets was/*were lost. (SP)

c. The key to the cabinet was lost. (SS)

d. The keys to the cabinet *was/were lost. (PS)

e. The keys to the cabinets *was/were lost. (PP)

(Bock & Miller, 1991:56)

In syntactic terms, the head noun is the highest noun within the subject NP. The verb agrees with that highest NP in terms of number. The head noun controls the agreement process, and thus it is called the *controller* of the agreement, whereas the verb is referred to as *target* (Nicol, Teller & Greth, 2001; Vigliocco et al. 1996).

Yet, subject-verb agreement is not always realized overtly in English. Number agreement is morphologically realized when the third-person forms of verbs are in the present tense (e.g. *comes, goes, brings*) and when the agreeing verb is *Copula be* and auxiliary *be* (i.e. *am, is/are* and *was/were).*

There are two accounts on how subject-verb agreement is implemented; feature-copying and feature-unification. In the former, the subject-verb agreement is considered to be a copying relationship in which the number feature of the head noun is copied onto the verb. The number feature of the controller (i.e. the head noun) is inherent and logically prior to the feature of the target (Francis, 1986:310). That is, the number feature associated with the subject head noun is copied rightward to the target, i.e. the verb (Nicol, Teller & Greth 2001:120; Franck et al. 2002). This copying relationship is shown in Figure 1 below for the examples (2d and 2e).

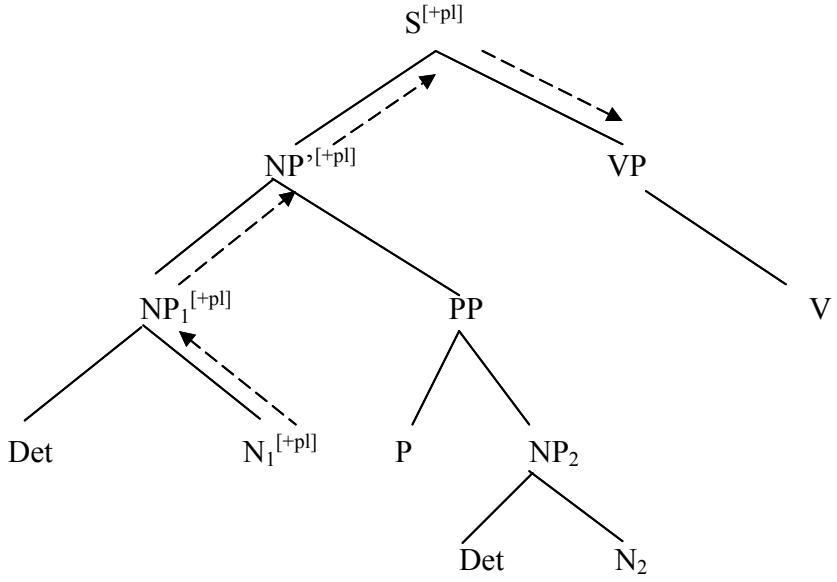


Figure 1 Agreement through feature-copying (adapted from Nicol et al. 2001:120)

The dashed lines in Figure 1 above represent the copying operation. The plural feature [+pl] of the N_1 percolates up to the NP_1, NP' and S node; and then it is copied or transmitted onto the verb.

According to the feature-copying account, errors such as (3) below arise when feature percolation (or migration) originates from the local noun instead of the head noun. Thus the local noun interferes with correct number specification.

(3) *The key to the cabinets **are** lost.

This erroneous feature-copying process is illustrated in Figure 2.

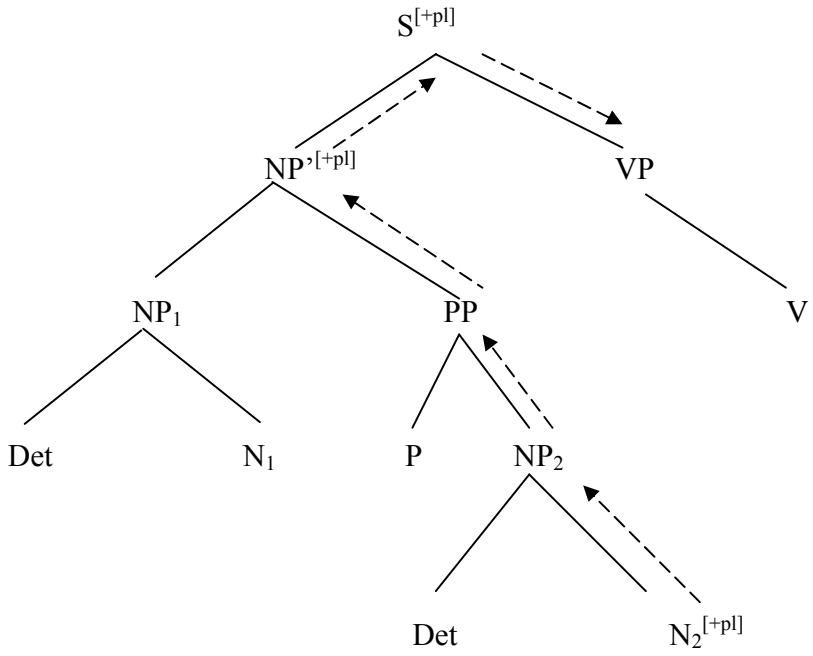


Figure 2 Erroneous feature-copying process (adapted from Nicol et al. 2001:122)

In the later account, i.e. in the feature-unification account (sometimes named feature-merging), features are not copied from the controller to the target, but they are unified. Number information is specified independently on the subject NP and on the verb

(Vigliocco et al. 1996; Hartsuiker et al. 2001). Feature-unification is represented with "U" in Figure 3 below.

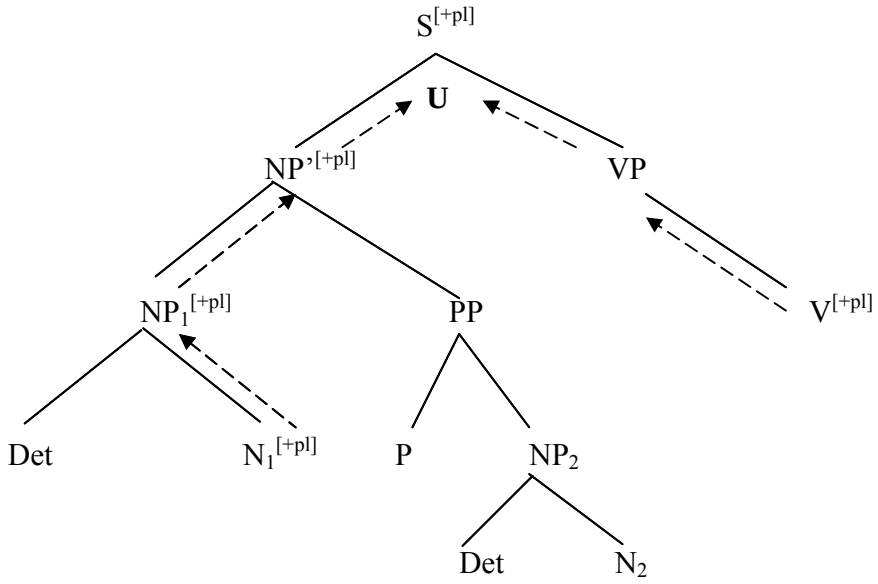


Figure 3 Agreement through feature-unification (adapted from Nicol & Greth, 2003:202).

It is argued that neither the feature-copying nor the feature unification account is universal. It is believed that agreement in languages such as Spanish and Italian is implemented via feature-unification due to the morphological structure of these languages (see Vigliocco & Nicol, 1998 for a detailed review). The implementation of the subject-verb agreement in Turkish is addressed here in order to identify any possible transfer effects from L1 Turkish to L2 English.

Subject-verb Agreement in Turkish

Turkish has rich inflectional morphology. Unlike English, it has a relatively more variable and freer subject-verb agreement system. The animacy of the subject noun and semantic considerations such as personification and solidarity play a role in Turkish. The predicate shows agreement with the subject in terms of person and number. Below is a list of conditions that govern number agreement in Turkish:

A. If the subject noun is animate and singular, a singular verb is required.

(4) a. Temsilcimiz her toplantıya katılır.

Our representative participates in all meetings.

*b. Temsilcimiz her toplantıya katılır**lar**.

Yet, even if the subject noun is animate and singular, the verb can still be plural when the speaker wants to emphasize deference.

(5) Selim Bey evde**ler** mi acaba?

Is Selim Bey at home, I wonder?

(Göksel & Kerslake, 2005:128)

B. If the subject noun is animate and plural, the verb can be singular or plural. Nevertheless, there are some slight meaning differences between them. When the verb is singular (6a), the speaker is more interested in the event rather than the individuals involved. On the other hand, when the verb is plural (6b), the emphasis is on the individuated participation of the human subjects in the action (Göksel & Kerslake, 2005).

(6) a. Temsilcilerimiz her toplantıya katılır.

Our representatives participate in all meetings.

b. Temsilcilerimiz her toplantıya katılır**lar**.

Our representatives participate in all meetings.

On the other hand, if an animate plural subject noun is not overtly expressed as in the case of 3rd person plural subject, the verb must be plural.

(7) Ø Bodrum'a gitti**ler**.

(*They) went to Bodrum*

(Göksel & Kerslake, 2005:129)

C. If the subject noun is inanimate and singular, a singular verb is required.

(8) a. Bu bilgisayar çalışmıyor.

This computer does not work.

*b. Bu bilgisayar çalışmıyor**lar**.

D. If the subject noun is inanimate and plural, a singular verb is obligatory.

(9) a. Bu bilgisayarlar çalışmıyor.

These computers do not work.

*b. Bu bilgisayarlar çalışmıyor**lar**.

However, an inanimate plural subject noun can also be followed by a plural verb if the subject noun is personified.

(10) Ağaçlar yüzümüze konfeti atıyorlar.

The trees are throwing confetti into our faces.

(Lewis, 1967:246)

Moreover, another exception to this rule is related to specificity. When specific inanimate subjects are referred to as "entities seen as moving or acting through a force that is in some way inherent to them", the verb can both be singular or plural (Göksel & Kerslake, 2005:130).

(11) a. Arabalar çok hızlı geçiyordu.

The cars were speeding past.

b. Arabalar çok hızlı geçiyorlardı.

As for the experimental constructions in which the sentential subject is made up of two NPs, the plurality feature of the head noun governs the number agreement inflection on the verb in the light of the rules summarized above.

(12) Animate head noun (=amca)

a. Kızın amcası çok ünlü. (SS)

The uncle of the girl is very famous.

b. Kızların amcası çok ünlü. (PS)

The uncle of the girls is very famous.

c. Kızların amcaları çok ünlü(ler). (PP)

The uncles of the girls are very famous.

d. Kızın amcaları çok ünlü(ler). (SP)

The uncles of the girl are very famous.

(13) Inanimate head noun (=oyuncak)

a. Çocuğun oyuncağı çok pahalı. (SS)

The toy for the kid is very expensive.

b. Çocukların oyuncağı çok pahalı. (PS)

The toy for the kids is very expensive.

c. Çocukların oyuncakları çok pahalı. (PP)

The toys for the kids are very expensive.

d. Çocuğun oyuncakları çok pahalı.(SP)

The toys for the kid are very expensive.

Turkish is a head-final language and in complex NPs such as *The toy for the kid* (Çocuk için oyuncak), the modifying noun 'çocuk' precedes the head noun 'oyuncak'. That is, in Turkish, the head noun 'oyuncak' is also the local noun when we consider the linear order of the words. Thus, the N1 in English (*toy*) becomes the N2 in Turkish; and the N2 in English (*kid*) becomes the N1 in Turkish.

Therefore, English and Turkish differ from each other with respect to the linear distance between the head noun and the verb. The head noun, which is also the local noun, is closer to the verb in Turkish. In addition, animacy of the head noun has no role in agreement computation in English whereas it is a major factor determining the plural inflection on the verb in Turkish (compare 12c and 12d; to 13c and 13d above). Most importantly, in the English constructions under investigation such as *The toy(s) for the kid(s) was/were…*there is a clear morphological number marking on the verb. Turkish does not normally realize number marking on verbs in similar constructions (see examples 12 and 13 above). Therefore, Turkish as the L1 may not be a relevant factor influencing positively the L2 learners' processing of such constructions in English.

CHAPTER 2

REVIEW OF LITERATURE

Introduction

This chapter discusses theoretical issues relevant to the present study and reviews the findings of previous research studies on L1 and L2 sentence processing. We first present a general discussion on psycholinguistic mechanisms involved in L1 sentence production and sentence comprehension and then review relevant L1 research findings. In the subsequent sections, we first discuss major issues in L2 sentence processing and summarize the studies investigating subject-verb agreement computation in L2.

First Language Sentence Processing

Sentence processing research is concerned with decoding written or spoken messages as well as encoding utterances congruent with the syntactic structure of the language to convey a predetermined message. Wingfield and Titone (1998:242) define the goal of sentence processing as arriving at the meaning of a sentence by determining the semantic relationships between words through automatic, rapid and unconscious mechanisms.

The process of constructing meaning while decoding written or spoken messages was once assumed to be a serial process consisting of four stages, namely; phonological, lexical, syntactic and semantic processing. Meaning was believed to be obtained after a

clause boundary or a full sentence is reached (Wingfield & Titone, 1998). In this model, syntactic processing is carried out independently from semantic processing. That is, the syntax is believed to be autonomous.

Interactive models of language processing, on the other hand, assume that both in auditory speech perception and visual sentence processing, syntactic and semantic processing proceed together. In the interactive view of sentence processing, top-down and bottom-up information are assumed to interact continually to assign meaning to the input. Through bottom-up processing, first acoustic signals in speech perception and orthographic input in reading are analyzed and then phonemes/letters, words and sentence structure are recognized. Finally, sentence meaning is reached. Bottom-up processing is facilitated by top-down processing whereby listeners/readers build expectations of what they have yet to hear/read (Wingfield & Titone, 1998).

In what follows, we will present different models of sentence production and sentence comprehension. As Taylor (1990:84) puts it, "sentence production and sentence comprehension are not exactly mirror images of each other, each having its own unique problems." Therefore, sentence production and sentence comprehension will be analyzed separately in the following section.

Sentence Production

In sentence production, while a speaker encodes an utterance, s/he goes through several cognitive stages. These cognitive stages involve conceiving a message, selecting words, formulating a structured sentence in a syntactic correct order and articulating the sentence (Taylor, 1990:112). Whether these stages are separate from one another or

whether they interact recursively has been investigated in different sentence production models.

Models of Sentence Production

Two basic speech production models, namely, the top-down serial model and the interactive parallel model differ from each other with respect to the emphasis they put on the relation among processing levels.

The Top-down Serial Model

The model, as the name suggests, is based on serial processing in which different levels proceed serially as illustrated in Figure 4 below.

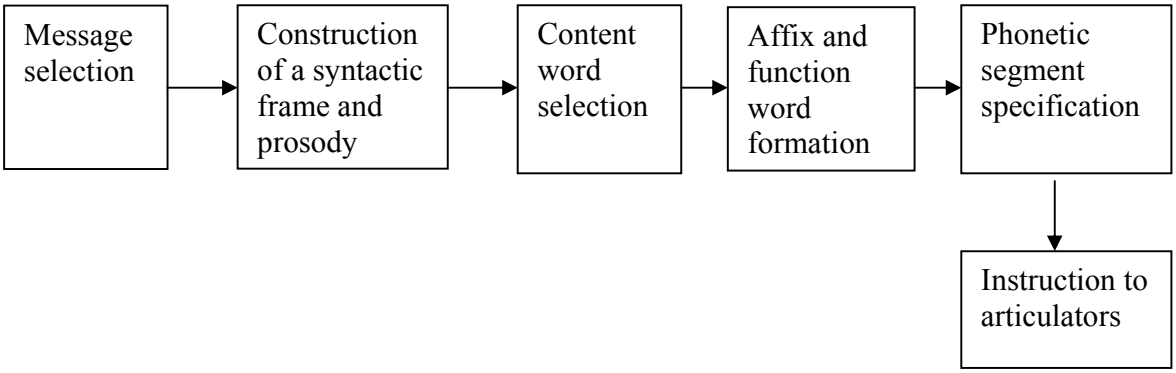


Figure 4 Levels of sentence production in top-down serial model (*adapted from* Taylor, 1990:112)

The top-down serial model assumes serial processing involving different stages in which one level must finish before processing at the next level can begin. In other words, higher-level processing, such as the conceptual level (i.e. message selection) is completed before lower-level processing, for example word selection, begins. Lower-level information cannot influence higher-level processing (Treiman, Clifton, Meyer & Wurm, 2003). It will be important to note at this point that the two tasks used in the present study involve subject-verb agreement production. Therefore, for our investigation, what will be relevant for us is the processes starting from the level where the affix/function word formation occurs up to the last level, where instruction to articulators takes place.

The Interactive Parallel Model

Unlike the top-down serial model, in the interactive parallel model, all the levels in Figure 4 are assumed to act in parallel and asynchronously (Taylor, 1990). In other words, these levels affect each other in that any output of one level is passed onto the next level.

Bock and Levelt's Model of Sentence Production

Like all other production models, in Bock and Levelt's (1994) model, the direction of processing is from the conceptual level to the articulation level. Thus, the model commences with the message level where the speaker's intended meaning is identified. It is followed by functional, positional and phonological levels. What makes this model

different from the two previous ones is that in Bock and Levelt's model, the functional and positional processing are termed grammatical encoding. Grammatical encoding is an unconscious experience in which the skeleton of utterances is formed (Bock & Levelt, 1994). Grammatical encoding subsumes functional and positional processing; each having two steps as illustrated in Figure 5.

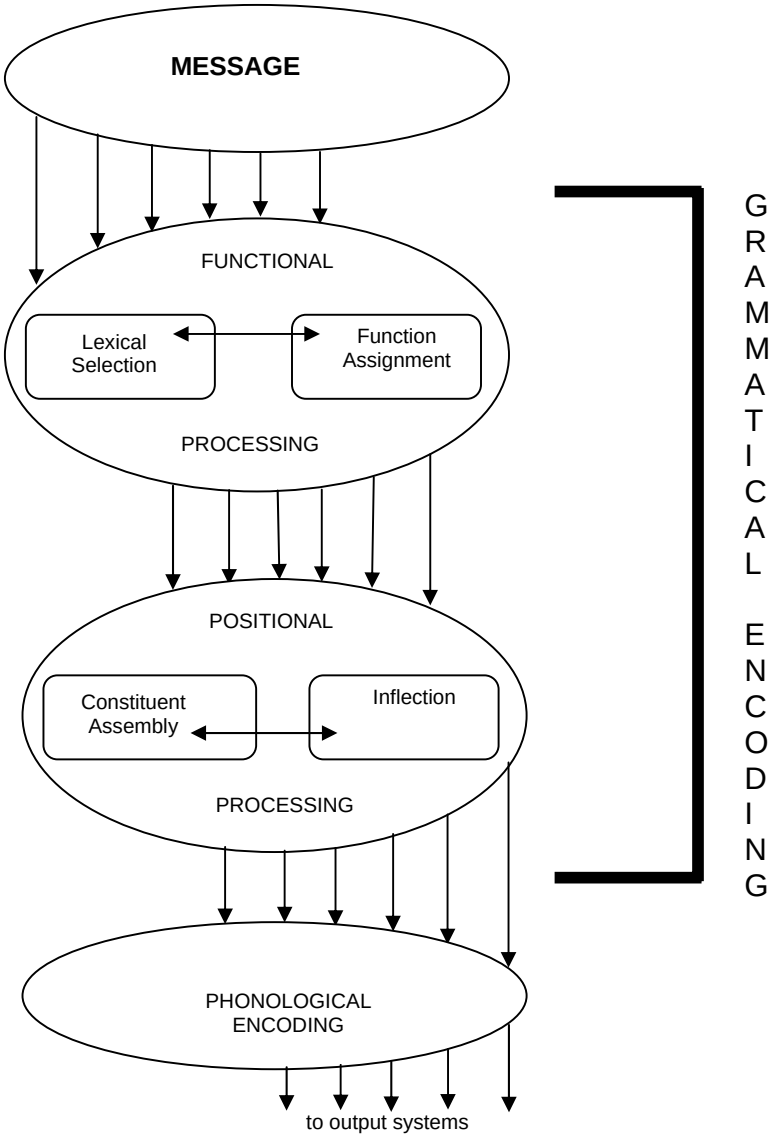


Figure 5: Levels of sentence production in Bock & Levelt's model (*from* Bock & Levelt, 1994:94)

Lexical selection is the level where lexical concepts and lemmas are identified. A lemma is a word as a syntactic entity. The nodes of lemma level represent syntactic processes which guide the grammatical encoding of a sentence (Bock & Levelt, 1994; Vigliocco & Franck, 1999). Syntactic relations and grammatical functions are assigned at the functional assignment level.

Positional processing is bifurcated, too, as constituent assembly and inflection. Constituent assembly involves word order and hierarchical relations among phrasal constituents. Inflection is the level where inflections carrying information about number, tense and aspect. are attached elaborating the nodes of a phrase structure (Bock & Levelt, 1994). Again, in this thesis, this is the level that will be relevant for our investigation of agreement morphology selection.

This model assumes that sentence production is an incremental system since a speaker initiates linguistic planning as soon as s/he selects the first few lexical concepts and prepares the rest while s/he is speaking or between parts of a sentence such as clause boundaries (Bock & Levelt, 1994; Treiman et al. 2003; Bock and Cutting, 1992).

This model is sometimes termed the *encapsulated model* because it suggests that there are dissociations among the use of semantic, syntactic and phonological information (Thornton & MacDonald, 2003).

We will come back to Bock and Levelt's model in the section where we discuss subject-verb agreement in production and comprehension systems.

Sentence Comprehension

As stated above, the goal of sentence processing is to extract meaning as quickly as possible. In most cases, the parser discards the structure of a sentence but retains the meaning of it. However, to comprehend the meaning, some parsing principles, automatic mechanisms and grammatical rules are needed (Frazier, 2002). The parser makes use of linguistic as well as non-linguistic information to reach meaning. The linguistic information consists of phonological, syntactic, semantic, lexical and pragmatic information. The question of whether or not linguistic and non-linguistic information is used independently or interactively is a controversy in psycholinguistics that will be discussed in detail below (Taylor, 1990).

Models of Sentence Comprehension

The sentence comprehension models aim to answer the basic question of how a parser analyzes a sentence to extract meaning. Similar to sentence production models, there are two main approaches to sentence comprehension; autonomous and interactive models. In the following section, we present the major premises of these two models and discuss their predictions in sentence processing.

Autonomous/Modular Processors in Sentence Comprehension

The comprehension system includes lexical, structural and interpretive processes. The lexical processor uses orthographic information to retrieve words from the lexicon. The structural processor uses syntactic information. Lastly, the interpretive processor utilizes world knowledge and constructs the meaning to the output of the structural processor (Taylor, 1990).

The garden-path model developed by Frazier (1978) is one of the most important autonomous/modular models of visual sentence processing which suggests that syntactic analysis is based on purely structural information. That is, the syntactic processor is independent of semantic and pragmatic factors. As Frazier (2002) formulates:

> In this model, perceivers incorporate each word of an input into a constituent structure representation of the sentence, roughly as each item is encountered. At each step in this process, the perceiver postulates the minimal number of nodes required by the grammar of the language under analysis, given the structure assigned to preceding items. (p.5)

The garden-path model proposes that the parser makes only one interpretation which is determined by a set of principles such as minimal attachment and late closure principles. According to the minimal attachment principle, the first interpretation of a sentence is the one that is the simplest in terms of the syntactic structure. Simplicity is related to the number of nodes in the phrase-structure of the sentence. For example, (14a) is a structurally ambiguous sentence as the PP, *with a book* can modify the verb *hit* or it can modify the NP, *the girl.* However, Frazier suggests that there is a universal tendency for

attaching the PP *with a book,* to the NP *the girl.* The late closure principle can be seen more clearly in another example in (14b).

(14) a. John hit the girl with a book.

b. Since Jay always jogs a mile seems like a short distance to him.

(Frazier, 2002:7)

As for the late closure principle, the parser is likely to close a clause boundary at the latest point possible. Therefore, in (14b) *a mile* is prone to be attached to the verb *jog* in the first parse. According to the late closure principle, the parser prefers to attach all incoming material to the phrase currently being processed, regardless of contextual factors (see Frazier, 2002 for a detailed discussion).

It should be noted here that the garden-path model of comprehension is similar to Bock and Levelt's (1994) production model because both claim that syntactic analysis is independent of semantic factors during initial analysis. Such similarity would help us understand the parallelisms found between production and comprehension studies in subject-verb agreement computation literature. These similarities will be discussed further in the Research on Subject-Verb Agreement in L1 Comprehension section.

Interactive Parallel Models

Unlike autonomous models, interactive models suggest that syntactic, semantic and pragmatic factors may interact at every stage of sentence comprehension. Without semantic cues, the syntax by itself may not dissolve ambiguous sentences (Taylor, 1990). For example, the constraint satisfaction model is an interactive model which proposes that sentence parsing is an incremental process of satisfying a variety of

constraints such as lexical constraints (e.g. grammatical class of a word) and contextual constraints (e.g. referential contexts or plausibility) (Gibson & Pearlmutter, 1998).

These models are based on the claim that the parser uses all possible sources of information including the syntax at the same time. That is, structural interpretations of a sentence are formed concurrently and retained until the parser reaches a point of choice (Koda, 2005:100). The model argues for parallel processing whereby the parser uses all possible sources of information such as semantics and the discourse context which are initially active as well as the syntactic information and the parser makes only one analysis by using all available sources of information (Gibson & Pearlmutter, 1998; Wingfield and Titone, 1998).

To sum up, multiple interpretations of a sentence are available to the processor and each alternative interpretation receives activation from some knowledge sources as well as being inhibited by the other interpretations. Lexical information, context and verb category are some of these competing knowledge sources (Treiman et al. 2003).

Before moving on to research on subject-verb agreement, it is necessary to discuss subject-verb agreement computations in production and in comprehension and mention why it is important to study agreement errors in sentence processing.

Subject-Verb Agreement in Production and Comprehension Systems

In sentence production, subject-verb agreement is computed during grammatical encoding level of processing where lemmas (i.e. words as syntactic entities) are retrieved from the mental lexicon on the basis of the speaker's intended meaning and they are assigned grammatical functions such as subject and object at the function

assignment level (see Figure 5). Agreement is constructed after grammatical functions are assigned but before constituents are ordered linearly (Vigliocco & Nicol, 1998; Vigliocco & Franck, 1999; Franck, Vigliocco & Nicol, 2002; Thornton & MacDonald, 2003).

To produce subject-verb agreement accurately, the speaker needs to access a set of conceptual, syntactic and morphological information. This access procedure includes lexical selection of a noun, assigning it to the subject function, selection of a verb, object noun assignment, construction of tense and finally concordance of the noun and the verb in terms of number (Vigliocco, Hartsuiker, Jerema & Kolk, 1996). Because sentence production is a rapid and automatic process, the procedure described above is completed very fast and effortlessly. Nevertheless, some errors might appear in this process, particularly when the subject is a complex NP containing more than one noun: e.g. *The toy for the kids* or *the managers of the factory.*

Despite their scarcity in spontaneous speech, errors in language production are windows to the complex and automatic systems. In other words, systematic errors of a certain type give clues about how mental mechanisms operate. Fromkin and Ratner (1998:312) state that errors are indirect evidence for the stages and cognitive computations in speech production. Indeed, errors in spontaneous production have made up the core of most language production models as they reveal the organization of the language production system (Nicol, 1995).

What makes subject-verb agreement errors so interesting is that subject-verb agreement is a long distance syntactic dependency among inflectional features. As Bock & Levelt (1994:975) note in such dependency relationships, two (or more) constituents of a sentence reflect a value of some feature that triggers an inflectional variation. An

error in that inflectional variation is likely to shed light on how constituents relate with each other. In addition, subject-verb agreement is a phenomenon found in most natural languages, and thus, a convenient phenomenon to study language processing cross-linguistically (Franck et al. 2002; Vigliocco, et al. 1996).

While the production system has clear-cut room for subject-verb agreement as a long distance dependency, the comprehension system is relatively more blurry as to when and how subject-verb agreement is computed. Comprehension systems are assumed to be different from production systems in the sense that they have different developmental and processing routines. For example, aphasia is a situation where production and comprehension systems are affected differentially. In some types of aphasia (e.g. nonfluent aphasia) while the production system is impaired, the comprehension remains relatively intact (Nicol, Forster & Veres, 1997).

Furthermore, unlike production of subject-verb agreement, computing subject-verb agreement is not quite central for sentence comprehension in languages, like English, which have a strict word order. That is, due to their fixed positions in a sentence, the subject and the verb of the sentence are identifiable without checking for agreement[1] (Nicol et al. 1997; Pearlmutter et al. 1999).

Another argument for the claim that subject-verb agreement is peripheral in sentence comprehension is that subject-verb agreement is not always overtly marked in

[1] That is, of course, not true in syntactically ambiguous sentences such as *Someone shot the servants of the actress who were on the balcony,* where subject-verb agreement plays a crucial role in disambiguating the sentence.

some languages. For example, subject-verb agreement in English is morphologically realized only with 3rd person singular in the present tense and auxiliary/ copula BE[2].

Nevertheless, in a reading comprehension study with monolingual L1 speakers of English, Pearlmutter et al. (1999) found that readers were sensitive to ungrammaticality caused by agreement. Parsers did in fact attend to agreement information and processing was disrupted when violations occurred. Therefore, in English, agreement information is used even in a context where the missing subject-verb agreement computation does not distort meaning (Pearlmutter et al. 1999).

In autonomous modular models, such as the garden-path model, subject-verb agreement is assumed to have an independent syntactic representation which mediates the mapping between form and meaning (Thornton & MacDonald, 2003:741). On the other hand, constraint-satisfaction models provide room for non-syntactic factors (i.e. semantic or discourse information) in comprehension. In other words, unlike modular models, the constraint-satisfaction models emphasize semantic factors in subject-verb agreement computation. Thornton & MacDonald (2003), for example, compare (15a) with (15b) noting that both are grammatically correct under different interpretations. The former interpretation holds that the two nouns in the subject NP refer to the same person whereas in the latter *my best friend* and *harshest critic* are different persons.

(15) a. My best friend and harshest critic is here.

b. My best friend and harshest critic are here.

(Thornton & MacDonald, 2003:741).

[2] Interestingly, as noted earlier, in contrast to English, Turkish does not have overt marking only for the 3rd person singular on verbs and other predicates.

Having discussed the processes a parser goes through while encoding and decoding subject-verb agreement, we now turn to the L1 studies which investigated the phenomenon in production and in comprehension.

Research on Subject-Verb Agreement in L1 Production

Due to its multi-faceted nature, the notion of subject-verb agreement has preoccupied many researchers in the field of psychology, linguistics, psycholinguistics, first and second language acquisition. The frequent occurrence of the subject-verb agreement (or concord) errors has been the most extensively studied question among researchers. As noted above, subject-verb agreement errors seem to emerge mostly when a sentential subject (e.g. *the key to the cabinets*) included a head noun (e.g. *key*) and a postmodifying NP (e.g. *the cabinets*) as illustrated in (16) below.

(16) *The key to the cabinets *were* rusty.

(Pearlmutter et al. 1999:438)

It was observed that the number of the subject head noun and the number of the postmodifying noun affect (in)accurate marking of number on the verb of the sentence.

One such observation was Bock and Miller's (1991) detection of the subject-verb agreement errors even in published documents such as newspapers. The example presented in (17) was taken from *The New Yorker* (November 17, 1986, p.86 cited in Bock & Miller, 1991; Bock 1995).

(17) a. Efforts to make English the official language is gaining strength throughout the U.S.

b. The readiness of our conventional forces are at all-time low.

These published examples that led Bock and her colleagues to study these errors, are called *errors of attraction* (Bock & Miller, 1991; Vigliocco et al. 1996; Bock, Eberhard, Cutting, Meyer & Schriefers, 2001). In attraction, the verb agrees with the closely preceding noun instead of the head noun of the subject NP. The preceding noun, which is generally called a local noun or sometimes a distracter noun, attracts or determines the number of the verb (Bock & Miller, 1991; Barker & Nicol, 2000).

Attraction or what Francis (1986) named *proximity concord* is defined as follows by descriptive grammarians; "It [attraction] denotes agreement of the verb with a closely preceding noun phrase in preference to agreement with the head of the noun phrase that functions as subject" (Quirk et al. 1972:757).

Errors of attraction were induced under laboratory conditions by using a special technique called *sentence preamble completion* or *agreement-error elicitation task* (Bock & Eberhard, 1993). The technique was first used by Bock and Miller (1991) and subsequently by many other researchers who studied subject-verb agreement in language production. In the sentence-preamble completion task (see Chapter 3 for a detailed description of the sentence preamble completion technique) participants are required to complete a set of given preambles to construct grammatically correct sentences. Sentence preambles whose nouns are manipulated in terms of singularity/plurality are exemplified below. Depending on the number feature of the nouns, each condition is assigned different names as Singular- Singular (SS), Plural- Singular (PS), Singular-Plural (SP) and Plural-Plural (PP).

(18) a. The key to the cabinet (SS condition)

b. The keys to the cabinet (PS condition)

c. The key to the cabinets (SP condition)

d. The keys to the cabinets (PP condition)

(Bock & Miller, 1991:56)

The unifying picture that has been disclosed by this body of research is that sentence preambles like (18b) and (18c) –where the head noun and the local noun differ with regard to number – led to more subject-verb agreement errors than either (18a) or (18d) in native speakers of English. This is called the *mismatch effect* or *congruency effect* (Anton-Méndez, Nicol & Garrett, 2002) simply because the two nouns mismatch in number. Furthermore, another interesting common finding is that the preamble (18c) (i.e. the SP condition) induces significantly more errors than the preamble (18b) (i.e. the PS condition). In other words, when the head noun is singular (i.e. *the key*) but the local noun is plural (i.e. *the cabinets*); speakers incorrectly tend to produce plural verbs. Thus, this is an asymmetry in the two mismatching conditions (see Eberhard, 1997 for a review).

English is not the only language that yields the mismatch asymmetry effect in subject-verb agreement. Vigliocco, et al. (1995) found the asymmetrical error pattern in Italian in the mismatch condition in which the head noun is singular and the local noun is plural. Likewise, the same effect was observed in Spanish (Vigliocco, Butterworth & Garrett, 1996), in French (Franck et al. 2002) and in Dutch (Hartsuiker et al. 2002). Moreover, Largy and Fayol (2001) studied subject-verb agreement in written French and they found the effects of number asymmetry in written production errors.

Accounts for Subject-verb Agreement Errors

Despite the simplicity of the agreement rule, the frequent occurrence of subject-verb agreement errors in constructions where the sentential subject is a complex NP has gained due interest. In an attempt to account for subject-verb agreement errors, a number of hypotheses have been put forward from different perspectives such as a linguistic perspective (e.g. the Syntactic Distance Hypothesis and the Markedness Account) or a cognitive perspective (e.g. the working memory account). These different accounts are discussed in the following sections along with the studies that tested them.

The Clause-Packaging Hypothesis

The Clause-Packaging Hypothesis is an account that is in line with the serial production models like the proximity account. The hypothesis assumes that a clause boundary is crucial for the production system in the sense that information in one clause does not interfere with information in another clause (Bock & Cutting, 1992). In this framework, constituents that share similar structural properties within a clause are potentially interfering in their competition for the same mechanisms (Franck et al. 2002:392). Therefore, agreement errors occur more within a clause than across clauses. To put it differently, intra-clause errors are more frequent than cross-clause errors. As Bock and Cutting (1992:104) note: "since agreement is clause bounded, […] information from one clause should be unlikely to interfere with the specification of agreement in another clause." Consequently, it is predicted that when there is a clause between the head noun

and the verb as in (19a), there should be fewer agreement errors than where there is a phrase between the head noun and its verb, illustrated in (19b).

(19) a. The editor who rejected the books [was here]

b. The editor of the history books [*were* here][3]

(Bock & Cutting, 1992: 104)

As predicted by the Clause-Packaging Hypothesis, Bock and Cutting (1992)[4] found that agreement errors were more frequent after phrasal postmodifiers than after clause postmodifiers (Bock & Cutting, 1992; see also Nicol, 1995). Yet, the mismatch asymmetry was observed not only with PP postmodifiers but also with clause postmodifiers. In all conditions, the PP postmodifiers yielded more errors than the corresponding conditions with clause postmodifiers. That is, the SP condition in the PP postmodifiers (e.g. *The editor of the books*) induced more errors than the SP condition in the clause postmodifiers (e.g. *The editor who rejected the books*). Thus, Bock and Cutting (1992:113) concluded that subject-verb agreement is computed within a clause boundary before constituents are ordered linearly as discussed above in the Agreement in Production and Comprehension Systems section. In other words, the sentential subject is identified, the verb is assigned and then the subject and the verb agree in number. Finally, these elements are sequenced linearly.

[3] It should be noted here that the preambles in (19) have syllable-wise equal length. In addition, Bock and Cutting (1992) used not only relative clause modifiers but also complement clauses (e.g. *the report that they controlled the fires*).

[4] See experiments 1 and 2 in Bock & Cutting (1992)

The Linear Distance Hypothesis and the Working Memory

Another hypothesis that accounts for errors that occur in subject-verb agreement computation is the Linear Distance Hypothesis, which is sometimes referred to as the *proximity account.* It suggests that attraction errors occur because of the agreement between a verb and its local noun (see Eberhard, 1997 for a discussion). The assumption here is that the verb agrees with the closely preceding noun. Yet, this hypothesis cannot explain why the verb incorrectly agrees with a plural local noun (i.e. SP condition) more often than with a singular local noun (i.e. PS condition). If the proximity determines the agreement form, one would expect errors in the PS condition as well. That is, the verb should potentially but incorrectly agree with the singular local noun. However, this is not what the studies revealed.

Bock and Miller (1991) and Bock and Cutting (1992) manipulated the length of the modifying phrase and/or clause in order to test the effects of the linear distance between the head noun and the target verb. The Linear Distance Hypothesis assumes that the verb agrees with the closely preceding local noun because the number (i.e. singularity or plurality) of the head noun must be maintained in the working memory until the verb is retrieved. However, the presence of the local noun between the head noun and the verb is a challenge for the working memory (Eberhard, 1997; Vigliocco & Nicol, 1998; Franck et al. 2002; Bock & Cutting, 1992; Bock & Miller, 1991). In brief, the more the distance between the sentential subject and its verb, the less mental energy is left to remember what the number of the subject was (Jespersen, 1924:345). To test

the working memory account, Bock and Miller (1991) compared forms such as (20a) to (20b):

(20) a. The key to the cabinets

b. The key to the ornate Victorian cabinets

(Bock & Miller, 1991:56)

They concluded that agreement errors were indifferent to the length of the postmodifying phrases as there was no significant difference between (8a) and (8b); in terms of inducing subject-verb agreement errors.

Similarly, Bock and Cutting (1992) looked at PP postmodifiers (21a and 21b), and clause modifiers (21c and 21d), and lengthened the modifiers by adding adjectives (21b and 21d) (see Experiment 3 in Bock & Cutting, 1992).

(21) a. The report of the destructive fires

b. The report of the destructive forest fires

c. The report that they controlled the fires

d. The report that they controlled the forest fires

(Bock & Cutting, 1992: 115)

They found that, as predicted in the Clause-Packaging Hypothesis, there were more errors after PP postmodifiers (21a and 21b) than after clause postmodifiers (21c and 21d). However, in contrast to Bock and Miller (1991), they found that (21b) did bring about more errors than (21a). In other words, the length of the postmodifying PP did matter in occurrence of errors as predicted by the Linear Distance Hypothesis. However, the length of the modifier was *not* found to cause an increase in the error rate in postmodifying clauses. Interestingly, there were more errors after short postmodifying clauses (21c) than long postmodifying clauses (21d). Yet, the difference was

insignificant. Additionally, short PP postmodifiers (21a) yielded more errors than short clause postmodifiers (21c); and long PP postmodifiers (21b) yielded more errors than long postmodifying clauses (21d).

This suggests that overall the NPs with PP postmodifiers induce more errors than NPs with clause modifiers.

Although the length was an influential factor in phrase condition in Bock and Cutting' study (1992), it was not influential in clauses. That is, the linear distance between the head noun and the local noun did matter only in the phrase condition. It is not the case that longer postmodifying clauses led to more agreement errors than shorter postmodifying clauses. Therefore, the Linear Distance Hypothesis of working memory account has been ruled out in favor of Clause-Packaging Hypothesis.

The Syntactic Distance Hypothesis

Vigliocco and Nicol (1998) also tested the Linear Distance Hypothesis in comparison with the Syntactic Distance Hypothesis. According to the latter hypothesis, an attraction error is a consequence of the syntactic closeness of the head noun and the local noun in hierarchical structure. However, the Linear Distance Hypothesis predicts that the verb agrees with the noun, which is linearly closest to the verb. Thus, the expectation is that error rates must decrease when the verb is further from the local noun. To test these hypotheses, Vigliocco and Nicol manipulated the classical subject-verb agreement error elicitation task in that the participants were given an adjective and then a preamble as in (22a). Then the participants were required to construct a question as in (22b).

(22) a. safe / the helicopter for the flights

b. Is the helicopter for the flights safe?

(Vigliocco & Nicol, 1998:B14)

In the declarative sentence (22a) the local noun is linearly close to the verb whereas in the question form (22b), it is linearly further from the verb. Yet, the distance between the head noun and the local noun does not change in the question form; it is still close to the head noun syntactically. If questions involving plural local nouns (e.g. *flights*) trigger fewer errors than declarative sentences, this supports the Linear Distance Hypothesis. That is, if there are less agreement errors such as **Are the helicopter for the flights safe?* in questions than declarative sentences (**the helicopter for the flights are safe*), this shows that the linear distance between the head noun and the verb plays a role because the further linear distance between the local noun and the verb in the question form prevents errors.

Vigliocco and Nicol (1998) observed that the very same participants produced considerable agreement errors and the mismatch asymmetry effect not only in declarative sentence formation but also in question formation. The mismatch asymmetry in the question formation task led to erroneous constructions like (23a) more often than the ones such as (23b).

(23) a. *Are the gift for the babies expensive?

b. *Is the gifts for the baby expensive?

The appearance of the mismatch asymmetry in the question formation task revealed that agreement errors are similarly distributed and equally common when the local noun is close to the verb and when it is not. Therefore, the linear distance between the local noun and the verb does not have an effect. Agreement errors arise as a consequence of the position of the local noun in the hierarchical structure of sentences.

Therefore, they concluded that agreement computation is a syntactic process unaffected by the linear ordering of constituents because:

> Agreement would be computed when a hierarchical frame for the to-be-uttered sentence is generated, prior to the serial ordering of the words. Therefore, these results suggest an architecture in which assigning grammatical roles and building hierarchical structures are separate from assigning word order. (Vigliocco & Nicol, 1998: B24).

As noted above, Vigliocco and Nicol supported the prediction of the Syntactic Distance Hypothesis by manipulating the distance between the local noun and the verb. In order to manipulate this distance, they used questions which, according to Franck et al. (2002) "do not allow direct comparison with data reported in the literature, which were all declarative sentences" (p.380). Therefore, Franck et al. (2002) modified the declarative sentence preambles by adding another "local noun" which they called *intermediate noun,* as in (24).

(24) The helicopter(s) for the flight(s) over the canyon(s)

(Franck et al. 2002:382)

Thus, they obtained two potentially interfering nouns: *the flight(s)* on the one hand, *the canyon(s)* on the other. The experimental conditions were determined with the combinations of the three nouns; by changing the number feature of the head noun, the intermediate noun and the local noun. In all experimental items, the local noun is a modifier of the intermediate noun so that in the hierarchical syntactic structure, the local noun is the most embedded one in the tree.

In their study, Franck et al. (2002) tested the predictions of three different accounts (namely, the Linear Distance Hypothesis, the Clause-Packaging Hypothesis

and the Syntactic Distance Hypothesis), which were forwarded to explain agreement errors. The predictions of these accounts are given again below with regard to double modifier subject NPs. a. *The Linear Distance Hypothesis:* Because the local noun is closer to the verb than the intermediate noun, the mismatching local noun is expected to yield more errors than the mismatching intermediate noun. That is, the SSP and PPS conditions would create more errors than the SPS and PSP conditions, respectively.

b. *The Clause-Packaging Hypothesis:* Since both the local noun and the intermediate noun operate within the same clause, they both have the same probability to attract verb number. That is, there might be no difference between the SSP and SPS; and between the PPS and PSP conditions in inducing agreement errors.

c. *The Syntactic Distance Hypothesis:* As the syntactic distance between the intermediate noun and the head noun is shorter than the distance between the local noun and the head noun, the plural intermediate noun might lead to more errors than a plural local noun.

Franck et al. (2002) tested a total of 8 conditions; SSS, SSP, SPS, SPP, PPP, PPS, PSP and PSS; and found that in contrast to the predictions of the Linear Distance Hypothesis, the SSP condition did not lead to more errors than the control condition; SSS condition. Moreover, the conditions where the head noun mismatched the intermediate noun (i.e. SPS and PSP conditions) caused more errors than the conditions where the head noun and the local noun mismatch the local noun (i.e. the SSP and PPS conditions). This finding falsifies the predictions of the Clause-Packaging Hypothesis, because the mismatching intermediate noun and the mismatching local noun do not seem to display equal likelihood to distort verb agreement despite being in the same clause. That is, the Clause-Packaging Hypothesis predicts that there would be no

difference between the SPS and SSP; and between PSP and PPS conditions, yet, there was a significant difference.

On the other hand, more errors in the SPS and PSP conditions than in the SSP and PPS conditions, respectively justify the predictions of the Syntactic Distance Hypothesis in that the intermediate noun attracted more errors than the local noun since it is syntactically closer to the head noun. There was no difference between SPS and SPP conditions, because the syntactically closer mismatching intermediate noun induced errors whether or not the local noun mismatched the head noun.

Therefore, the number feature of the local noun does not seem to determine the agreement process on condition that there is an intermediate noun between the head noun and the local noun. In other words, "attraction appears to be determined by the syntactic distance between the local noun and the head noun in the hierarchical structure at the stage of grammatical encoding." (Franck et al. 2002:390). They concluded that those elements that interfere with the agreement competition are the features of the constituent which are "situated high enough in the tree". A local noun embedded low in the tree has less chance to influence the agreement process than a local noun situated high in the tree which creates serious interference in the process (p.393). The position of the intermediate noun and the local noun are illustrated in Figure 6.

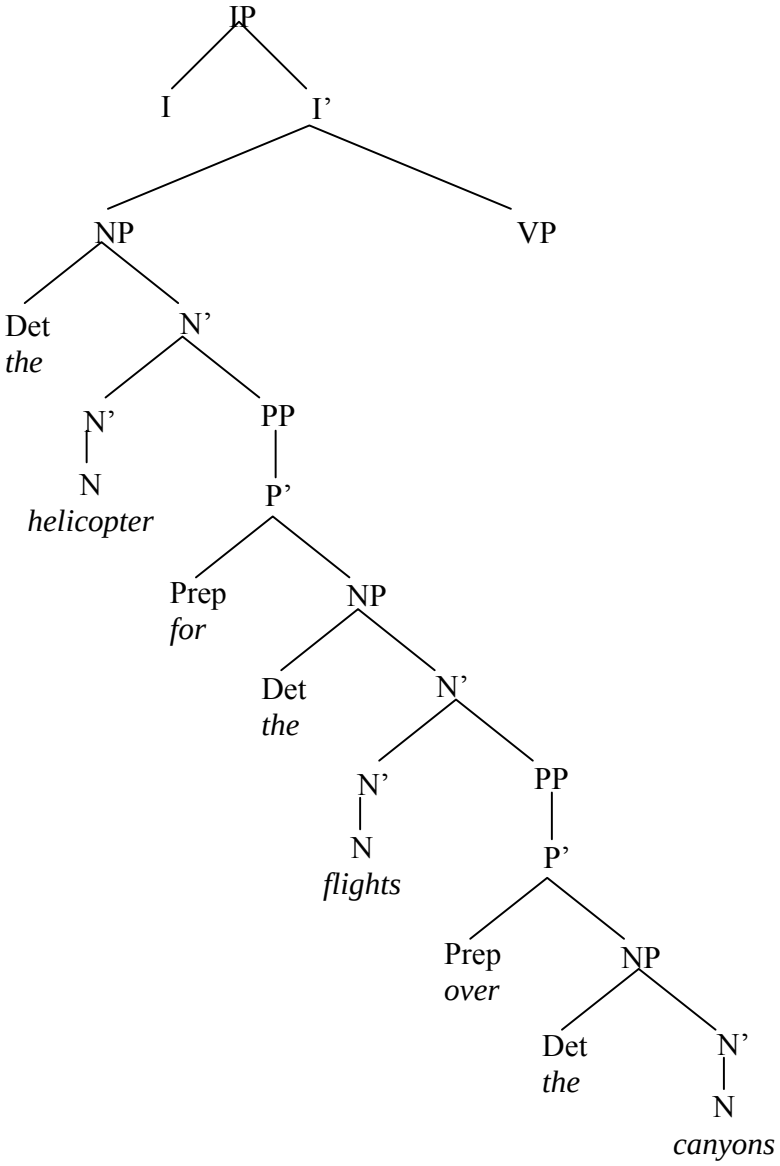


Figure 6 The phrase structure of the double-modification preambles.

Hartsuiker et al. (2001:548) raised an important point that the Syntactic Distance Hypothesis does not differentiate the distance between the local noun and the sentence-node (i.e. the highest subject NP projection) from the distance between local noun and the verb. They note that according to the feature-copying approach (see Chapter 1), the distance between the local noun and the sentence-node plays a role in agreement

computation. However, according to the feature-unification approach, in which the verb can be independently specified for number, the syntactic distance between the local noun and the verb affects agreement processes.

Hartsuiker et al. (2001) tested the two possible syntactic distances, the distance between the head noun and the local noun; and the distance between the local noun and the verb in Dutch by manipulating the distances. They had two conditions: one in which the local noun was embedded in subject-modifier, the other in which the local noun was embedded in direct-object. The distance between the local noun and the head noun is shorter in subject-modifier condition than in direct-object condition. On the other hand, the distance between the local noun and the verb is shorter in the direct-object condition than in the subject-modifier condition. These distances are illustrated in Figure 7.

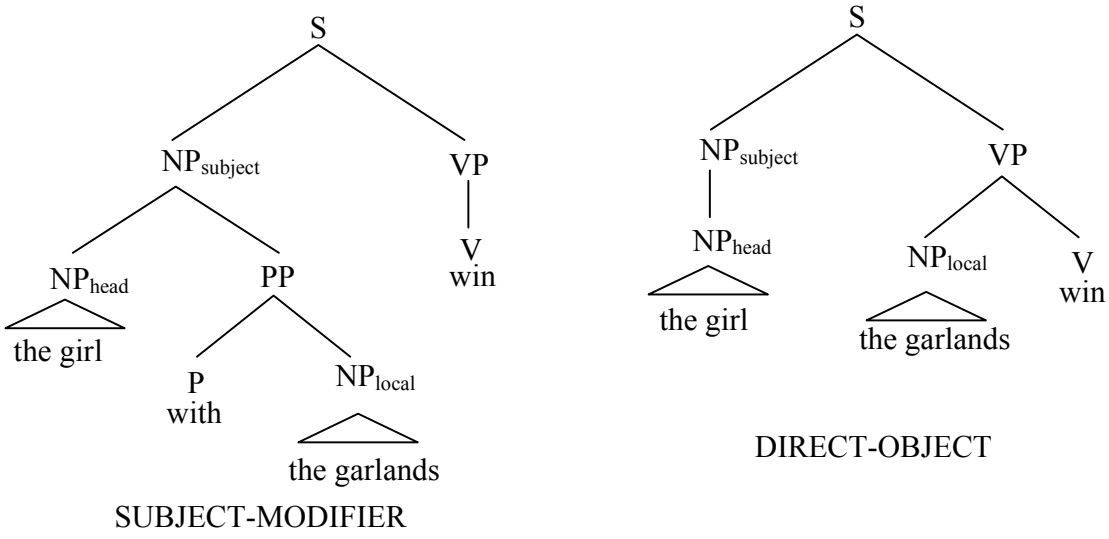


Figure 7 The syntactic tree structures of the two Dutch subordinate clauses in the subject-modifier condition and the direct object condition (adapted *from* Hartsuiker et al. 2001:549)

The syntactic distance between local noun and head noun is measured in terms of the intervening phrasal nodes. The number of the intervening phrasal nodes is two in the direct object condition (VP and S), but there is only one node (PP) in the subject modifier condition (Hartsuiker et al. 2001:559).

Therefore, if the syntactic distance between the local noun and the head noun is more influential in subject-verb agreement computation, one would expect more errors in the subject-modifier condition. If, on the other hand, the distance between the local noun and the verb is determinant, then more errors should be observed in the direct-object condition. Note that closer syntactic distance is predicted to lead to more agreement errors. (25a) and (25b) below are examples for Hartsuiker et al.'s (2001) experimental items in subject-modifier and direct-object conditions, respectively.

(25) a.Karin zegt dat het meisje met de krans en (win)
Karen says that the girl with the garland s (win)

b. Karin zegt dat het meisje krans en (win)
Karen says that the girl the garland s (win)

(Hartsuiker et al. 2001:552)

Hartsuiker et al. (2001) used a sentence preamble completion task in which they asked the participants to read the sentence fragments aloud and complete them by using the verb stem given (i.e. *win* in (25) above). They found more errors in the subject-modifier SP condition than in the direct-object SP condition. In other words, more errors were observed in constructions where the distance between the local noun and the head noun is shorter. Another interpretation of this condition is that the number of errors decreases in sentences where the distance between the local noun and the verb is shorter (i.e. direct-object condition). Hence, they ruled out the hypothesis that the syntactic

distance between the local noun and the verb is determinant of the mismatch effect whereas they supported the hypothesis that the shorter distance between the local noun and head noun induces subject-verb agreement errors as proposed by the feature-copying approach. Hartsuiker et al. (2001) concluded that the shorter the distance in the syntactic tree between local noun and the subject, the fewer the mismatching number feature has to migrate, and the more agreement errors one observes (p.565).

The Markedness Account

The final and the most cited account for the mismatch asymmetry in subject-verb agreement is the Markedness Account. It was put forward by Bock and Eberdhard (1993). According to this account, the *subcategorized* plural feature of a noun is the determinant of agreement marking on the verb.

The mismatch asymmetry is a result of the difference in the markedness of the nouns. In this context, markedness was defined with respect to possessing a certain property. Eberhard (1997) states that in grammatical oppositions such as plurality vs. singularity, the marked category is usually a derivation of the unmarked category. That is, the marked element is mostly the morphologically marked element. Therefore, the plural form of a noun is marked whereas the singular form is unmarked (see Eberhard, 1997 for a comprehensive discussion). Because a noun with a specified feature value (i.e. plural form) is more salient than a singular noun with no feature value (or with a weak feature value), a plural local noun induces more errors than a singular local noun.

According to Eberhard (1997:149), the subject-verb agreement mechanism checks whether the head noun of the sentential subject possesses a marked number

feature. If the head noun is singular (i.e. unmarked), the mechanism retrieves a singular verb. However, if the head noun is plural (i.e. marked), then a plural verb is retrieved. A plural local noun may disrupt this feature checking process, because the mechanism mistakenly detects the marked number feature on the local noun and retrieves a plural verb. A singular local noun, on the other hand, may not interfere with this process as it is unmarked.

Eberhard (1997) manipulated the number specification of the head and local nouns to test the hypothesis. She added quantifiers/numerals such as *one, each* and *every* to nouns to specify singularity of the noun as in (26b) below.

(26) a. The key to the cabinets

b. One key to the cabinets

(Eberhard, 1997:152)

Eberhard reasoned that explicit number marking on a singular head in the SP condition (26b) would yield fewer errors than the control condition as in (26a). She also predicted that in the PS condition, an explicit quantifier of the singular local noun (27b) would induce more errors than its control condition (27a).

(27) a. The keys to the cabinet

b. The keys to one cabinet

(Eberhard, 1997:155)

In sentence completion tasks in English, adult native speakers produced more errors when the singular head noun was unmarked (26a) than when the singular head noun was specified with a quantifier (26b). As for the quantified singular local nouns, local nouns illustrated in (27b) caused more errors than the singular local nouns with the

determiner *the* in (27a) above. Overall, in the PS condition in (27b) considerably more errors were observed than in SP condition (26b).

In a follow-up study, Eberhard (1997) added plural quantifiers to plural local nouns in order to test the possibility that the above findings were due to strengthened number feature of singular nouns. If this was the case, the addition of plural quantifiers such as *a few* in (28b) in SP condition would cause more errors than a plural local noun with the determiner *the* (28a).

(28) a. The key to the cabinets

b. The key to a few cabinets.

(Eberhard, 1997:158)

Yet, there was no difference in the number of errors between (28a) and (28b). Eberhard (1997) concluded that "the additional feature or property of the marked noun [i.e., plurality] results in increased activity in the processing system, and that increased activity interferes with processing the unmarked information" (1997:163).

Eberhard defines the subject-verb agreement computation as a feature-checking process. That is, the mechanism checks whether or not the head noun (the highest node) has a number feature. If there is no number feature activated, singular agreement is assumed by default. If, on the other hand, there is an activated number feature, the mechanism specifies plural verb number.

In this feature checking process, according to Eberhard (1997: 163), three factors lead the mechanism to err. First, the activated number feature may decay over time (due to working memory load). That is why, in Bock and Cutting (1992), longer postmodifying phrases caused more errors than the shorter ones. The second factor is that other phrasal nodes that have marked number feature (i.e. a plural local noun) create

noise in the system. That is why, we observe mismatch asymmetry in NP-PP constructions.

The source of the number feature comprises the third factor that affects subject-verb agreement errors. Because number is a property of nouns and represented by inflection, the number feature coming from a head noun is more salient and highly activated than a number feature coming from a determiner. That is why, (27b) caused more errors than (26b).

To sum up, in Eberhard's (1997) Markedness Account, an intervening marked element activates the number feature in the processing system and interferes with processing of the unmarked information.

Research on Subject-Verb Agreement in L1 Comprehension

The consistent finding of the mismatch asymmetry in sentence production studies gave impetus for subject-verb agreement studies on L1 comprehension. Comprehension mechanisms have been investigated to identify to what extent production and comprehension systems are parallel or divergent. As mentioned earlier, there are some fundamental differences between production and comprehension systems.

Yet, fundamental differences between production and comprehension do not rule out the possibility that the two systems operate similarly with respect to underlying cognitive mechanisms. Therefore, studies in comprehension aimed at investigating one such underlying mechanism, namely the computation of subject-verb agreement in constructions in which the sentential subject contains two nouns. Whether the mismatching number features of these nouns in a sentential subject cause a processing

difficulty (Nicol, Forster & Veres, 1997) in L1 comprehension, as in production, has been the central question in these studies. Moreover, if there is a processing difficulty in parsing a sentence, detecting the exact position or timing of the difficulty would provide insight into the complexities of the comprehension system.

In the following section, we will present main research findings of some studies on agreement processing.

Unlike production of a sentence, comprehension is a relatively internal and covert system in which processes cannot be observed directly. Therefore, researchers have utilized indirect means of observing subject-verb agreement computation and possible processing difficulties that resulted from the number mismatch of the two nouns in a sentential subject position. In order to investigate the mismatch asymmetry, Nicol, et al. (1997) used a maze task and sentence classification task. In a maze task, participants are given the first word of a sentence on the computer such as *the* in Figure 8 below, and then two alternative continuations of the sentence (i.e. *hesitates* and *announcement* in Figure 8), only one of which is grammatical, are presented (i.e. *the announcement by the director was disturbing to everyone* in Figure 8) . The two alternative continuations usually belong to different lexical categories (i.e. noun, verb, adjective and so on).

The	…
hesitates	announcement
pillow	by
the	door
instead	director
was	ink
disturbing	elephant
to	egg
under	everyone

Figure 8 Illustration of the maze technique from Nicol et al. (1997:574)

The participants must decide which one of these alternatives is a better continuation for the sentence. As the participant presses a key to select the appropriate word, the two alternative words disappear. The RT for the verb of the sentence is computed so that the decision making time is analyzed in comparison with different conditions such as SS, SP, PS and PP.

Similar to the findings from the sentence preamble completion task, the maze task revealed that the participants spent longer choosing the verb in the SP condition than in SS condition. However, the RT difference between PP and PS conditions was not significant. Nicol et al. (1997) replicated their study with a sentence classification task where the participants are asked to decide whether or not the sentence on the computer screen has an accurate order of words. This task was used to check for the accuracy of the maze task.

The four conditions of sentences such as (29a-d) below were analyzed along with the ill-formed distracters (29e-f).

(29) a. The author of the speech was subsequently well rewarded.

b. The author of the speeches was subsequently well rewarded.

c. The authors of the speeches were subsequently well rewarded.

d. The authors of the speech were subsequently well rewarded.

e. The car powerful quickly past drove other competitors the.

f. The large pumpkin was the for used pie pumpkin.

(Nicol et al. 1997:577)

The results of the sentence classification task were identical to those of the maze task. That is, it took the participants longer to classify sentences in SP condition than the sentences in SS condition. And yet, such a difference was not found between the PP and PS conditions.

In order to ensure that the RTs obtained were due to the processing of agreement features but not due to some confounding factors or a chance factor, Nicol and her colleagues manipulated the items in another sentence classification task by replacing the number-inflected verbs with uninflected verbs as in (30).

(30) a. The author of the speech will be well rewarded.

b. The author of the speeches will be well rewarded.

c. The authors of the speeches will be well rewarded.

d. The authors of the speech will be well rewarded.

(Nicol et al. 1997:579)

They found no significant difference among the RTs for the four conditions. Thus, they could confidently conclude that the difference between the SS and SP conditions with the inflected verbs were due to subject-verb agreement computation.

In an attempt to investigate the reasons of the mismatch asymmetry, Nicol et al. manipulated the syntactic distance between the head noun (i.e. *owner*) and the mismatching noun (i.e. *realtors*) but keeping the linear distance constant. They used relative clause structures with different attachment sites, illustrated below.

(31) a. The owner of the house who charmed the realtor was no longer willing to sell. (High attachment SS)

b. The owner of the house who charmed the realtors was no longer willing to sell. (High attachment SP)

c. The owner of the house which charmed the realtor was no longer willing to sell. (Low attachment SS)

d. The owner of the house which charmed the realtors was no longer willing to sell. (Low attachment SP)

(Nicol, et al. 1997:583)

However, it is important to note that unlike in any other study that investigated subject-verb agreement, in this study, the mismatching noun under analysis is the object of the relative clause; not the postmodifying noun in the PP (i.e. *house*). That is, the SP condition symbolizes the singular head noun (i.e. *owner*) and the plural noun in the relative clause (i.e. *realtors*).

They predicted that readers will demonstrate a great mismatch effect in the high attachment condition, since in this condition (31b), the syntactic distance between the mismatching noun (i.e. *realtors*) and the head of the relative clause (i.e. *house*) is shorter. They observed a considerable slowdown in the RTs only in the SP High Attachment (31b) condition as they predicted. Thus, they suggested that the internal structure of the subject NP has a significant effect on processing ease/difficulty. The

plural feature is transmitted accidentally and the head is mistakenly assumed to be plural.

In sum, Nicol et al. (1997) concluded that the mismatch asymmetry is apparent in comprehension (as well as in production). Because only the plural form is feature marked, only the plural local nouns cause interference. The number feature of an upcoming verb is checked for number by a backward-checking mechanism. That is, as the parser encounters an inflected verb, the subject NP is checked for number. If the verb is not inflected, number-checking would not be necessary**.**

Pearlmutter, Garnsey and Bock (1999) used word-by-word self-paced moving window reading technique and eye-tracking to examine whether or not readers are sensitive to agreement violations. These two techniques provided them with data to investigate the timing of sensitivity to agreement violations in the form of response time latencies and regressive saccades.

To test participants' sensitivity to ungrammaticality, they constructed grammatical and ungrammatical sentences with two matching and mismatching nouns in the subject NP. These sentences are exemplified below with the condition labels.

(32) a. The key to the cabinet was rusty from many years of disuse.

Match Grammatical

b. The key to the cabinets was rusty from many years of disuse.

Mismatch Grammatical

c. The key to the cabinet were rusty from many years of disuse.

Match Ungrammatical

d. The key to the cabinets were rusty from many years of disuse.

Mismatch Ungrammatical

(Pearlmutter, Garnsey and Bock, 1999:432)

These items were tested both in a self-paced reading and in an eye-tracking task. The pattern of RTs at the word following the verb (i.e. *rusty*) in both tasks was the same. The pattern is illustrated in Figure 9 below.

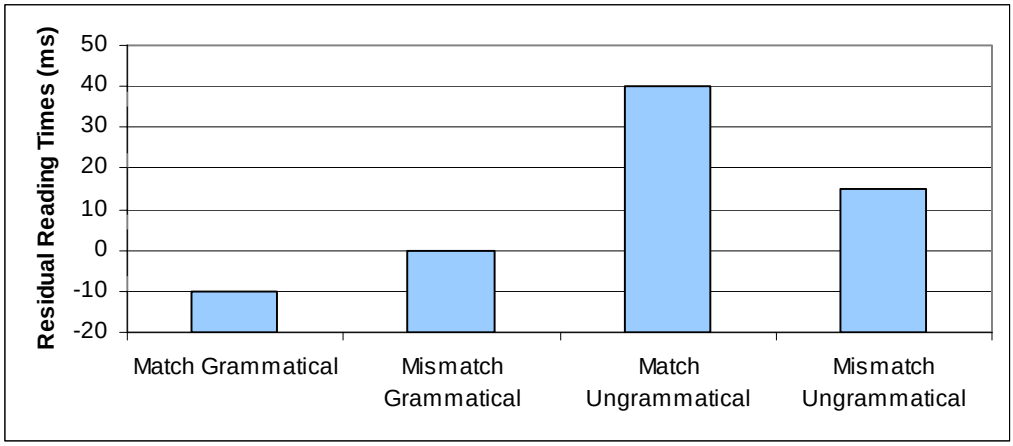


Figure 9 The distribution of RTs in Pearlmutter, Garnsey and Bock, 1999 (Adapted from Pearlmutter et al. 1999:434).

The findings revealed that readers were sensitive to ungrammaticality due to agreement errors since they spent more time in ungrammatical sentences regardless of the head noun matching or mismatching with the local noun in number. The RTs in the ungrammatical conditions were longer than the grammatical conditions because of the readers' sensitivity to ungrammaticality. That is, the readers had difficulty when there is a violation of agreement. Moreover, the match ungrammatical condition had longer RTs than the mismatch ungrammatical condition because the mismatch condition is more prone to create error instances than the match condition. In addition, the Figure 9 above

indicates a processing difficulty that resulted from the mismatch in number between the head noun and the local noun in the grammatical conditions. In other words, grammatical mismatch condition yielded longer RTs than grammatical match condition.

All the conditions in (32) reflected singular head nouns but not the plural ones. Pearlmutter et al. (1999) added plural head nouns in grammatical constructions so that they could examine the reasons for NP-mismatch effect. They investigated the Markedness Account which they referred to as the head-overwriting account. Pearlmutter et al (1999:429) note that on this account the marked plural local noun can sometimes inappropriately override the unspecified head noun form (i.e. singular), thereby creating errors. "A plural head noun is much less likely to be inadvertently overwritten [by a singular local noun] both because it is plural and thus explicitly marked and because the local noun is unmarked and has no feature to override that of the head noun" (Pearlmutter et al. 1999:429-430).

Pearlmutter et al. also tested the linearity account based on the closeness of the local noun to the verb and the mismatch between the local noun and the verb. They named the latter account *word-to-word transition probability.* Based on the head-overwriting account, they predicted that in the PS condition, processing time would be no different than the PP condition for reasons discussed in the Markedness Account section. On the other hand, their prediction related to the word-to-word transition of the number feature to the verb was that the PS condition would be more difficult to process than the PP condition and the PP condition would be as difficult as SP condition. Thus, they tested items like (33).

(33) a. The key to the cabinet was rusty from many years of disuse. (SS)

b. The key to the cabinets was rusty from many years of disuse. (SP)

c. The keys to the cabinets were rusty from many years of disuse. (PP)

d. The keys to the cabinet were rusty from many years of disuse. (PS)

(Pearlmutter et al. 1999:445)

When the readers encountered the verb, they were slower in the SP condition than the SS condition whereas there was no such difference in RTs between the PP and PS conditions. However, while reading the word following the verb (i.e. *rusty*) the participants spent more time with the PP than the PS condition, according to Pearlmutter et al. due to the complexity of the discourse model. Nevertheless, in the singular head conditions (i.e. SS and SP conditions), the classical pattern was observed. That is, the SP condition induced longer RTs than the SS condition at the verb segment.

To sum up, the SS-SP mismatch effect was observed at the verb. Therefore, once more, the mismatch asymmetry was observed in comprehension as well as in production. In other words, number mismatch between the head noun and the local noun caused a processing difficulty only in the singular head-mismatch condition. Hence, Pearlmutter et al. (1999) ruled out the word-to-word transition probability which predicted that the local noun tends to agree with the verb. They state that the mismatch effect is the result of interference between the head noun's number marking and the local noun's number marking (1999:447).

Pearlmutter and colleagues concluded that agreement computation is based on similar mechanisms in production and in comprehension; and markedness of the plural applies to both systems. Comprehension difficulty results from an inadvertent overwriting process as the head noun's number specification is replaced by the local noun's number specification.

Thornton and MacDonald (2003) studied subject verb agreement computation in comprehension as well as in production. They aimed at investigating the effect of a non-syntactic factor such as plausibility between the nouns and the verb within a constraint-based framework. Although the plausibility effect discussed in Thornton and MacDonald (2003) is far beyond the scope of the present study, the comparison between the production and comprehension tasks they utilized is important. They used a sentence preamble completion task for production. Yet, they modified the task in such a way that their participants were given not only the preamble but also the verb. They were asked to produce a passive construction by adding the suitable auxiliary verb. As for the comprehension, Thornton and MacDonald (2003) used a word-by-word self paced reading task with items such as (34) below.

(34) The album by the classical composer was *played/praised* by the radio station

Although the production task was rather controlled relative to previous production studies, they observed a mismatch asymmetry compatible with other studies. In other words, the SP condition yielded significantly more errors than the SS condition whereas the difference in the number of errors between PS and PP conditions were very small and insignificant. More importantly, in the comprehension task, which included the same stimuli with the production task, they observed a more salient mismatch effect in the SP condition than in the PS condition, in the form of longer RTs. It appeared that the processing difficulty in comprehension occurred while reading the auxiliary and the verb. Therefore, by using the same sentence preambles and verbs, Thornton and MacDonald found a similar pattern of error distribution in production and in

comprehension. They suggest that similar mechanisms may underlie agreement processes in both domains (2003:756).

Pearlmutter (2000) compared the Linearity account and the Syntactic Distance Hypothesis in comprehension by means of sentential subjects which contain two intervening nouns as in (35) below.

(35) The lamp near the painting of the house was damaged in the flood

(Pearlmutter, 2000:91)

Recall that similar items investigated by Franck et al. (2002) were reported in the Syntactic Distance Hypothesis section. They studied the production domain whereas Pearlmutter (2000) investigated similar constructions in comprehension. Yet, their predictions were the same; if the hierarchical distance influences the nature of the processing system, the (mis)match between the intermediate noun (N2, i.e., *painting*) and the head noun (N1, i.e., *lamp*) will possibly cause processing difficulty. The prediction underlies the fact that the syntactic distance between the intermediate noun (N2) and the head noun (N1) is shorter than the syntactic distance between the local noun (N3, i.e., *house*) and the head noun. In addition, the shorter the distance between two elements, the more likely their number features to interfere; thereby raising processing difficulty. If, on the other hand, the linearity account applies to the processing system, a mismatch between the local noun (N3) and the head noun (N1) will lead to interference because the linear distance of the local noun to the verb is shorter than the distance between the intermediate noun (N2) and the verb. Therefore, the linearity account predicts that the mismatch between the head noun (N1) and the local noun (N3) is the determinant of a processing difficulty (see the Accounts for Subject-Verb Agreement Errors section for a more detailed review).

Pearlmutter (2000) utilized a non-cumulative word-by-word self-paced moving window paradigm in which processing difficulty is expected to be observed in the form of prolonged RTs. Two sets of items were constructed the first of which was singular-head items as in (36a-d).

(36) a. The lamp near the painting of the house was damaged in the flood. SSS

b. The lamp near the painting of the houses was damaged in the flood. SSP

c. The lamp near the paintings of the house was damaged in the flood. SPS

d. The lamp near the paintings of the houses was damaged in the flood. SPP

(Pearlmutter, 2000:92)

The second set of items were all plural-head constructions exemplified in (37a-d) below.

(37) a. The lamps near the paintings of the houses were damaged in the flood. PPP

b. The lamps near the painting of the houses were damaged in the flood. PSP

c. The lamps near the paintings of the house were damaged in the flood. PPS

d. The lamps near the painting of the house were damaged in the flood. PSS

(Pearlmutter, 2000:95)

Pearlmutter (2000) found no difference between the RTs of the SPS and SSP conditions. That is, neither the N2 mismatch nor the N3 mismatch revealed a difficulty over the other. In addition, there was no difference in RTs either between the SPP and the SPS condition or between the SPP and SSP conditions. However, when there was no mismatch in number (i.e. SSS condition), the participants were apparently faster than any other singular head conditions. Although these findings could not rule out either the linear or the hierarchical account, additional analysis on the plural head conditions clarified the picture. When the intermediate noun (N2) mismatched the head noun and also the local noun (i.e. PSP condition), the participants had more difficulty in parsing

the verb phrase than when the intermediate noun (N2) matched the head noun (i.e. PPS condition).

Therefore, the element which was syntactically closer to the head noun interfered more than the element which was more distant. Pearlmutter (2000) states that in parsing the feature value of a verb, the parser follows the syntactic tree structure of the sentence. According to him, the head noun was more susceptible to interference even from a weakly interfering element (i.e. N3) in the singular-head conditions because the singular head noun is unmarked. Therefore no difference was observed between the SSP and SPS conditions. On the other hand, the plural head noun was marked and so it was more resistant to the effect of a weaker interfering element, namely the mismatching N3. Thus, the plural head could filter out the interference from N3 and the PSP and PSS conditions were more difficult than PPS and PPP conditions (Pearlmutter, 2000:96).

The findings related to the singular head noun conditions were not parallel to what Franck et al. (2002) found in production where they found that the SSP condition was similar to SSS condition in causing production errors. In addition, in Franck et al. (2002) SPS condition caused more errors than SSP condition which was not observed in Pearlmutter (2000). However, the two studies revealed that PSP condition created more difficulty than both PPP and PPS conditions. Therefore, both of them were able to rule out the linearity account because the local noun (N3) was not the determinant of processing difficulty.

In conclusion, studies in comprehension of English subject-verb agreement in L1 revealed that constructions involving two nouns that mismatch in number in the sentential subject caused processing difficulty. In addition, mismatch asymmetry was observed in comprehension studies. Comprehension mechanisms in L1 seemed to

operate in a fashion similar to the production routines. In other words, there is a parallelism between production and comprehension in the sense that subject-verb agreement operate similarly in both modalities. The present study aims to investigate the comprehension as well as production mechanisms involved in processing subject-verb agreement in L2 English. Thus, our aim is to compare the results of the production task to the results of the comprehension task.

Second Language Sentence Processing

In the previous section, we have summarized the theoretical framework underlying L1 sentence comprehension and sentence production, and the studies concerned with subject-verb agreement in L1 processing research. We now move onto L2 sentence processing, which is a relatively newer area of research. An increase in the number of psycholinguistic studies in L1 paved the way to similar studies in the field of SLA. Thus, psycholinguistic studies in general and sentence processing studies in particular have recently become more prevalent in the field of SLA.

The basic drive behind this move towards processing research in L2 lies in the assumed distinction between competence and performance. Competence refers to abstract and implicit representation of linguistic knowledge. Performance, on the other hand, refers to how we use this unconscious linguistic knowledge (Mitchell & Myles, 1998:46). This implicit knowledge cannot be investigated directly, thus, there is no way of directly tapping it. Nevertheless, because language performance is assumed to be an imperfect reflection of competence, examining some limited data from language performance can be considered an indirect way of characterizing the underlying

competence. Juffs (2004:200) assumes that processing performance can provide a window onto grammatical competence. White (2003:17) also proposes that only when results from a variety of tasks and populations show the same trends, we can gain insights into competence (see also Felser, 2005 for a detailed discussion).

To sum up, psychologically-oriented L2 processing research enriched the methods we use, thereby taking us one step forward in trying to understand the underlying linguistic knowledge.

Issues in L2 Sentence Processing Research

A number of issues have previously been investigated by means of offline measures such as grammaticality judgments and truth value judgments to discover what the unconscious linguistic system consists of. The issues examined by online methodologies are limited, due to the novelty of these methodologies.

The real-time processing of wh-movement has so far been the most frequently studied topic in L2 sentence processing. For example, in a much cited research study, Juffs and Harrington (1995) examined subject-extracted vs. object-extracted wh-movement (in 38a and 38b, respectively) by using grammatical and ungrammatical sentences in order to compare advanced adult Chinese learners of English to native English speakers in their judgments. The main objective in this study was to examine whether or not L2 learners demonstrate L1-based difficulty in L2 sentence processing. Therefore, Juffs and Harrington examined an L1 Chinese group as Chinese and English differ from each other with respect to the presence of overt wh-movement. Since Chinese does not have overt wh-movement, the L1 Chinese group was expected to have

problems in processing complex wh-constructions with or without subjacency violations.

(38) a. Who did Ann say _____ likes her friend?

b. Who did Jane say her friend likes _____?

(Juffs & Harrington, 1995:516)

They used self-paced moving window technique and full sentence reading. They found that both the Chinese learners and the native speakers had difficulties with grammatical subject-extracted wh-sentences (as in 38a), but not in object-extracted wh-sentences (as in 38b). But the L2 group did much worse in the online task than the native group on subject-extracted sentences. Therefore, Juffs and Harrington (1995:503) suggest that L2 learners' difficulty with the subject-extraction may be due to problems with parsing structures rather than deficiency in grammatical competence.[5]

Juffs and Harrington (1996) expanded their earlier work by examining garden path sentences such as (39) below.

(39) Who does Bill believe to hate the manager?

(Juffs & Harrington, 1996:296)

They compared L1 Chinese speaking learners of English to native English speakers to see whether they behave similarly with garden path sentences. Their self-paced word-by-word reading task revealed that the two groups were quite similar in terms of accuracy but the L2 speakers were slower than the native speakers.

[5] Juffs (2005) replicated Juffs and Harrington's (1995) study and added the groups of L1 Japanese and L1 Spanish learners of L2 English. He found the very same finding even with the Spanish group whose L1 has overt wh-movement. Similar to the first study; the L2 groups had more difficulty with subject-extraction than with object-extraction. It should be noted here that his results from the offline accuracy task were parallel to the online task results.

Marinis, Roberts, Felser and Clahsen (2005) also studied wh-movement in order to investigate L1-based processing difficulty in L2 English. Both native English speakers and L2 English speakers from different L1 backgrounds participated in this study. The L2 groups included speakers coming from different L1s with and without overt wh-movement. The main question was to investigate whether L2 learners make use of intermediate gaps while processing long-distance wh-dependencies. The intermediate gap is exemplified below in (40) where (40a) includes an intermediate gap whereas (40b) does not.

(40) a. The nurse *who*$_i$ the doctor argued $\boldsymbol{e_i}$ that the rude patient had angered e_i is refusing to work late.

b. The nurse *who*$_i$ the doctor's argument about the rude patient had angered e_i' is refusing to work late.

(Marinis et al. 2005:61)

They found that L2 learners did not make use of the intermediate gaps while parsing such sentences whereas the native speakers did. They concluded that L2 learners are less sensitive to syntactic information (i.e. phrase-structure-based processing mechanism) in sentence processing than native speakers.

Another widely studied issue in L2 sentence processing is relative clauses. Relative clause attachment ambiguity resolution is an important part of this body of research.

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

(Felser, Roberts, Marinis & Gross, 2003: 457)

In (41) above, the relative clause (i.e. *who was on the balcony)* can be attached to the first noun (N1 i.e. *servant*) and also to the second noun (N2 i.e. *the actress*) thereby

creating a global ambiguity. Native speakers and L2 speakers were tested to examine whether they both had the same attachment preference (i.e. N1 or N2 attachment). Native speakers of English were observed to prefer the N2 attachment (Felser et al. 2003; Omaki & Ariji, 2005; Dusias, 2001). However, there is no consensus over what the non-native speakers of English prefer. Therefore, Felser et al. (2003) claim that because L2 learners do not apply structure-based parsing strategies like native speakers do, such processing problems may prevent L2 learners from ever achieving native-like competence in the L2. Yet, the issue of relative clause attachment is still being investigated cross-linguistically through various methods particularly by considering the effects of L1 on L2 parsing strategies (Papadopoulou, 2005; Dinçtopal, 2007).

Another related issue investigated within this line of research is L2 processing of reduced relative clauses such as (42)

(42) The bad boys seen during the morning were playing in the park.

(Juffs, 1998:122)

Juffs (1998) raised the question of whether L2 learners are able to process reduced relative clauses online. His self-paced word-by-word reading test showed that the advanced L2 learners behaved similarly but not identically to the native speakers. The non-native speakers were much slower than the natives.

Results of many different studies revealed that adult L2 learners of English behaved differently from adult native speakers of English in a number of online experiments. In addition, Clahsen and his collaborators found that child L1 sentence processing was identical to adult L1 processing (Roberts, Marinis, Felser & Clahsen, 2007; Clahsen & Felser, 2006). Clahsen and Felser (2006:2) explain such findings through a hypothesis that the structural parser does not change over time (i.e. the

continuity of parsing hypothesis). According to their Shallow Structure Hypothesis, L2 learners process linguistic information relying more on lexical-semantic cues rather than on syntactic details. In other words, L2 learners under-use syntactic information, and thus, there are fundamental differences in grammatical processing between native and non-native speakers of a language no matter how proficient the L2 learner is.

It is interesting that although the L2 acquisition of subject-verb agreement and agreement morphology have been studied extensively in the generative SLA literature, online studies on agreement processing do not take up much space in the psycholinguistics literature. Online L2 studies on subject-verb agreement remained in shadowlands until 2000s despite extensive L1 work that dates back to 1991 (Bock & Miller, 1991).

The following section discusses this limited number of L2 processing studies on subject-verb agreement.

Research on Subject-verb Agreement in L2 Production and Comprehension

Among the few L2 studies on processing subject-verb agreement, Jiang (2004) was the first to study L2 English speakers' sensitivity to the subject-verb agreement morphology in an online self-paced reading task. Target constructions involved sentential subjects made up of two NPs. The aim was to identify processing difficulties that L2 learners have with inflectional bound morphemes in spontaneous communication.

Jiang argues that there are two potential reasons for what he calls *morphological insensitivity*: competence deficit or performance deficit. According to the Competence Deficit Approach, L2 learners' acquisition of morphology is incomplete because even if

they know all the rules explicitly, these rules are not internalized, and fail to become implicit knowledge. Therefore, L2 learners cannot accurately use inflectional morphemes consistently in spontaneous speech. The Performance Deficiency Approach, on the other hand, considers difficulties with morphology as difficulties in accessing, retrieving or controlling the internalized knowledge of the target language. According to this second approach, problems with production of L2 morphemes are not due to a competence deficit.

Jiang (2004) tested L1 Chinese L2 English speakers via a self-paced word-by-word moving window reading task to see whether these advanced L2 English speakers are sensitive to the number morpheme in comparison to native controls. First, he compared the SS and SP conditions in grammatical environments. RTs were observed in 3 segments underlined below:

(43) a. The key to the cabinet was rusty from many years of disuse.

b. The key to the cabinets was rusty from many years of disuse.

(Jiang, 2004:612)

He found that the native speakers showed longer RTs in the SP condition (43b) than in the SS condition (43a). Longer RTs were observed on the 2nd and the 3rd segments (i.e. *was* and *rusty*, respectively), but not on the 1st segment (i.e. *cabinet(s)*). The L2 speakers, in contrast, showed no significant difference in RTs between the SS and SP conditions. The L2 speakers spent more time reading the 1st segment in the SP condition (i.e. *cabinets*) than in the SS condition (i.e. *cabinet*). Jiang suggests that this difference in the plural local noun is based on the word length and orthography and claims that the L2 speakers are not sensitive to the number morpheme.

Among the test items, Jiang (2004) also had sentences in the grammatical PS condition (44a) and the ungrammatical SS condition (44b).

(44) a. The bridges to the island were about 10 miles away.

b. The bridge to the island were about 10 miles away.

(Jiang, 2004:617)

The native speakers showed longer RTs on the 2nd segment in the SP condition (43b) than the SS condition (43a). They spent more time reading the ungrammatical SS condition (44b) than the grammatical PS condition (44a). As for the L2 speakers, there were some differences between the SS (43a) and the SP (43b) conditions; and between the PS (44a) and the ungrammatical SS (44b) conditions, but these were not statistically significant.

Jiang (2004:622) suggests that the L2 speakers are insensitive to the number morphemes in the tests even if these morphemes induce ungrammaticality. He claims that because the non-native speakers did not show sensitivity to the ungrammaticality in agreement as in (44b), the Performance Deficiency Approach would be a less likely cause for morphological difficulty in L2. He concludes that his findings are consistent with the Competence Deficit Approach since the number morpheme and subject-verb agreement is in the explicit knowledge base of the L2 learners but they are not internalized and automatized. As a result, those Chinese learners of L2 English are insensitive to number morpheme.

Jiang raises an important issue that this insensitivity may be peculiar to this group of Chinese learners of L2 English since grammatical number is seldom encoded in Chinese (2005:627).

The question of whether or not morphological richness in the L1 plays a role in the acquisition of L2 morphology is important and the present study can contribute to this question by providing data from L1 Turkish, a language with a rich verbal inflection system. If we follow Jiang's argumentation, L1 Turkish speakers are expected to perform better in detecting agreement violations compared to Jiang's L1 Chinese group.

The only production study conducted in L2 is a series of experiments run by Nicol and her colleagues. Nicol et al. (2001) investigated English learners of L2 Spanish and Spanish-English bilinguals with regard to their agreement computation in the L2. Their performance in the sentence-preamble completion task was compared to the findings of previous L1 studies. The construct under investigation in Nicol et al. (2001) was distributivity. That is, single-token (grammatically and conceptually singular phrases such as 45a) and multiple-token (grammatically singular but conceptually plural phrases such as 45b) items were compared only in the SS and SP conditions. In addition, they examined why the distributivity effect arises in some languages such as Spanish, Italian and Dutch but not in English.

20 English learners of L2 Spanish were found to produce more errors with multiple-token items (45b) than with single-token items (45a).

(45) a. The bridge to the islands

b. The address on the envelops

(Nicol et al. 2001:132)

This tendency was parallel to what was found in L1 studies in Spanish (Vigliocco et al. 1996). Yet, 13 of these 20 participants were tested in their L1, English, but no multiple-token effect was found. A detailed analysis revealed that these 13 participants did have

no multiple-token effect in the Spanish test, either. To sum up, the L2 learners did not demonstrate a consistent pattern in terms of distributivity and conceptual plurality.

Nicol et al. (2001) also tested Spanish-English early bilinguals in English and found that multiple-token items created more errors than single-token items. This finding was inconsistent with the findings of previous studies of L1 English (Bock & Miller, 1991; Vigliocco et al. 1996). As a result, they suggest that the L2 speakers including early bilinguals carry over the agreement routines from their L1 (Nicol et al. 2001:131).

In a follow-up study, Nicol and Greth (2003) tested adult English learners of L2 Spanish who were at the upper-intermediate level in their L2. They were tested both in English and in Spanish. The task was a sentence completion task and the participants were given an adjective. Items like (46a-d) were used to compare single-token and multiple-token items in the SS and SP conditions.

(46) a. irresponsible / the babysitter for the girl(s) SINGLE-TOKEN

b. minor / The defect in the car(s) MULTIPLE-TOKEN

c. brillant / La luz sobre la(s) mesa(s) SINGLE-TOKEN

brilliant / the light over the table(s)

d. gigant / La chiminiea de la(s) cabana(s) MULTIPLE-TOKEN

gigantic / the chimney of the cabin(s)

(Nicol & Greth, 2003:199)

They found more agreement errors in the Spanish task than in the English task. Both in L1 and L2 there was a distributivity effect. That is, in the multiple-token SP condition there were more errors than in the single-token SP condition both in English and in Spanish. The number of agreement errors in the SS conditions did not differ

considerably in terms of language and distributivity. Moreover, the participants' agreement errors in single- and multiple-token items correlated across languages. In other words, there was a pattern in error distribution in English and in Spanish. Therefore, Nicol and Greth concluded that whatever speakers were doing in L1, they were also doing it in L2. They implement subject-verb agreement similarly in their L1 and L2.

Conclusion

The body of research summarized above reached some tentative results. Studies generally demonstrated that L2 processing differ from L1 processing in the sense that L2 processing is much slower and less automatized than processing in L1.

The present study focuses on whether or not L1 Turkish speakers of L2 English differ from native English speakers in processing routines and in their computation of subject-verb agreement errors. The present study aims to contribute to the field by supplying data from L2 English speakers from L1 Turkish background. The morphosyntactic characteristics of Turkish are different from English in many respects. The rich morphology of L1 Turkish may increase the sensitivity of L2 English learners (cf. Jiang, 2004) for L2 agreement morphology. Nevertheless, it is important to note that with respect to the subject-verb agreement features under investigation, English and Turkish differ from each other in an interesting way: English marks plural overtly on the predicate when the subject NP is plural, whereas Turkish has overt marking of the third person plural on the predicate only when the 3rd person plural NP is not expressed in the sentence. In most other cases, the overt marking of the third person plural on the

predicate is not obligatory (Göksel & Kerslake, 2005). Given this, L1 Turkish might not contribute positively to L2 learners' morphological sensitivity in L2 English.

Another important question addressed in the present study is whether or not adult L2 learners can attain native-like processing routines in the L2 end-state. Therefore, data collected from end-state L2 learners can contribute to our understanding of the characteristics of L2 processing and help us identify whether or not convergence on native-like processing is possible in the ultimate L2 state.

In addition, the design of the present study can build on the previous efforts in the field. We investigate the four grammatical conditions; SS, SP, PP, and PS not only in comprehension but also in production whereas the previous online studies in L2 were limited to singular head conditions; SS and SP only, and they either tested comprehension or production.

CHAPTER 3

METHODOLOGY

Introduction

In this chapter, first, research questions are listed and the variables are defined. Then tasks (two production, one comprehension and one written grammar tasks) administered in the study are described. Finally, data analysis procedures are explained.

Research Questions

The present study aims to investigate how adult Turkish learners of L2 English process subject-verb agreement in constructions with a sentential subject made up of two NPs. The processing routines of the end-state L2 English learners are investigated in comparison to those of native English speakers. These issues are investigated in the light of the following research questions:

1. Do the attraction errors, if any, appear in similar conditions of the NPs in production of declarative sentences and questions?
2. To what extent are native English speakers and end-state L2 learners similar in production of subject-verb agreement in declarative sentences and questions?
3. Do the attraction errors, if any, appear in similar conditions of the NPs in production and comprehension of subject-verb agreement?

4. To what extent are native English speakers and end-state L2 learners similar in processing subject-verb agreement and attraction in comprehension?
5. To what extent does the linear distance or the syntactic distance between the local noun and the head noun determine the attraction errors in L2 sentence processing?

Variables

In the comprehension test, these questions are investigated via the numerical dependent variable: reaction times on the 3rd segment which is the verb position as in the example *the toy / for the kid / **is** / expensive.*

This variable is measured by the self-paced moving window technique. As for the production tests, the dependent variables are the number of agreement errors, repetition errors and miscellaneous responses in the declarative sentence production task and the question formation task.

The independent variables are the number of the head noun and the number feature of the local noun (i.e. singularity or plurality). Each of these categorical variables have two levels; singular and plural conditions.

Another independent variable is the participant characteristic in terms of the native languages. The two levels of this categorical variable are native and non-native speakers (i.e. subject type).

Participants

The L2 group consisted of 21 advanced L1 Turkish learners of L2 English who have been exposed to English for periods ranging from 10 to 46 years (mean length of L2 exposure: 24.5 years). All of them have lived in an English-speaking country (the USA and the UK) to obtain their undergraduate and/or graduate degrees. The mean length of stay in the L2 country is 5.3 years. 15 of the L2 speakers have been working as professors at English-medium universities in Istanbul. Therefore, they use English at work and in their social environments. 13 participants rated their overall ability in English as near-native, whereas 6 participants rated themselves as advanced speakers of English. All of them received their first exposure to L2 English in formal classroom settings in Turkey. Data from 2 L2 speakers were excluded from the analysis as outlier participants because of their low accuracy rate in the offline grammar test. Therefore, there were 19 L2 speakers (16 female, 3 male) in the comprehension test. Table 1 summarizes information on language backgrounds of L2 speakers[6].

Table 1 Language Background of L2 Speakers (n=19)

	Minimum	Maximum	Mean
Age	27	56	36.8
Age of onset to learn English	10	23	12.3
Age of arrival in the L2 country	18	29	25
Years of residence in the L2 country	1.5	9	5.6

[6] 11 of the people in the L2 group reported that they speak a foreign language besides English. The third languages reported are French, German or Spanish at beginner and intermediate levels.

The production test results of an L2 speaker could not be analyzed due to technical problems. Thus, in the production test, there were 18 participants (16 female, 2 male) in the L2 speaker group.

A total of 21 native English speakers[7] participated in the study as a control group. 13 of the native speakers were tested during their brief stay in Istanbul. 6 of them were English teachers and 2 of them were professors at an English-medium university in Istanbul. The rest were graduate students. All of them have had university education in a variety of fields.

Yet, data from 1 native speaker was excluded from the analysis as an outlier participant because of his low accuracy rate in the offline grammar test. Therefore, there were 20 native speakers (10 female, 10 male) in the comprehension test. The mean age of this group is 31.3. Furthermore, the production test results of 2 native speakers could not be analyzed due to technical problems. Thus, in the production test, there were 18 participants (10 female, 8 male) in the native speakers group.

All of the participants are computer-literate people who use computers in their daily activities. Thus, the fact that the tests were given via computers did not become a confounding factor to the test results.

Production Task

The production task was a variation of sentence-preamble completion task originally employed by Bock and Miller (1991). The task involved completion of a sentence whose

[7] All of the native speakers have some knowledge of a language other then their mother tongue. They reported a variety of languages such as French, Arabic, Russian, Danish, Greek, Danish and Turkish as their second (and/or third) languages at beginning, intermediate or advanced levels.

beginning is given to the reader. The reader is then asked to complete the sentence to have a grammatical construction.

Materials and Design

This task involved completion of two different sentence types: declarative sentences and questions. Two sets of items for each sentence types were constructed. Each set included 20 sentence preambles consisted of a head noun followed by a preposition and a local noun (e.g. *the toy for the kid)*. An adjective that is matched to each preamble was given on the screen prior to the preamble. The adjectives had semantically plausible connections to the matched preambles. Each preamble had 4 different versions constructed by manipulating the number features of the two NPs, thereby representing four conditions (i.e. SS, SP, PP, and PS). There were five different preambles for each condition. For example, five preambles were constructed in the SS condition; another five were constructed in the SP condition, etc. In addition, each preamble was constructed in four conditions but these are counterbalanced across four sets of experimental lists. In other words, when a participant was given an SS version of a particular preamble, the SP version of the very same preamble was given to another participant. Thus, a participant saw a particular preamble only once.

Participants were given a trial adjective and sentence preamble pair at the beginning of both tasks. The experimental items were displayed in a random order. The complete lists of the experimental items used in the declarative sentence production task and the question formation production task are presented in Appendix F and Appendix G, respectively.

Procedure

L2 speakers took the production task at least one day after the comprehension task. However, the native speaker group had to do the production task immediately after the comprehension task due to practicality considerations. Participants were tested individually in front of a computer and the experiments were run on SuperLab Pro 2.0 software. They were instructed that when they pressed the space bar they would see an adjective. A second key press replaced the adjective with a sentence beginning (e.g. *expensive/ the toy(s) for the kid(s)*). The adjectives and the sentence preambles were placed at the centre of the computer screen. Their task was to press the space bar again and when they saw a blank screen they would make up a grammatical declarative sentence or a question using the sentence beginning and the adjective. In this technique, participants did not have either the adjective or the sentence preamble on the screen in front of them while completing the sentence. That is, they had to keep in mind the adjective, the preamble as well as the number features of the head and the local NPs. This might have made the task cognitively more overloading for the working memory. To reduce this load, we designed the experiment in such a way that the intervals between the adjective and the preamble; and the intervals between the preamble and the blank screen were self-paced. Although the participants were asked to speak as quickly as possible, they were at least able to arrange their own speed while reading the adjective and the preamble.

The order of the two sections (e.g. construction of the declarative and question forms) was randomized, so some participants did the declarative sentences first and the

questions later. Other participants took these two sections in the reverse order so that we could control a potential carryover effect of one section on the other. They were instructed on what type of a sentence (declarative sentence or question) they were expected to produce at the beginning. Both sessions were recorded on an audio tape. Participants completed both sections of the production task in about 10 minutes.

Scoring

The oral responses of the participants were transcribed. Each sentence was analyzed under four categories; agreement errors, repetition errors, miscellaneous responses and correct responses (see Appendix H for sample transcriptions). Table 2 below summarizes these categories and shows some sample responses/errors. *Typical Agreement Errors* included a correctly repeated sentence preamble and adjective but an inaccurate form of the verb. When the participants produced an agreement error but immediately corrected their own errors, only the initial erroneous utterance was scored (e.g. "*The river along the valleys were beautiful. was beautiful. Pardon."*). These cases were scored as agreement errors and they are labeled as *self-corrected agreement errors*. *Typical Repetition errors* were sentences that have incorrectly repeated preambles. For example, a participant says *the cakes for the guests* whereas the original preamble was *the cake for the guest.* Such sentences were counted as repetition errors even if the verb is correctly inflected according to the uttered preamble. It should be noted here that in the related literature, the correct repetition of the adjective is also required. However, in the present study, in the repetition error category, we included cases in which the participant could not remember the exact adjective given but instead used a similar or

synonymous adjective or used the adjective in the previous item. The correct repetition of the adjective increased the memory load whereas the working memory component is beyond the scope of the present study.

Miscellaneous responses included sentences that had changes in the original structure of the sentence preambles. For instance, some participants, upon seeing the preamble *the candies for the kid,* produced questions like *Were the candies unhealthy for the kids?* Similarly, some participants changed the genitive construction of a preamble and uttered phrases such as *the sailor's maps* instead of *the maps of the sailor.* Such responses were labeled as *Structural Change.*

In addition, miscellaneous responses included responses in which a participant produced only the sentence preamble because s/he could not remember the adjective. In such cases, there was neither a verb nor an adjective. Such responses are classified under the *Adjective Recall* category.

Again with respect to other miscellaneous responses, sometimes a participant produced nothing but expressions like *I forgot this one* or *I don't remember*. Such items were scored as *Total Recall* responses. Another example for the miscellaneous responses included cases where the participant repeated the preamble and the adjective accurately but did not produce a verb, and this was referred to as *Missing Verb Responses*. Moreover, if the participant did not press the space bar for the blank screen to appear, what s/he produced was counted as miscellaneous response.

Correctly repeated adjective and preamble as well as a correctly completed sentence with an agreeing verb form are counted as correct responses.

Table 2 Scoring Procedure: Categories of the Oral Responses

Adjective	**Preamble**	**Category Label**	**Agreement Errors**	**Correct Response**
impressive	the study of the researchers	Typical Agreement Errors	The study of the researchers were impressive to the world.	The study of the researchers was impressive.
frightening	the shark under the boats	Self-corrected Agreement Errors	The shark under the boats are ... is frightening.	The shark under the boats is frightening
fake	signatures on the form		Is the signatures on the form fake? Are the signatures on the form fake?	Are the signatures on the form fake?
Adjective	**Preamble**	**Category Label**	**Repetition Errors**	**Correct Response**
delicious	the cakes for the guests	Typical Repetition Errors	Are the cakes for the guest delicious?	Are the cakes for the guests delicious?
lazy	the secretaries of the director		The secretary of the director is are lazy.	The secretaries of the director are lazy.
Adjective	**Preamble**	**Category Label**	**Miscellaneous Responses**	**Correct Response**
subjective	the report by the officer	Structural Change	Was the officer's report subjective?	Was the report by the officer subjective?
unhealthy	candies for the kids		Were the candies unhealthy for the kids?	Were the candies for the kids unhealthy?
important	the problems of the teenagers	Adjective Recall	Are the problems of the teenagers … I forgot again.	Are the problems of the teenagers important?
retired	the judge of the courts		The judge of the courts …	The judge of the courts is retired.
disappointing	the promises of the minister	Total Recall	I don't remember.	The promises of the minister are disappointing.
confidential	the letters to the journalist		I forgot that.	Are the letters to the journalist confidential?
new	the computers with the viruses	Missing Verb	The computers with the viruses new.	The computers with the viruses were new.

Comprehension Task

A word-by-word self paced reading paradigm that allowed the collection of word (or phrase) level reading times was employed as a comprehension task. In this technique, We were able to identify the specific loci of processing difficulties in the form of prolonged reading times. In addition, the participant determined the reading speed, not the experimenter (Juffs, 2005; Juffs & Harrington, 1995). The test was run using the SuperLab Pro 2.0 package.

Materials and Design

The comprehension task consisted of 106 items that included 40 experimental stimuli, 6 trial sentences and 60 filler items. The experimental stimuli consisted of 40 different target sentences each including 4 conditions. There were two match and two mismatch conditions. In the former, the number feature of the head and the local noun were the same; Singular/Singular and Plural/Plural (i.e. SS and PP). In the latter, the head and the local nouns had different number features; Singular/Plural and Plural/Singular (i.e. SP and PS). The match conditions were the control conditions of the corresponding mismatch conditions.

Each condition was represented by 10 items in the test. The sentential subject of the target sentences were all complex NPs made up of a head noun followed by a preposition and a local embedded NP such as *the toy for the kid.* The verb of the sentence is either the copula *be* (in its past or present form) or the auxiliary *be* which precedes the progressive or the participle form of a lexical verb. The auxiliary or the

copula *be* is followed by 1-4 other words (e.g. *The recommendation by the expert was neglected by the board.*)

40 experimental sentences were counterbalanced within 4 sets. In other words, each of the 4 sets included a different version (i.e. SS, SP, PP and PS) of the very same sentence. Therefore, each participant saw a particular sentence only once. That is, while a participant saw the SS condition of the first target sentence, s/he saw the SP condition of the second target sentence and the PP condition of the third target sentence and so on. Thus, each participant saw an equal number of the four conditions.

A Yes/No question related to each target sentence was constructed, and it followed the related target sentence so as to guarantee that the participants actually read the sentence. The questions were arranged in such a way that the answer to the half of the comprehension questions was expected to be *yes* and the answer to the other half was expected to be *no* (see Appendix A for the experimental sentences and the related comprehension questions).

There were 60 filler items in the test in order to divert the participants' attention from number and agreement issues. 50 of the fillers included ambiguous relative clause attachment sentences and the rest included reduced relative clauses taken from Juffs (1998). Appendix B includes a list of filler sentences.

6 trial items were given to the participants to practice the test and the software program. 3 of the trial items were similar to the target sentences and the other 3 to the filler items. A list of these trial items are shown in Appendix C.

All of the sentences in the test were initially checked by a native speaker of English with respect to their plausibility and acceptability. The 4 sets were randomized

among the participants. In addition, before the participants took the test, they were asked to fill in a background questionnaire taken from Gürel (2004) (see Appendix D and E).

Procedure

All 106 sentences were divided into four segments as follows:

(47) a. The toy / for the kid / was / very expensive.
1 2 3 4

This segmentation allowed us to detect a probable processing delay at a particular segment.

Participants were tested individually in a silent room. They were seated in front of a computer and read the instructions on the screen. The experimenter explained the instructions to make sure that the participants understood the procedure. They were told that as they pressed a certain key on the keyboard, they would read some sentences that are divided into segments and that they would neither see the whole sentence nor would they be able to reread previous segments or sentences. Moreover, they were informed that their reading speed and comprehension of the sentences were important, so they were expected to answer the comprehension questions correctly. Having read the instructions, the participants went on with the trial items.

They first pressed the space bar on the keyboard and the first segment was displayed. When they finished reading the first segment, they pressed the space bar, and the next segment appeared exactly at the same spot of the previous segment on the screen. As they read all of the segments, a related comprehension question (e.g. *Was the toy for the kid cheap?*) appeared on the screen as a whole. Participants responded to the

question by pressing the key which was labeled *YES* with a piece of green paper, on the middle right of the keyboard or by pressing the key which was labeled *NO* with a red piece of paper on the middle left of the keyboard. After they pressed a key to answer the question, the first segment of the next sentence appeared and the same procedure was repeated. All the segments and the questions were presented at the centre of the computer screen. The computer recorded the time between successive key presses in milliseconds. When a comprehension question is answered incorrectly, the related item is excluded from the analysis.

Sentences except for the trial items were randomized across participants to ensure that participants do not see the sentences in the same order. It usually took the participants 25 to 30 minutes to complete the test.

Offline Task

A written grammar test was administered to assess whether the participants have the knowledge of the subject-verb agreement rule. This task was given as complementary to the other two online tasks to compare L2 learners' abstract grammatical knowledge of agreement and their online use of this knowledge. The task is used as an inclusionary criterion. Participants who achieved at least 90 % accuracy in the test were included in the analysis.

One of the native speakers scored 65 (out of 100) and was excluded from the analysis. In the L2 group, data from two participants could not be used due to low accuracy. One did 82, and the other 78.5 on the offline test. Among the participants whose data were included in the analyses, the minimum offline test score is 96.5.

Materials and Design

A 54-item-written-test was constructed with 28 experimental items and 26 fillers. The experimental items consisted of examples of the 4 conditions (i.e. SS, SP, PP, and PS) described above. Each condition was represented by 7 sentences. (see Appendix I). Each item included a pair of sentences (one grammatical and one ungrammatical sentence). Ungrammaticality in the sentences depended on the subject-verb agreement. Participants were asked to circle the sentence that sounded correct in each pair.

Procedure

The participants were given the written-test as the final task after the comprehension and production tasks. There was no time limitation in this task. The participants completed the test in 10-15 minutes. Participants who scored less than 90 % accuracy in this test are excluded from the study. As mentioned earlier in the Participants section data from 1 native and 2 L2 speakers were excluded from the analysis. These participants were treated as outliers because of low accuracy in the offline task.

Conclusion

To sum up, the native and L2 speakers of English were compared and contrasted on their processing of subject-verb agreement. Two different online techniques were employed in two modalities; a self-paced moving window technique to test comprehension and a

sentence preamble completion task to test production. The production task required production of declarative sentences and questions. An offline grammar test accompanied the online tests. The results of these tests are reported in the following chapter.

CHAPTER 4

RESULTS

Introduction

This chapter presents the results of the quantitative analysis of the data collected by means of the three tasks described in the previous chapter. We present the results of each task separately. First of all, the results of the declarative sentence production task were presented. Then, the results of the question formation task follow. Finally, we report the results of the self-paced moving window reading task.

Results of the Production Tasks

The Declarative Sentence Production Task

Agreement Errors

As described in the Scoring section, each agreement error scored as 1, because there were five items representing each condition (i.e. SS, SP, PP and PS). The participants' scores ranged from 0 to 5, depending on the number of errors. Taking all the participants into account (i.e. the native and the L2 group), application of the scoring criteria yielded 635 (88.2 %) correct responses; 27 (3.80 %) agreement errors; 37 (5.1 %) repetition errors and 21 (2.9 %) miscellaneous responses. Table 3 below presents the distribution

of responses for these four scoring categories across the experimental conditions and the participants groups.

Table 3 Distribution of Responses in the Declarative Sentence Production

		Correct Responses		Agreement Errors		Repetition Errors		Miscellaneous Responses	
		Number of Responses	%	Number of Responses	%	Number of Responses	%	Number of Responses	%
Native Speakers	SS	89	98.9	0	0	1	1.1	0	0
	SP	79	87.8	5	5.5	3	3.3	3	3.3
	PP	78	86.7	1	1.1	7	7.8	4	4.4
	PS	84	93.3	2	2.2	2	2.2	2	2.2
	Total	330		8	8.9	13	14.4	9	10
	%	91.7		2.2		3.7		2.5	
L2 Speakers	SS	87	96.7	0	0	1	1.1	2	2.2
	SP	70	77.8	7	7.8	8	8.9	5	5.5
	PP	77	85.6	3	3.3	8	8.9	2	2.2
	PS	71	78.9	9	10	7	7.8	3	3.3
	Total	305		19		24		12	
	%	84.7		5.3		6.7		3.4	

Both groups produced more correct responses when the head noun and the local noun were both singular. Agreement errors were more common in the SP condition in the native group whereas they were more common in the PS condition in the L2 speakers group. Items in the SS condition did not lead participants in either group to repeat the number of the nouns incorrectly. However, this was not the case with the items in the PP condition. That is, PP condition yielded relatively more repetition errors in both groups.

To conduct an analysis of variance to compare the distribution of agreement errors across conditions and groups, we checked for the distribution of the scores in each condition. The data was not normally distributed according to a series of normality tests.

Firstly, skewness and kurtosis coefficients were not within the limits of normality (skewness; $.00_{SS}$, $.73_{SP}$, 2.58_{PP}, 2.60_{PS}; kurtosis: $.00_{SS}$, -1.55_{SP}, 4.95_{PP}, 7.35_{PS}). Moreover, the Shapiro-Wilk test of normality revealed that the distributions of the four sets of scores on agreement errors were not normally distributed (W_{SS}=.00, p< .001; W_{SP}=.42, p<.001; W_{PP}=.52, p<.001; W_{PS}=.45, p<.001).

The agreement error data in the PP and PS conditions violated the assumption of equality of variances, too. That is, Levene's test showed that the variances of the scores in the PP and the PS conditions were unequal (F_{SS}=.00, F_{SP}=1.816, p>.18; F_{PP}=4.92, p<.05; F_{PS}=12.08, p<.001).

As a result, because the assumptions of ANOVA were not met, we conducted non-parametric tests that are relatively more assumption-free for our ordinal data (Field, 2000; Huck, 2004). Thus, we conducted a Mann-Whitney U test so as to answer our research question whether the native and non-native speakers differed in terms of production of agreement. The test revealed that the two groups did not differ, on the average, in any of the four conditions. (Mann- Whitney U_{SS}=162, p=1.00; U_{SP}=1.44, p=.49; U_{PP}=144, p=.29; U_{PS}=124, p=.239). That is, the L2 speakers of English produced agreement errors similar to the native controls.

The first research question investigates the distribution of agreement errors among the experimental conditions. In order to compare the four conditions with regard to agreement errors within each group, we conducted a Wilcoxon matched-pairs signed-ranks test. The test revealed that the native speakers produced significantly more errors in the SP condition than in the SS condition (z= -2.24, p=.025). There was no difference between the PP and PS conditions (z= -.58, p=.56); between the SS and PS conditions (z= -1.41, p=.16) and between the PP and SP conditions (z= -1.63, p=.10).

We observed a SS-SP mismatch effect but not a PP-PS mismatch effect. There was no difference between SP and PS agreement errors, though (z= -1.34, p= .18). Hence, the native speaker participants tend to make more agreement errors only in the SP condition.

As for the L2 speakers, the SP condition caused significantly more agreement errors than the SS condition (z= -2.64, p=.008). Just as the native speakers group, PP-PS and SP-PS pairs did not differ from each other (z= -1.40, p=.16 and z= -.63, p=.53, respectively). On the other hand, unlike native speakers, the L2 speakers demonstrated a significant difference in their treatment of the SS and PS conditions (z= -2.26, p=.024). They produced more agreement errors in the PS condition than in the SS condition. Moreover, in the L2 group there was a gap between the SS and SP but not between the PP and PS conditions. In this respect, the L2 speakers were similar to the native controls.

The agreement error scores of the two groups across the experimental conditions can also be observed in Figure 10 below:

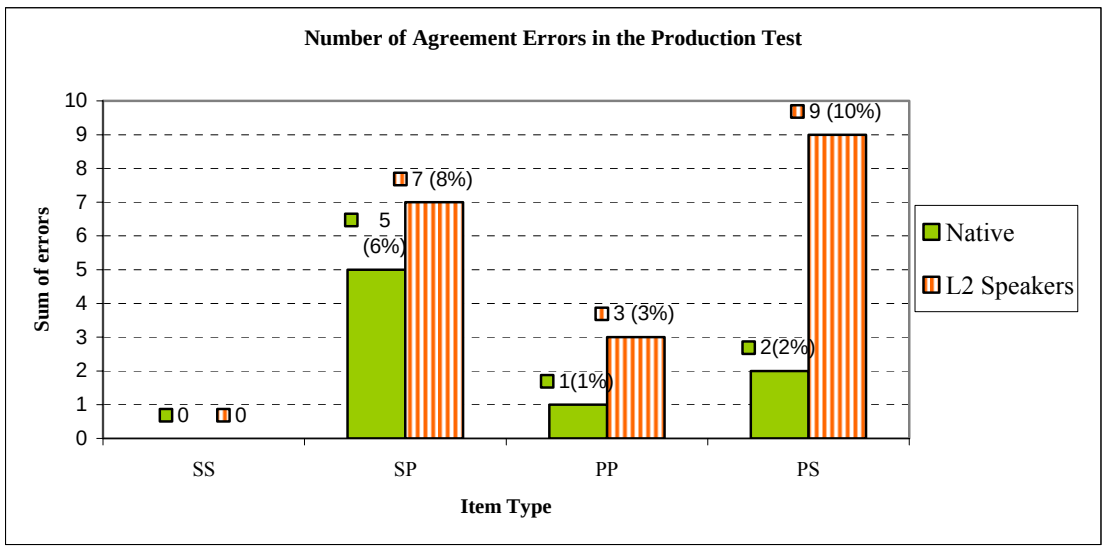


Figure 10 Number of agreement errors in the declarative sentence production task

Repetition Errors

We also analyzed the repetition errors to check whether there was a similar trend in the distribution of errors across the conditions. Because the data did not meet normal distribution assumption (Shapiro-Wilk W_{SS}=.25, p<.001; W_{SP}=.53, p<.001; W_{PP}=.67, p<.001; W_{PS}=.47, p<.001), we ran nonparametric tests. Just as in the agreement error data, the two groups did not significantly differ in any condition in terms of the average number of repetition errors they produced (Mann-Whitney U_{SS}=162, p=1.00; U_{SP}=133, p=.231; U_{PP}=153, p=.75; U_{PS}=134, p=.198).

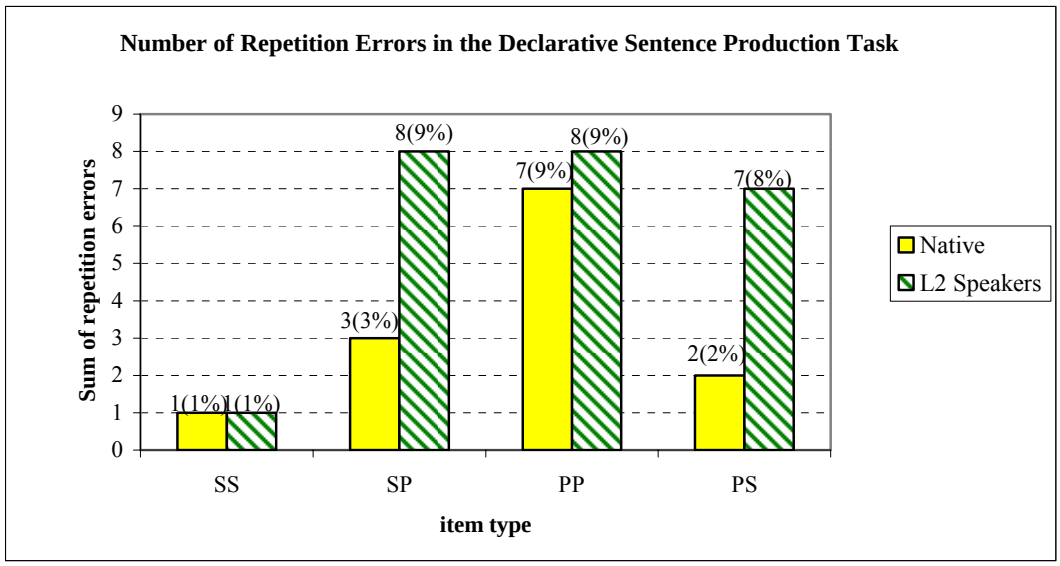


Figure 11 Number of repetition errors in the declarative sentence production task

Wilcoxon matched-pairs signed-ranks test revealed that the native group produced significantly more repetition errors in the PP condition than either the SS or the PS condition (z= -1.89, p<.05; z= -2.236, p<.05, respectively). The number of repetition

errors produced by the native speakers in the SP, PP and PS conditions was quite similar to one another. Yet, their repetition errors decreased considerably in the SS condition. In other words, the repetition errors in the SS condition was significantly less than the SP and PP conditions ($z= -1.89$, $p<.05$; $z= -2.33$, $p<.05$, respectively) but not less than the PS condition ($z= -1.67$, $p=0.96$).

Although not statistically significant, the repetition errors produced by the L2 speakers were more than those produced by native speakers. As for the comparisons among the item types, the number of errors that the L2 speakers produced in the SP, PP and PS conditions did not differ from one another.

As a result, the trend observed in the production of repetition errors was not parallel to the one observed in the production of agreement errors. However, it should be emphasized that with respect to the agreement and repetition errors, the native and the L2 speakers performed in a similar fashion. In other words, conditions that triggered more errors (both the agreement and repetition errors) were the same in both groups.

The Question Formation Task

The distribution of responses in the question formation task is summarized in the Table 4. As the numbers suggest, the overall accuracy rate of the native speakers is less than their correct responses in the declarative sentence production task. In contrast, the L2 speakers had more correct responses in the question production task than declarative sentence production. In both groups, the number of agreement errors decreased

considerably whereas the number of repetition errors increased in comparison to the declarative sentence production.

Table 4 Distribution of Responses in the Question Formation Task

		Correct Responses		Agreement Errors		Miscellaneous Responses	
		Number of Responses	%	Number of Responses	%	Number of Responses	%
Native Speakers	SS	87	96.7	0	0	1	1.1
	SP	78	86.7	1	1.1	4	4.4
	PP	74	82.2	0	0	4	4.4
	PS	80	88.9	4	4.4	1	1.1
	Total	319		5	5.5	10	11.1
	%	87.8		1.3		2.7	
L2 Speakers	SS	88	97.8	0	0	1	1.1
	SP	71	78.9	3	3.3	3	3.3
	PP	76	84.4	1	1.1	3	3.3
	PS	82	91.1	5	5.5	1	1.1
	Total	317		9		8	
	%	88.1		2.5		2.2	

Agreement Errors

The fifth research question investigated the effect of linear and syntactic distance on production of agreement errors. We asked the participants to form questions so as to manipulate the distance between the verb and the local noun by means of question formation. Recall that in declarative constructions, the local noun (i.e. the postmodifying noun embedded in the PP) is linearly the closest item to the verb. However, in questions,

as the verb moves to the sentence-initial position, the linear distance between the local noun and the verb increases. With respect to the distance between the local noun and the head noun, the linear and the syntactic distance between these two nouns is the same in declarative statements and questions.

The statistical procedures used in the declarative sentence production task were also used in the analysis of the agreement errors in the question formation task. The data could meet neither the normality assumption nor the equality of variances assumption. The Shapiro-Wilk test of normality revealed that none of the experimental conditions were normally distributed (W_{SS}=.00; W_{SP}=.25, p<.001; W_{PP}=.46, p<.001; W_{PS}=.35, p<.001). The Levene's test showed that the equality of variances assumption was met for the agreement errors data in the SS and PS conditions but it was violated by the SP and PP conditions (F_{SS}=.00; F_{SP}=4.92, p=.03; F_{PP}=4.51, p=.41; F_{PS}=.049, p=.826).

Therefore, we conducted nonparametric tests on our ordinal scale data. To compare the two participant groups, a Mann-Whitney U test was run. Results showed that the L2 speaker participants did not differ from the native speaker group in terms of the average production of agreement errors in any of the four conditions (Mann-Whitney U_{SS}=162, p=1.00; U_{SP}=144, p=.29; U_{PP}=153, p=.32; and U_{PS}=145, p=.42).

We conducted Wilcoxon matched-pairs signed-ranks tests for each group so that we could compare the agreement errors produced in different conditions. The native speakers did not show any difference across conditions in the number of agreement errors they produced. No mismatch effect was found in conditions where the head noun is singular and plural. That is, there was no difference between the SS and SP agreement errors (z= -1.00, p=.317) and between the PP and PS agreement errors (z= -1.34, p=.180).

Likewise, the L2 speakers revealed the very same results in that they did not produce significantly more agreement errors in the SP condition than in the SS condition in the question formation task (z= -1.73, p=.083). In addition, agreement errors did not differ between the sentences in the PP and PS conditions (z= -1.41, p=.157).

Figure 12 below summarizes the total number and the percentages of agreement errors in the question formation task. Groups showed a similar trend in the sense that agreement errors were most common in the PS condition. For example, both groups produced agreement errors in forming questions such as * *Is the signatures on the form fake?,* where the moved verb did not agree with the plural head noun but with the singular noun. Thus, contrary to what we have found in the declarative sentence production task, the PS condition led more agreement errors than the SP condition in both groups in the question formation task. Yet, this difference was not statistically significant. The match conditions, on the other hand, SS and PP conditions, were almost error-free.

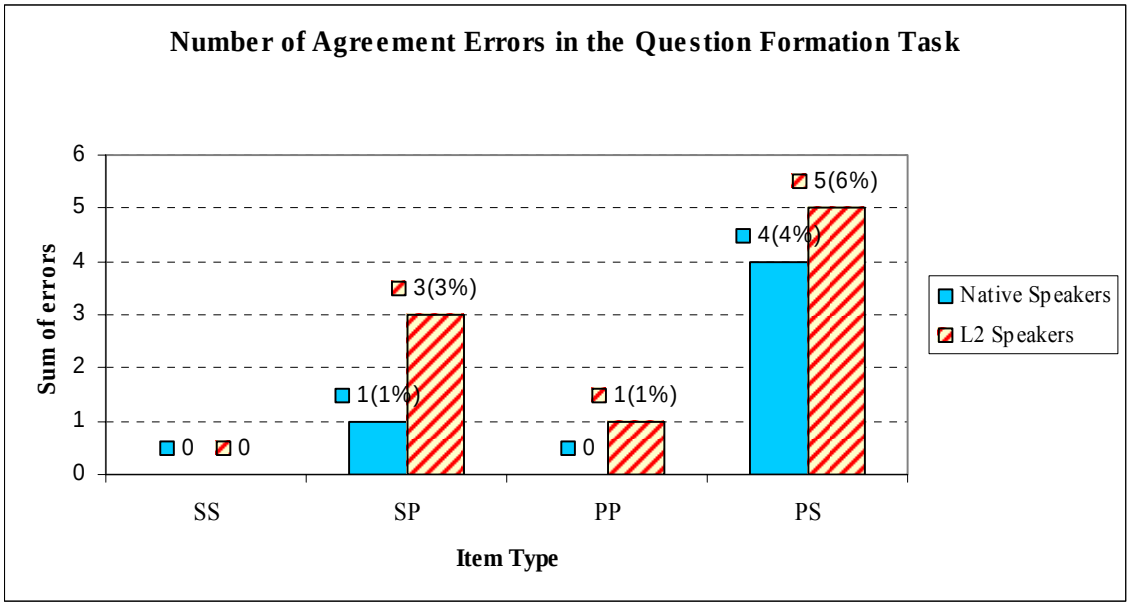


Figure 12 Number of agreement errors in the question formation task

Repetition Errors

Just like the repetition errors in declarative sentences, the repetition errors in questions were the same in both groups (Mann-Whitney U_{SS}=161.50, p=.97; U_{SP}=111.00, p=.069; U_{PP}=154.00, p=.78; U_{PS}=135.00, p=.21).

The distribution of the native speakers' repetition errors did not reveal any significant difference across the conditions according to the Wilcoxon signed-pairs test. Figure 13 below summarizes the total number and the percentages of repetition errors and it displays that the native speakers made a considerable number of repetition errors in the PP condition just as they did in the declarative sentence production task. In other words, the native speakers performed similarly in the declarative sentence production task and in the question formation task with regard to the repetition errors.

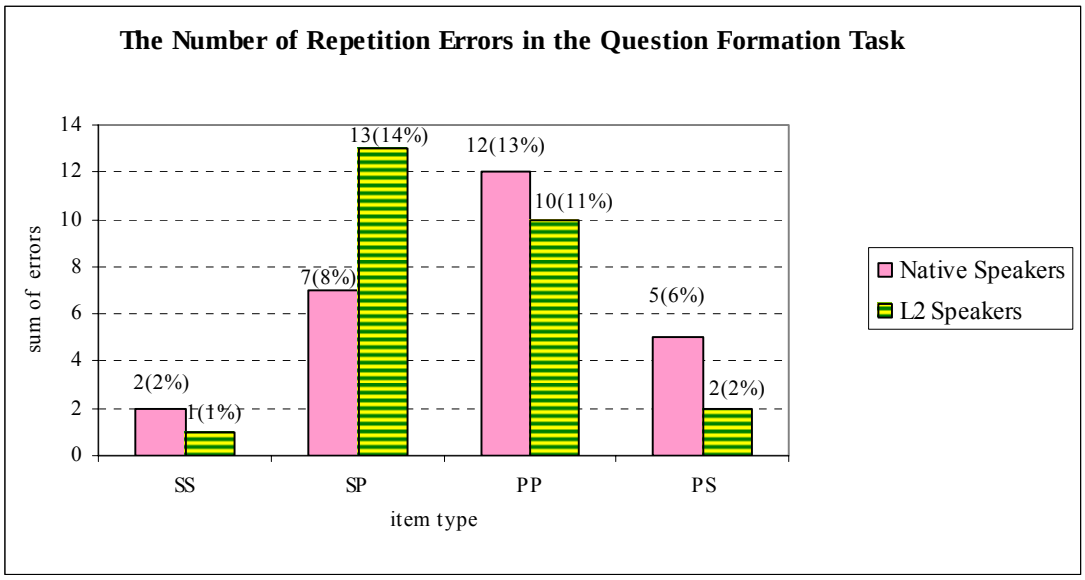


Figure 13 The number of repetition errors in the question formation task

The L2 speakers produced more repetition errors in the SP condition than the SS condition ($z= -3.20$, $p<.001$) and more errors in PP condition than the PS condition ($z= -2.27$, $p<.05$). In addition, they produced more errors in the PP condition than in the SS condition ($z= -2.31$, $p<.05$) and more errors in the SP condition than the PS condition ($z= -2.84$, $p<.01$) as the Figure 13 shows. The L2 speakers demonstrated a similar trend in the declarative sentence production task for the SS, SP and PP conditions; yet, they produced less repetition errors in the PS condition in the declarative sentences than in the question formation task.

To summarize, with the L2 speakers we found a singular head mismatch effect (i.e. SS vs. SP) in repetition errors but there was not a plural head mismatch effect (i.e. PP vs. PS) in either task. The native speakers, however, did not even show any singular head mismatch effect. As a result, there seems to be no meaningful relation between the

groups' repetition errors and agreement errors either in declarative sentence formation or in question formation.

Results of the Comprehension Task

In online comprehension task, the mean accuracy rate was quite high for both groups; the native speaker group and the L2 group demonstrated 97.25% and 96.85% correct accuracy rate, respectively. The participants' high comprehension scores suggest that both groups were reading the sentences for comprehension and they were able to understand the meanings of the sentences.

Figure 14 shows the overall reading trends of the native speakers. Recall that the 1st, 2nd, 3rd, 4th and 5th segments correspond to *the toy / for the kid / is / very expensive/ Was the toy expensive?*, respectively.

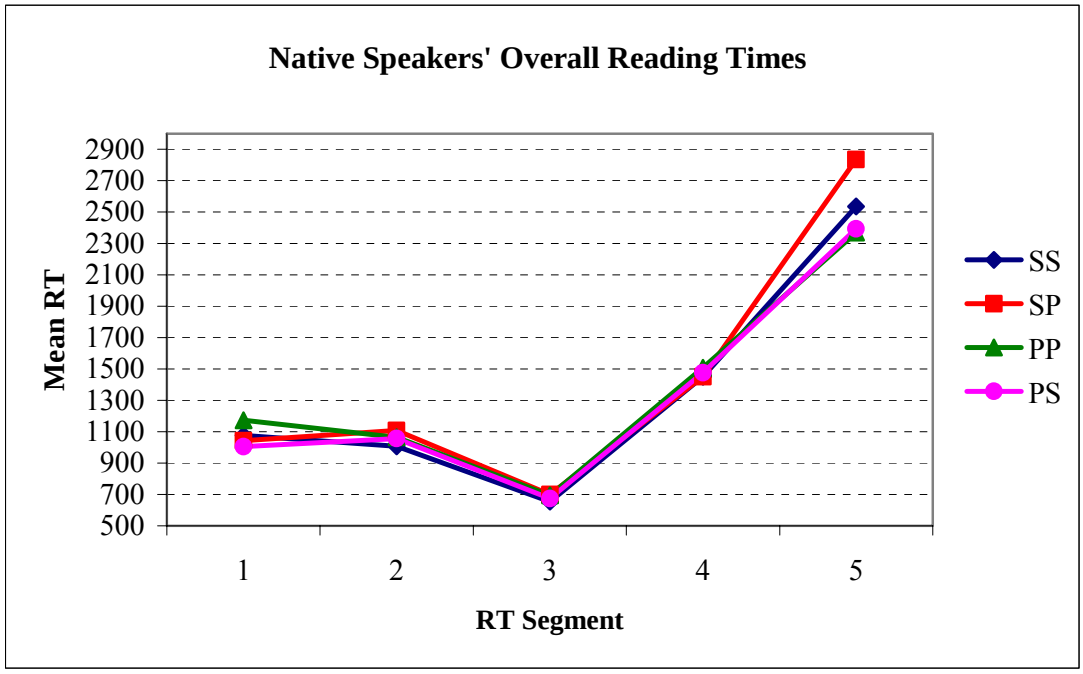


Figure 14 Native speakers' reading times in all segments

Figure 15 below illustrates the comprehension task results of the L2 group. As can be seen in the figure, in the PS condition, L2 speakers spent more time on the 1st segment. Just like native speakers, it took the L2 speakers longer to read the 2nd segment in the SP condition. The increase in the RT in the SP condition in the 2nd position might depend on the plural marking on the local noun where the head noun was singular.

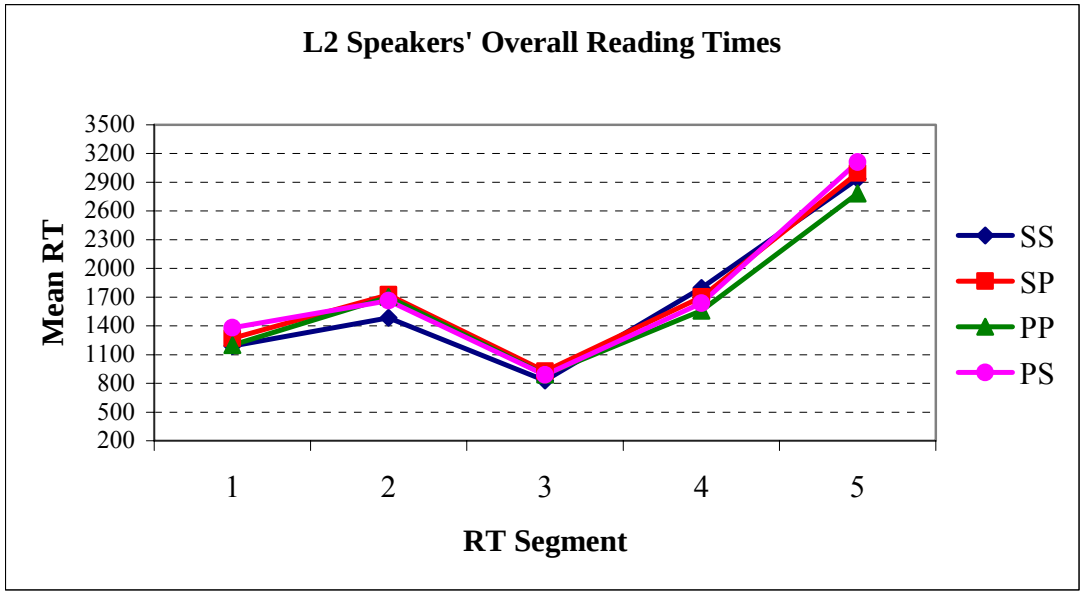
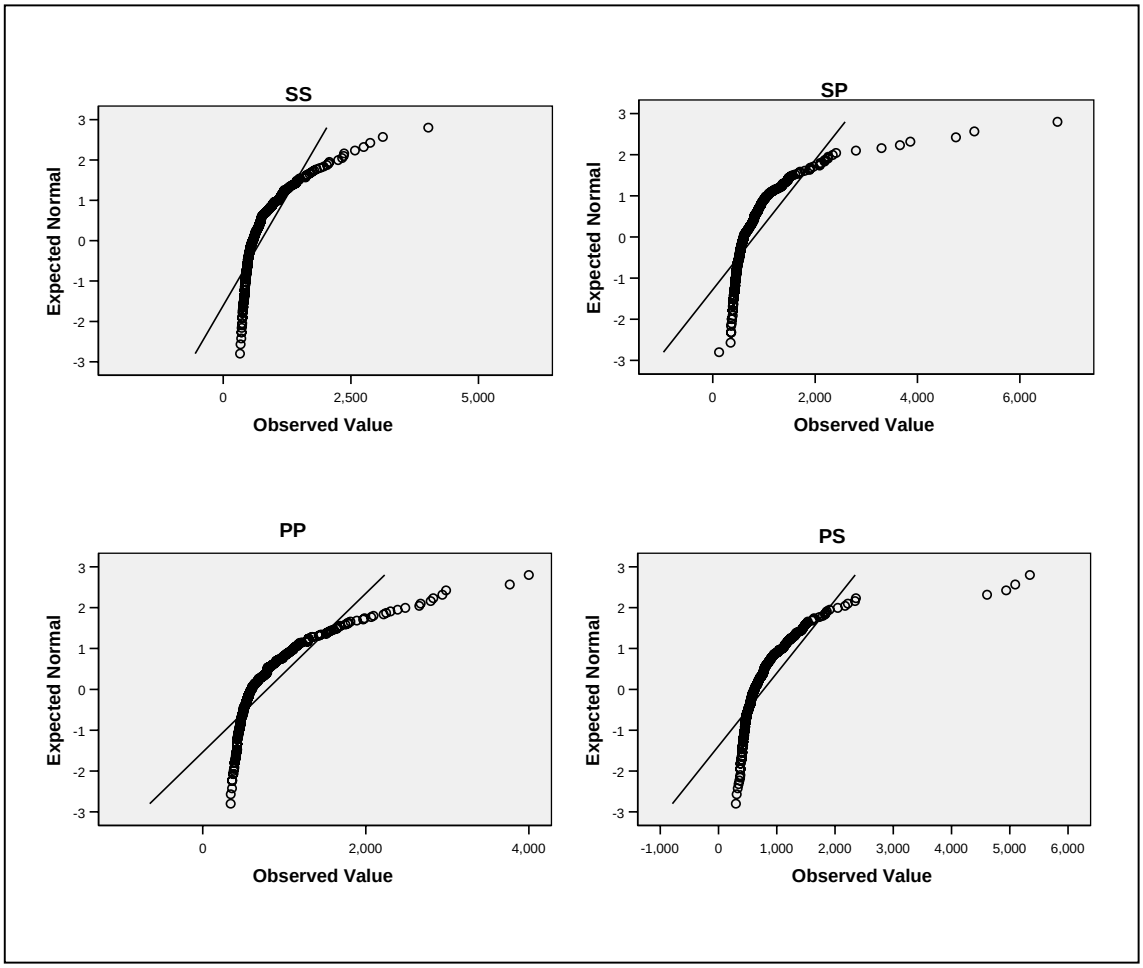


Figure 15 L2 speakers' reading times in all segments

Basically, the low RTs on the 3rd segment and the relatively higher RTs on the 4th and the 5th segment depend on word length. We are not interested in the RTs on the 4th and the 5th segments because the lengths of the words in these positions are not equal in each sentence. As we are interested in the verb agreement, we analyze the RTs on the 3rd position in detail.

We aimed to compare the RTs of the 4 experimental conditions across the two participant groups. So we aimed at an analysis of variance with subject type (native vs. L2 speakers) as between-subject factor and item type (i.e. SS, SP, PP and PS) as the within-subjects factor.

Thus, we checked for the assumptions of two-way mixed ANOVA. We analyzed the distribution of the RTs in 4 conditions in the 3rd segment. None of the conditions



were distributed normally (skewness: 2.88_{SS}, 4.62_{SP}, 2.73_{PP}, 4.84_{PS}; kurtosis: 11.36_{SS}, 30.48_{SP}, 9.62_{PP}, 32.32_{PS}). Shapiro-Wilk test of normality also reflected values for a non-normal distribution (W_{SS}=.69, p<.001; W_{SP}=.57, p<.001; W_{PP}=.70, p<.001; W_{PS}=.57, p<.001). Figure 16 illustrates the non-normal distribution of the RTs.

Figure 16 Normal Q-Q plots: RTs on the 3rd segment

The data were square root transformed to compensate for the positively skewed distribution. Yet, the transformation could not rectify the distribution (skewness: 1.89_{SS}, 2.57_{SP}, 1.81_{PP}, 2.66_{PS}; kurtosis: 4.38_{SS}, 10.13_{SP}, 3.82_{PP}, 11.55_{PS}). The Shapiro-Wilk test was used to confirm that the RTs were not normally distributed (W_{SS}=.82, p<.001; W_{SP}=.77, p<.001; W_{PP}=.82, p<.001; W_{PS}=.78, p<.001).

A further data transformation was designed to reduce the degree of nonnormality by means of logarithm 10 transformation. The transformation approached the RT values to relatively more normal skewness and kurtosis values (skewness: 1.19_{SS}, 1.22_{SP}, 1.12_{PP}, 1.28_{PS}; kurtosis: 1.17_{SS}, 2.55_{SP}, $.92_{PP}$, 2.60_{PS}) but the Shapiro-Wilk test showed nonnormality (W_{SS}=.90, p<.001; W_{SP}=.90, p<.001; W_{PP}=.90, p<.001; W_{PS}=.92, p<.001).

Not only the assumption of normal distribution but also the equality of variances and sphericity assumptions were violated. Levene's tests show that the variances of the RTs across groups were unequal (F_{SS}=13.70, p<.001; F_{SP}=13.65, p<.001; F_{PP}=13.68, p<.001; F_{PS}=8.07, p<.001). In addition, Mauchly's test of spherecity revealed that the assumption of spherecity was violated (Mauchly's W=.93, df=5, p<.001).

Therefore, despite having continuous data, we used nonparametric tests because the data did not meet the assumptions of ANOVA. The Mann Whitney U test was used to compare the groups. The test revealed that the native speakers were faster than the L2 speakers in reading the verb no matter what the experimental condition was (Mann-Whitney U_{SS}=14039, p<.001; U_{SP}=14575, p<.001; U_{PP}=14278, p<.001; U_{PS}=13350, p<.001). That is, with all item types, the L2 group spent significantly more time than the

native speaker group with respect to their average RTs on the 3rd segment of the experimental items.

The native speaker participants showed significantly longer RTs in the SP condition than the SS condition; the Wilcoxon signed rank test displayed a significant difference ($Z= -2.052$, $p<.05$). Yet, there was no such difference between the PP and the PS conditions ($Z= -.277$, $p=.781$). We found a SS-SP mismatch effect but not a PP-PS mismatch effect.

The L2 speaker group demonstrated exactly the same trend in the sense that they spent more time reading the verb in the SP condition than the SS condition. However, this difference between the SS and SP condition was marginally significant according to the Wilcoxon signed rank test ($z= -1.89$, $p=.058$). Furthermore, there was no difference between the PP and the PS conditions ($z= -.49$, $p=.62$).

Figure 17 below, illustrates the mean RTs on the 3rd segment of experimental conditions for the two groups.

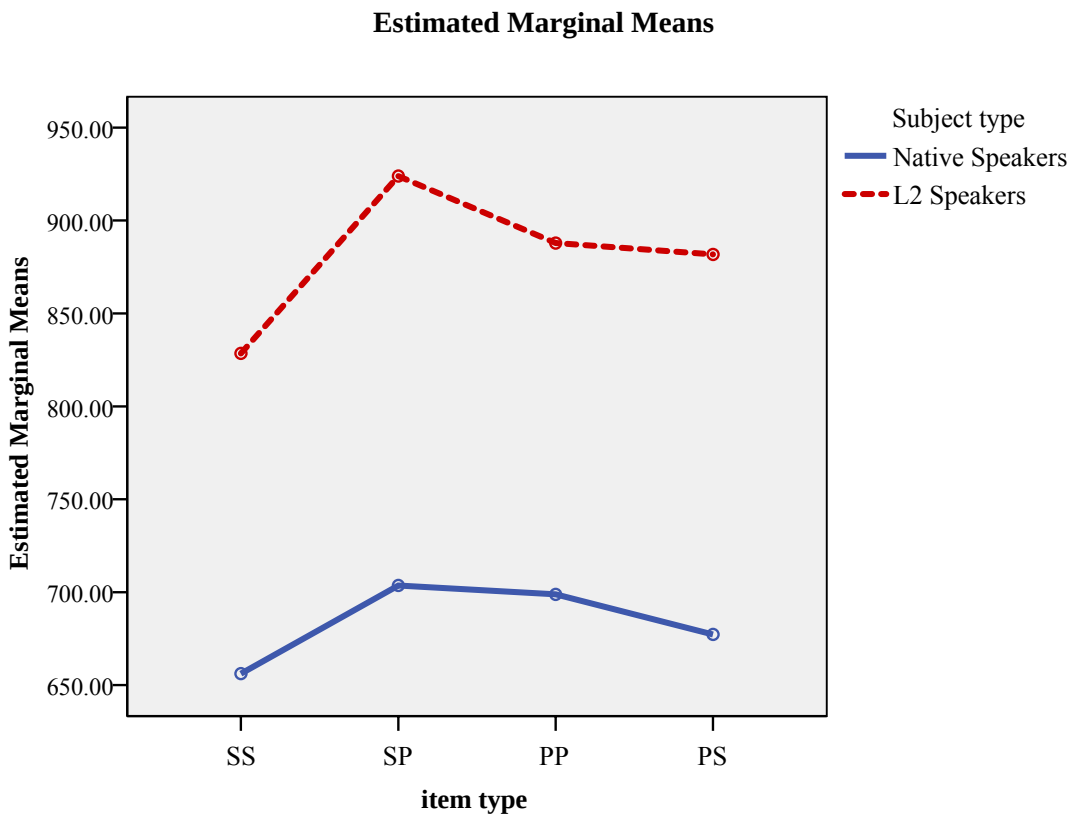


Figure 17 Estimated marginal means

As the above figure clarifies, both the native and the L2 speakers demonstrated similar performance across conditions. Nevertheless, the native speakers were faster readers. In other words, the L2 speakers behaved just like the native speakers except that they were slower. Another important point is that although there is no mismatch in the number feature of the nouns in the PP condition, this condition required longer RTs than the PS condition for both groups of participants. Table 5 below is a more detailed presentation of Figure 17 as it shows the means and the standard deviations of the two groups.

Table 5 Means and Standard Deviations of the RTs on the 3rd Segment

	Native Speakers		L2 Speakers	
Item Type	Mean	Standard Deviation	Mean	Standard Deviation
SS	656.15	340.80	828.52	546.46
SP	703.60	425.19	923.89	781.81
PP	698.79	391.73	887.87	604.17
PS	677.27	342.94	881.78	707.91

Conclusion

In this section, we discussed the results of the two production tasks (formation of subject-verb agreement in declarative sentences and questions) as well as the results of the word-by-word self paced reading task designed to test comprehension and processing of subject verb agreement.

The first research question investigates the distribution of the attraction errors across the experimental conditions in the declarative sentence production and the question formation task. In both tasks, the singular and the plural match conditions gave almost the same number of agreement errors. The mismatch conditions induced more errors than the match conditions in both tasks. In L1 question formation task, the SP condition caused more errors than the PS condition (Vigliocco & Nicol, 1998). Both the native and the L2 speakers made more errors in the PS condition than the SP condition in the current question formation task. On the other hand, in the declarative sentence production task, there were more errors in the SP condition than the PS condition in the native speakers group.

Recall that our second research question was concerned with potential differences between L2 speakers and native speakers. Overall, the L2 group did not

differ from the native speakers in the production tasks. The distributional trends of the attraction errors were similar in both groups except that the PS condition induced the biggest number of errors in the L2 group whereas the native speakers made more errors in the SP condition than the PS condition in the declarative sentence production task.

As for the differences between subject-verb agreement in production and in comprehension (our third research question), we found that attraction errors appear only in the SP condition in declarative sentence production. Similarly, in comprehension, the difficulty in processing the SP condition appears in the form of prolonged RTs. Moreover, this parallelism in our production and comprehension results is not confined to the L2 speaker participants, because the native controls showed similar results in both modalities. However, in the question formation task, none of the conditions differed significantly from one another with respect to the number of agreement errors neither in the L2 nor in the native speakers group.

In the online reading task, L2 speakers were found to be similar to native speakers in terms of the patterns of subject-verb agreement processing. Nevertheless, overall, they were slower than the native speaker group.

CHAPTER 5

DISCUSSION AND CONCLUSION

Introduction

The main motive behind the present study was to investigate the question of to what extent end-state Turkish L2 speakers of English are similar to native English speakers with regard to the processing of subject-verb agreement in sentences with complex NPs. We analyzed processing in two modalities; production and comprehension. We used three tasks; a sentence preamble completion task to elicit declarative sentences, a sentence preamble completion task to elicit questions and a self-paced moving window reading task. In the production tasks, we compared the L2 speakers with the native controls on the basis of the number of the subject-verb agreement errors they produced in each experimental condition. In the comprehension task, we compared the RTs of the two groups on the 3rd segment where they read the verbs of the target sentences.

In the following section, we first summarize the results of the tasks again and discuss the findings with respect to native and non-native speaker differences in processing of subject-verb agreement. Then, we discuss the pedagogical implications of the findings. Finally, the limitations of the study will be presented and recommendations for future research will be provided.

Discussion

The declarative sentence production task revealed that both the native speakers and the L2 speakers showed mismatch effect in producing agreement errors. Both groups produced more agreement errors in the SP condition than the SS condition whereas the number of the agreement errors they produced in the PP and PS conditions were the same in both groups. The results of the declarative sentence production task are in line with previous research studies that reported the asymmetrical distribution of errors for singular and plural head nouns (e.g. Bock & Miller, 1991; Bock & Cutting, 1992; Bock & Eberhard, 1993; Vigliocco et al. 1995; Vigliocco & Nicol, 1998; Thornton & MacDonald, 2003).

The proportion of agreement errors in earlier studies cited above ranges from 3% to 6%. In declarative sentence production, the percentage (agreement) error rate was 2.2% for the control group and it was 5.3% for the L2 group. In question formation, the agreement error rates were 1.3% and 2.5% for the native speakers and the L2 speakers, respectively. Therefore, we can say that overall, the percentage agreement error rates observed in the present study were similar to what was reported in previous studies.

Moreover, in terms of the distribution of the agreement errors across conditions, the English native speaker group of the present study behaved like English native speakers reported in previous studies cited above. Similar to previous research findings, the difficulty order we found in native speakers was the SP, PS, PP, SS sequence. That is, the SP condition was the condition where most agreement errors occurred and the SS condition was the least problematic condition. Actually, similar to most of the earlier

studies, there was no agreement error at all in the SS condition in either group in the present study.

The L2 speakers in the present study, on the other hand, produced slightly more errors in the PS condition than the SP condition. However, this difference was not significant. The results of our declarative sentence production task are compatible with Nicol and Greth's (2003) findings that revealed a SS-SP mismatch effect in the L1 English-L2 Spanish participants.

The present study revealed that L1 Turkish speakers of L2 English and the native controls produced similar subject verb agreement errors in both production tasks**.** They produced more agreement errors in the SP condition than the SS condition but the PS condition was not different from the PP condition. Therefore, we can say that the end-state L2 learners of English process subject-verb agreement just as the native speakers of English do. In other words, the mechanisms that govern the production of the subject-verb agreement seem to have been acquired by our Turkish end-state L2 learners of English at the native-speaker level.

In search of how these mechanisms operate, we tested the Linear and Syntactic Distance Hypotheses discussed earlier in Chapter 2. Our prediction was that if we found agreement errors in declarative sentences but not in questions, this would support the linear-distance hypothesis. If, on the other hand, we found similar agreement errors in both tasks, this would falsify the Linear Distance Hypothesis, and thus, the Syntactic Distance Hypothesis would be more plausible.

As for our findings, in the question formation task, we did not observe a mismatch effect even between the SS and SP conditions either in the L2 group or in the native speakers group. That is, declarative sentence-SP condition triggered more

agreement errors (e.g. **the signature on the forms are expensive)* than declarative sentence-SS condition. However, the mismatch effect between the SS and SP conditions was not observed in questions in either group. This supports the Linear Distance Hypothesis, suggesting that the verb erroneously agrees with the plural local noun. In questions, there were more agreement errors in the PS condition than the SP condition That is, errors such as **Is the signatures on the form fake?* are found to be more frequent than errors such as **Are the signature on the forms fake?* However, this difference was not significant.

These findings are incompatible with the earlier work of Vigliocco and Nicol (1998) who reported a significant difference between the SS and the SP conditions in both question formation and declarative sentence production. The number and the distribution of agreement errors they observed in the two tasks were quite similar. Thus, Vigliocco and Nicol (1998) claimed that the linear proximity of the local noun to the verb did not matter, because in their study, agreement errors were similarly distributed and equally common when the postmodifying noun is adjacent to the verb and when it is not. That is, in their study, even if the plural-marked local noun is not adjacent to the verb in questions, the verb still erroneously agreed with the plural local noun instead of singular head noun.

In the present study, we observed the effect of linear distance not only in the L2 speakers group but also in the native controls. In other words, our findings of the question formation task support the linear distance hypothesis rather than the Syntactic Distance Hypothesis as we did not observe an asymmetrical error distribution in the question formation task although we did in the declarative sentence production task.

The recency of the plural postmodifying noun to the verb is likely to lead to subject-verb agreement errors when the head noun is singular. In both declarative sentence production and question formation tasks, the Turkish learners of L2 English performed similarly to the native English speakers who participated in the study. The agreement error proportions in the L2 group were slightly higher than the native group. Nevertheless, the proportion of repetition errors and miscellaneous responses were similar in the two groups in both tasks. This finding seems to suggest that native speakers and end-state L2 English speakers are not different in the processing routines they follow.

In the comprehension task, the findings of the present study confirm Pearlmutter et al.'s (1999) findings in the sense that the participants showed processing difficulty while reading the verb in the SP condition but not in the PS condition. That is, we observed a significant difference in RT latencies in the SP condition compared to the SS condition, but there was no difference between the PP and PS conditions. Moreover, the RT trend we observed is the same as what Pearlmutter et al. (1999) found. The RT sequence (from the highest to the lowest error rate) is as follows: SP, PP, PS, SS. This trend in the distribution of the RTs was the same in Nicol et al. (1997), where the RTs to the four conditions were investigated via a maze task and a sentence classification task discussed in Chapter 2.

The very same RT trend was observed with our L2 speaker participants, too; yet, they were slower than the native speakers. In other words, the RTs across the four conditions were similar to the RTs of the native controls.

These findings are in contradiction with what Jiang (2004) found as he did not observe a mismatch effect between the SS and SP conditions with the L2 speaker

participants while the native speaker participants showed an SS-SP mismatch effect. Jiang (2004) claimed that the mechanisms such as erroneous feature percolation that underlie the subject-verb agreement computation may be unique to native speakers and L2 speakers typically show greater variations in their RTs. Thus, he claimed that the L2 speakers had the explicit knowledge of agreement computation but that knowledge was not an integrated part of their L2 competence as suggested by the Competence Deficit Approach.

In contrast, our findings suggest that however slower they are than native speakers, the L2 group is similar to the native speakers in processing subject-verb agreement in comprehension as well as in production. The fact that the L2 speakers showed parallel RTs across four conditions supports the Performance Deficiency Approach. The prolonged RTs in the SP condition in the self-paced reading task and the increased number of agreement errors in the declarative sentence production task can be attributed to L2 speakers' failure to access and control the related knowledge of the subject-verb agreement morpheme rather than morphological insensitivity on the part of the L2 learners.

The findings of the declarative sentence production and self-paced moving window comprehension task are in line with the markedness account, which suggests that the SP condition is more prone to lead to attraction errors than the PS condition, because the plural feature of the local noun in the complex NP of the SP form is marked, so it attracts verb agreement and thus causes interference in the agreement mechanism. However, the singular local noun in PS is unmarked and does not lead to errors. As predicted by this account, we observed mismatch effect in the declarative sentence production and in the comprehension task. In other words, the present study showed that

the markedness account applies to both modalities as pointed out by earlier studies (Bock & Eberhard, 1993; Eberhard, 1997; Vigliocco & Nicol, 1998; Pearlmutter et al. 1999).

This finding also provides evidence for the parallelism in the computation of subject-verb agreement in production and in comprehension. The markedness of the plural local noun interferes with the production system and causes production errors. As for the comprehension system, the plural local noun is incorrectly replaced by the number feature of the head noun, which is called head-overwriting process by Pearlmutter et al. (1999).

Pedagogical Implications

The findings of the present study highlight the distinction between the L2 speakers' competence and their performance on the subject-verb agreement computation. Although the end-state L2 learners have the knowledge of grammatical rules that govern subject-verb agreement in English, they sometimes produce subject-verb agreement errors and process the relevant agreement features more slowly than native speakers. The errors and the relative slowness in accessing the correct agreement feature indicate difficulties in processing, and not necessarily any deficit in abstract linguistic representation of the agreement feature. Most importantly, as our findings show, processing problems do not exclusively apply to L2 speakers of English but also to native speakers. This suggests that even adult L2 learners can achieve native-like sentence processing performance in the ultimate L2 state (see Birdsong, 2006 for a detailed discussion of this topic).

Recall that all of the L2 speakers in the present study learned English in a formal environment. Although they spent some time in the L2 country, they can still be considered classroom L2 learners. This suggests that even learners coming out of instructed SLA programs can ultimately achieve native-like processing patterns in the L2. It has indeed been suggested that special explicit processing instructions that can be applied in L2 classrooms can develop L2 learners' processing capacity and increase their processing speed (VanPatten, 2002b:249).

VanPatten and his colleagues have formulated an instructional technique named processing instruction which aims at helping learners make form-meaning connections (VanPatten & Cadierno, 1993; VanPatten & Oikkenon, 1993; VanPatten, 1996). The form here refers to surface structures such as inflections and articles whereas meaning refers to the referential meaning of a particular form (VanPatten, 2002a; VanPatten, 2002b). For instance, plural –'s is a form whose meaning is *more than one.* VanPatten (2002b:242) distinguishes processing from noticing since the former requires connection between the form and its meaning. Learners may notice a form but not process it.

Processing instruction promotes explicit instruction in grammar to maximize the volume of input that is being processed. It tries to "push learners to process input in ways they would not normally do, by altering their processing strategies" (VanPatten, 2002b:244). Processing instruction has three components, the first of which is explicit instruction. That is, learners are exposed to planned and organized teaching on how a linguistic structure works. Then, they are provided with some structured input. Structured input refers to manipulated input in a way that learners have to attend to form and structure, otherwise they cannot get the meaning. Then, learners are involved in some referential activities (VanPatten, 1996; VanPatten, 2002a; VanPatten, 2002b).

The present study revealed relatively high performance on the part of the L2 learners. Nevertheless, L2 learners' performance can still be much better especially in comprehension where they are much slower than the native speakers. Therefore, we suggest that L2 learners who systematically have problems in L2 processing can benefit from processing instruction. For example, following explicit instruction on subject-verb agreement, structured input consisting of complex NPs can enrich the input learners are exposed to. NPs in the sentential subject position can be manipulated in their number as we did in the present study (i.e. SS, SP, PP and PS) so that the learners would receive input on a construction which potentially causes processing failure. Then, they could be given a referential activity such as a picture matching. For example, learners can be asked to match sentences in SS, SP, PP and PS conditions with corresponding pictures (VanPatten, 1996, chapter 3). Such an awareness raising activity would force learners to pay attention to a formal property of the language, namely plural –'s to get the meaning of the sentence as suggested by VanPatten's model.

The aim of his instructional model is to change learners' processing strategies for a better processing of input "that could subsequently be tapped for production as well" (VanPatten & Cadierno, 1993:240). Structured input and explicit instruction does not guarantee error free production of subject-verb agreement; yet, they direct learners' attention to surface features. Moreover, it should be noted here that processing instruction is not a teaching method per se, but it is a kind of input-based grammar instruction that can be given as supplement to a communicative curriculum (VanPatten, 1996; VanPatten, 2002b). In other words, it is part of a larger instructional methodology that encourages input enhancement in the sense that structured input can be helpful if given complementary to natural or authentic L2 input.

Nevertheless, the long term effects of explicit instruction has been the focus of considerable research. Numerous studies have shown failure in the long run despite explicit instruction (see Doughty, 2003 for a detailed discussion).

Limitations and Suggestions for Further Research

The findings of the present study should be considered with caution as the study does not provide conclusive results due to the following limitations. Firstly, the study involved only 19 adult native Turkish learners of L2 English who spent at least 1.5 years in an English–speaking country. This study should be replicated with a larger sample in both the L2 and the control group. A larger sample size would increase the statistical power of the analyses and solve the problem with the normality assumption of the parametric tests. In other words, the replication of this study should include more participants so that we could run an ANOVA.

Secondly, because of practicality considerations, we ran the two production tasks immediately one after another with the native speaker participants. In order to eliminate a potential carryover effect, there should have been a longer interval between the two tasks.

Thirdly, the number of the participants in the comprehension and the production tests were not the same due to some problems with the recording of the production data. We had some technical problems while recording the production data of two native speakers and an L2 speaker. That is, their data could not be recorded. Nevertheless, we did not exclude the comprehension data of those participants in order not to lose data.

There were 5 items for each experimental condition and there were no filler items in the production tasks due to time limitations. Yet, we would have gained more statistical power if we had had more items and fillers.

Moreover, the ecological validity of the sentence preamble completion task is assumed to be problematic when compared to the errors in the spontaneous speech (Vigliocco & Nicol, 1998; Bock et al. 1999). The task is quite controlled in the sense that an adjective was provided to guarantee an inflected verb. To obtain further evidence, spontaneous speech data can be collected to see whether or not similar agreement errors occur in these contexts.

Finally, in this study, we did not consider potential effects of individual differences in working memory capacity which, according to Juffs (2001), should be investigated as a separate variable in any research on sentence processing. Further research that investigates the role of working memory in L2 sentence processing might contribute to the field.

Conclusion

Overall, the present study provides valuable data to examine the question of how the subject-verb agreement mechanism operates in L2 English production and comprehension of adult native Turkish speakers. Results show that L2 speakers perform similarly with the native controls except for the slightly lower accuracy rate in the production tasks, and the longer RTs in the comprehension task. Thus, we can conclude that the two groups show comparable processing routines in subject-verb agreement computation in production and comprehension. Similar results obtained in sentence

production and comprehension suggest that similar underlying cognitive mechanisms are involved in comprehension and production of subject-verb agreement, a conclusion in line with the arguments of the markedness account (Eberhard, 1997).

Thus, we cannot claim that L2 speakers have deficiency in language processing due to a failure to integrate explicit linguistic knowledge to their implicit competence. Online production errors and comprehension latencies might simply be results of problems with processing mechanisms such as retrieval or control which is a problem that also applies to native speakers.

Furthermore, the present study gives insights into the subject-verb agreement computation in the sense that linear proximity of a potential intervening element (i.e. a plural local noun) is salient in determining the appearance of attraction errors. In other words, when a mismatching plural local noun is linearly closer to the verb, it is more likely to attract agreement errors than when it is linearly further away from the verb.

In conclusion, the present study emphasizes the importance of sentence processing studies in identifying the underlying mechanisms that govern L2 comprehension and production. Also, our study foregrounds the need for further psycholinguistic research to be carried out in different experimental paradigms to explore the exact nature of linguistic representation and processing in the end-state L2.

APPENDIX A

EXPERIMENTAL ITEMS IN THE COMPREHENSION TEST

The following items appeared in the test in 4 conditions; SS, SP, PP and PS. Each condition had its corresponding question form as exemplified in the first item. The rest of the items include only the SS form of the question for practicality purposes.

1. a) The toy for the kid was very expensive.
   b) The toy for the kids was very expensive.
   c) The toys for the kids were very expensive.
   d) The toys for the kid were very expensive.
   Question (a): Was the toy for the kid cheap?
   Question (b): Was the toy for the kids cheap?
   Question (c): Were the toys for the kid cheap?
   Question (d): Were the toys for the kids cheap?

2. a) The responsibility of the resident is mentioned in the contract.
   b) The responsibility of the residents is mentioned in the contract.
   c) The responsibilities of the residents are mentioned in the contract.
   d) The responsibilities of the resident are mentioned in the contract.
   Question (a): Is the responsibility of the resident mentioned in the contract?

3. a) The assignment for the student was rather challenging.
   b) The assignment for the students was rather challenging.
   c) The assignments for the students were rather challenging.
   d) The assignments for the student were rather challenging.
   Question (a): Was the assignment easy?

4. a) The advisor of the student is not well-informed.
   b) The advisor of the students is not well-informed.
   c) The advisors of the students are not well-informed.
   d) The advisors of the student are not well-informed.
   Question (a): Is the advisor well-informed?

5. a) The question in the exam is very difficult.
   b) The question in the exams is very difficult.
   c) The questions in the exams are very difficult.
   d) The questions in the exam are very difficult.
   Question (a): Is the question in the exam difficult?

6. a) The trainer of the team is experienced.
   b) The trainer of the teams is experienced.
   c) The trainers of the teams are experienced.
   d) The trainers of the team are experienced.
   Question (a): Is the trainer experienced?

7. a) The warning to the pilot was reported several times.
b) The warning to the pilots was reported several times.
c) The warnings to the pilots were reported several times.
d) The warnings to the pilot were reported several times.
Question (a): Was the warning reported?

8. a) The representative from the faculty was reluctant to join the committee.
b) The representative from the faculties was reluctant to join the committee.
c) The representatives from the faculties were reluctant to join the committee.
d) The representatives from the faculties were reluctant to join the committee.
Question (a): Was the representative reluctant?

9. a) The expectation of the immigrant was not met.
b) The expectation of the immigrants was not met.
c) The expectations of the immigrants were not met.
d) The expectations of the immigrant were not met.
Question (a): Was the expectation of the immigrant met?

10. a) The question to the candidate was not clear enough.
b) The question to the candidates was not clear enough.
c) The questions to the candidates were not clear enough.
d) The questions to the candidate were not clear enough.
Question (a): Was the question clear?

11. a) The decision of the manager is insensible.
b) The decision of the managers is insensible.
c) The decisions of the managers are insensible.
d) The decisions of the manager are insensible.
Question (a): Is the decision of the manager sensible?

12. a) The message to the spy was confidential.
b) The message to the spies was confidential.
c) The messages to the spies were confidential.
d) The messages to the spy were confidential.
Question (a): Was the message revealed?

13. a) The statue in the exhibition is gorgeous.
b) The statue in the exhibitions is gorgeous.
c) The statues in the exhibitions are gorgeous.
d) The statues in the exhibition are gorgeous.
Question (a): Is the statue in the exhibition gorgeous?

14. a) The nanny of the baby was very old.
b) The nanny of the babies was very old.
c) The nannies of the babies were very old.
d) The nannies of the baby were very old.

Question (a): Was the nanny young?

15. a) The error of the student was unpredictable.
b) The error of the students was unpredictable.
c) The errors of the students were unpredictable.
d) The errors of the student were unpredictable.
Question (a): Was the error predictable?

16. a) The editor of the magazine was unwilling to resign.
b) The editor of the magazines was unwilling to resign.
c) The editors of the magazines were unwilling to resign.
d) The editors of the magazine were unwilling to resign.
Question (a): Was the editor of the magazine willing to resign?

17. a) The lawyer of the robber was murdered.
b) The lawyer of the robbers was murdered.
c) The lawyers of the robbers were murdered.
d) The lawyers of the robber were murdered.
Question (a): Was the robber murdered?

18. a) The sign on the road was not visible.
b) The sign on the roads was not visible.
c) The signs on the roads were not visible.
d) The signs on the road were not visible.
Question (a): Was the sign on the road visible?

19. a) The plane at the airport is ready to take off.
b) The plane at the airports is ready to take off.
c) The planes at the airports are ready to take off.
d) The planes at the airport are ready to take off.
Question (a): Is the plane in the airport ready to take off?

20. a) The operation of the surgeon was video-taped.
b) The operation of the surgeons was video-taped.
c) The operations of the surgeons were video-taped.
d) The operations of the surgeon were video-taped.
Question (a): Was the operation video-taped?

21. a) The train to the city is expensive.
b) The train to the cities is expensive.
c) The trains to the cities are expensive.
d) The trains to the city are expensive.
Question (a): Is the train to the city cheap?

22. a) The accountant of the company is working hard.
b) The accountant of the companies is working hard.
c) The accountants of the companies are working hard.

d) The accountants of the company are working hard.
Question (a): Is the accountant working hard?

23. a) The napkin near the vase is dirty.
b) The napkin near the vases is dirty.
c) The napkins near the vases are dirty.
d) The napkins near the vase are dirty.
Question (a): Is the napkin clean?

24. a) The gift from the visitor is quite valuable.
b) The gift from the visitors is quite valuable.
c) The gifts from the visitors are quite valuable.
d) The gifts from the visitor are quite valuable.
Question (a): Is the gift from the visitor valuable?

25. a) The tree behind the house was cut down for the view.
b) The tree behind the houses was cut down for the view.
c) The trees behind the houses were cut down for the view.
d) The trees behind the house were cut down for the view.
Question (a): Is the tree cut down for the view?

26. a) The aunt of the boy was invited to the school to solve the problem.
b) The aunt of the boys was invited to the school to solve the problem.
c) The aunts of the boys were invited to the school to solve the problem.
d) The aunts of the boy were invited to the school to solve the problem.
Question (a): Was the aunt of the boys invited to the school?

27. a) The letter to the editor is quite interesting.
b) The letter to the editors is quite interesting.
c) The letters to the editors are quite interesting.
d) The letters to the editor are quite interesting.
Question (a): Is the letter to the editor read?

28. a) The main road to the hospital is sealed off.
b) The main road to the hospitals is sealed off.
c) The main roads to the hospitals are sealed off.
d) The main roads to the hospital are sealed off.
Question (a): Is the road to the hospital sealed off?

29. a) The command to the soldier is very tough.
b) The command to the soldiers is very tough.
c) The commands to the soldiers are very tough.
d) The commands to the soldier are very tough.
Question (a): Is the soldier tough?

30. a) The announcement by the anchor is not understood.
b) The announcement by the anchors is not understood.

c) The announcements by the anchors are not understood.
d) The announcements by the anchor are not understood.
Question (a): Is the announcement by the anchor clear?

31. a) The recommendation by the expert was neglected by the board.
b) The recommendation by the experts was neglected by the board.
c) The recommendations by the experts were neglected by the board.
d) The recommendations by the expert were neglected by the board.
Question (a): Was the recommendation neglected?

32. a) The form for the applicant is lost.
b) The form for the applicants is lost.
c) The forms for the applicants are lost.
d) The forms for the applicant are lost.
Question (a): Is the forms lost?

33. a) The project by the architect was approved.
b) The project by the architects was approved.
c) The projects by the architects were approved.
d) The projects by the architect were approved.
Question (a): Did they approve the project?

34. a) The nurse for the patient was working without a break.
b) The nurse for the patients was working without a break.
c) The nurses for the patients were working without a break.
d) The nurses for the patient were working without a break.
Question (a): Was the nurse working hard?

35. a) The book of the author was published last month.
b) The book of the authors was published last month.
c) The books of the authors were published last month.
d) The books of the author were published last month..
Question (a): Was the book rejected by the publisher?

36. a) The translator of the textbook is very successful.
b) The translator of the textbooks is very successful.
c) The translators of the textbooks are very successful.
d) The translators of the textbook are very successful.
Question (a): Is the translator successful?

37. a) The advertisement on the board is difficult to read.
b) The advertisement on the boards is difficult to read.
c) The advertisements on the boards are difficult to read.
d) The advertisements on the board are difficult to read.
Question (a): Is the advertisement easy to read?

38. a) The threat to the official was investigated in detail.

b) The threat to the officials was investigated in detail.
c) The threats to the officials were investigated in detail.
d) The threats to the official were investigated in detail.
Question (a): Did they investigate the official?

39. a) The interpreter of the conference is making a lot of money.
b) The interpreter of the conferences is making a lot of money.
c) The interpreters of the conferences are making a lot of money.
d) The interpreters of the conference are making a lot of money.
Question (a): Is the interpreter poor?

40. a) The ticket for the concert was sold out.
b) The ticket for the concerts was sold out.
c) The tickets for the concerts were sold out.
d) The tickets for the concert were sold out.
Question (a): Was there any ticket left?

APPENDIX B

FILLER SENTENCES IN THE COMPREHENSION TEST

1. The dean of the faculty that gave a speech today is promising.
2. The rector of the university that wrote a new book was on TV.
3. The author of the book that had a blue yacht is funny.
4. The manager of the company that resigned last week is still popular.
5. The author of the play that was killed last month was famous.
6. The doctor of the clinic that has dark blue eyes is successful.
7. The pilot of the plane that used illegal drugs is very old.
8. The child of the house that has expensive toys is lovely.
9. The accountant of the company that lives in London is well-known.
10. The captain of the ship that works out everyday impresses us.
11. The animals of the farm that had been slaughtered had been photographed.
12. The fish of the aquarium that has a small fin is lovely.
13. The poet of the poem that was arrested today shocked us.
14. The tenant of the house that came from Germany surprised us.
15. The student of the school that speaks three languages impresses us.
16. The winner of the ticket that worked in a factory disappeared.
17. The driver of the car that had a heart attack caused an accident.
18. The doctor of the hospital that examined fifty patients impressed us.
19. The gardener of the house that grows organic fruit is old.
20. The prime minister of the country that got sick yesterday is restless.
21. The ambassador of the country that resigned last week has a lot of problems.
22. The farmer of the land that got injured last week was prosperous.
23. The mayor of the city that has signed the contract celebrates the victory.
24. The queen of the country that has three children is wealthy.
25. The clown of the circus that makes children laugh is well-known.
26. The ship of the captain that was painted blue looks gorgeous.
27. The picture of the painter that was completed last year looks magnificent.
28. The statue of the sculptor that is made of bronze is interesting.
29. The restaurant of the cook that has a nice view looks attractive.
30. The farm of the farmer that has a wooden fence looks strange.
31. The house of the woman that has big windows looks weird.
32. The trip of the guide that lasted four hours was boring.
33. The house of the architect that has marble pillars looks impressive.
34. The machine of the mechanic that has many indicators works well.
35. The church of the priest that has very high walls looks mysterious.
36. The building of the engineer that has red bricks looks reliable.
37. The film of the director that was made last year was successful.
38. The symphony of the composer that was played well won the award.
39. The department of the secretary that was opened last year became well-known.
40. The orchestra of the conductor that gathered last week performed well.
41. The club of the player that was founded last year is famous.
42. The kennel of the dog that has small windows is frightening.
43. The bank of the client that had several branches went bankrupt.

44. The study of the researcher that involved many experiments is convincing.
45. The orphanage of the child that was closed last year was horrible.
46. The firm of the lawyer that is in the downtown pays a lot of tax.
47. The school of the teacher that had very high walls was depressing.
48. The bus of the driver that has emergency exits is dependable.
49. The building of the constructor that has a baroque style is new.
50. The story of the author that was in the newspaper was sad.
51. The tall man in his uniform was a very nice person.
52. The large birds eaten in the garden could not see the cat.
53. The black horse chosen at the stadium won five prizes this year.
54. The bad boys seen during the afternoon were playing in the park.
55. The young woman invited in her uniform was stressful.
56. The big cat taken into the house was trembling.
57. The fast runner noticed at the race was accused of doping.
58. The children watched in the playground started fighting.
59. The new car washed before the rain is dirty now.
60. The questions asked by the students surprised the teacher.

APPENDIX C

TRIAL SENTENCES IN THE COMPREHENSION TEST

1) The miner of the gold that had the impurities isn't worth much.
Question: Is the gold worth much?

2) The friend of the kids is notorious.
Question: Are the kids notorious?

3) The chemicals of the drug that had a nasty effect hurt everyone.
Question: Did the drug have a nasty effect?

4) The friends of my cousin are coming to my birthday party.
Question: Are my friends coming to the party?

5) The security guards in front of the store is on alert.
Question: Are the security guards on duty in front of the store?

6) The manager of the factory that had the loud voice was efficient.
Question: Was the factory efficient?

APPENDIX D

BACKGROUND QUESTIONNAIRE FOR L2 SPEAKERS

I agree to participate in this study:

Signature:_____ Name:_____

Date:_____

I. PERSONAL INFORMATION (Will Remain Confidential)

Last Name, First Name:_____

Telephone Number:_____ E-mail address:_____

Sex: Female Male:

Date of Birth:_____ Place of Birth: City:_____ Country:_____

Occupation:_____

Highest Level of Schooling: Secondary_____ High school_____ University _____

II. LINGUISTIC INFORMATION

Mother Tongue: _____

Language of Education:

Primary School:_____ Secondary School:_____

High School:_____ University:_____

Age & Place of first exposure to English: _____

How often do you use English? _____

Where do you generally use English? Home:_____Work:_____ Social:_

_____

Have you lived in an English-speaking country before?_____If so, how long did you stay there?

Country (1) _____ Age of arrival: _____ Length of stay: _____

_____

Country (2) _____ Age of arrival: _____ Length of stay: _____

_____

III. ENGLISH LANGUAGE PROFICIENCY

Have you ever taken any standardized English Proficiency Test (e.g. TOEFL, IELTS)?_____

_____

How would you rate your linguistic ability in English in the following areas?

	Beginner	Intermediate	Advanced	Near-Native
Reading				
Writing				
Speaking				
Listening				
Overall Competence				

IV. SECOND LANGUAGE(S): (besides English) _____

	Beginner	Intermediate	Advanced	Near-Native
Reading				
Writing				
Speaking				
Listening				
Overall Competence				

Thank you very much for your contribution.

APPENDIX E

BACKGROUND QUESTIONNAIRE FOR NATIVE SPEAKER PARTICIPANTS

I agree to participate in this study:

Signature:_____ Name:_____

Date:_____

III. PERSONAL INFORMATION (Will Remain Confidential)

Last Name, First Name:_____

Telephone Number:_____ E-mail address:_____

Sex: Female Male:

Date of Birth:_____ Place of Birth: City:_____ Country:_____

Occupation:_____

Highest Level of Schooling: Secondary_____ High school_____ University _____

IV. LINGUISTIC INFORMATION

Mother Tongue: _____

Language of Education:

Primary School:_____ Secondary School:_____

High School:_____ University:_____

IV. SECOND LANGUAGE(S): _____

_____

	Beginner	Intermediate	Advanced	Near-Native
Reading				
Writing				
Speaking				
Listening				
Overall Competence				

Thank you very much for your contribution.

APPENDIX F

ITEMS IN THE DECLARATIVE SENTENCE PRODUCTION TASK

The following items appeared in 4 conditions in the test but the list below includes only the singular-singular form for practicality purposes.

1. comfortable	the ferry to the island
2. retired	the judge of the court
3. well-known	the doctor of the baby
4. impressive	the study of the researcher
5. young	the producer of the documentary
6. frightening	the shark under the boat
7. complicated	the answer to the question
8. insane	the murderer of the victim
9. long	the email to the secretary
10. famous	the uncle of the girl
11. beautiful	the river along the valley
12. serious	the report by the doctor
13. lazy	the secretary of the director
14. satisfactory	the payment to the manager
15. trivial	the risk of the operation
16. disappointing	the promise of the minister
17. handsome	the actor in the movie
18. cunning	the plan of the enemy
19. important	the suggestion to the patient
20. reasonable	the idea of the expert

APPENDIX G

ITEMS IN THE QUESTION FORMATION TASK

The following items appeared in 4 conditions in the test but the list below includes only the singular-singular form for practicality purposes.

1. stressful	the protest in the street
2. subjective	the report by the officer
3. important	the problem of the teenager
4. dangerous	the side-effect of the medicine
5. old	the coach to the village
6. famous	the doctor of the soccer team
7. detailed	the comment from the editor
8. fake	the signature on the form
9. violent	the hooligan in the game
10. delicious	the cake for the guest
11. rich	the owner of the restaurant
12. unhealthy	the candy for the kid
13. colorful	the brochure for the exhibition
14. red	the bench under the tree
15. original	the invoice for the customer
16. blurry	the map of the sailor
17. confidential	the letter to the journalist
18. rusty	the key to the door
19. young	the writer of the article
20. new	the computer with the virus

APPENDIX H

TRANSCRIPTIONS

Transcriptions of the Declarative Sentence Production Task

Native Speakers

Participant 1
The promises of the minister are disappointing.
The payments to the managers are satisfactory
The judge of the courts are retired.
The producer of the documentary is young.
The doctor of the babies is well known.
The rivers along the valley are beautiful.
The ferry to the island is comfortable.
The impressive studies of the researcher are is retired.
The suggestions to the patients are important.
The murderers of the victim are insane.
The secretary of the director is lazy.
The plan of the enemies is cunning.
The actor in the movie is handsome.
The idea of the experts is reasonable.
The uncle of the girls is… something.
The shark under the boats is frightening.
The risks of the operations are trivial.
The email to the secretary was long.
The answers to the questions were complicated.

Participant 2
The risks of the operation were trivial.
The promise of the minister is disappointing.
The plans of the enemies were cunning.
The suggestions to the patient are important.
The uncles of the girls are famous.
The judges of the courts were retired.
The payments to the managers were satisfactory.
The sharks under the boats are frightening.
The actor in the movies is handsome.
The producer of the documentary is young.
The secretary of the directors is lazy.
The ferry to the islands is comfortable.
The study of the researcher was impressive.
The report by the doctor was serious.
The email to the secretaries was long.
The doctors of the baby were well-known.

The murderer of the victim is insane.
The rivers along the valley are beautiful.
The answers to the question are complicated.
The idea of the expert .. I forgot..

Participant 3
The rivers along the valleys are beautiful.
The secretary of the director is lazy.
The judge of the courts is …..empty
The actor in the movie is handsome.
The doctors of the babies are well-known.
The risks of the operation are trivial.
The plan of the enemies is cunning.
The murderers of the victim are insane.
The answers to the questions are complicated.
The producer of the documentary is young.
The payment to the managers is successful.
The promises of the minister are disappointing.
The email to the secretary is long.
The study of the researcher is ….. I have no idea.
The shark under the boats are .. is frightening.
The ideas of the expert are interesting.
The reports of the doctor are serious.
The uncle of the girls is famous.
The suggestion of the patients is important to the parent.
The ferry to the island is comfortable.

L2 Speakers

Participant 1
The murderers of the victim are insane.
The risks of the operation is operations are trivial.
The producer of the documentary is young.
The rivers along the valleys are beautiful.
The ferry to the island is comfortable.
The doctors of the babies are well-known.
The answers to the questions are complicated.
The judge of the courts …
The promises of the minister are disappointing.
The secretary of the director is lazy.
The studies of the researcher are impressive.
The email to the secretary is long.
The reports by the doctor are serious.
The uncle of the girls is famous.

The suggestions to the patients are important.
The plan of the enemies is cunning.
The ideas of the expert are reasonable.
The payment to the managers is satisfactory.
The actor in the movie is handsome.
The shark under the boat is dangerous? I forgot.

Participant 2
The ferry to the islands is comfortable.
The promise of the minister is disappointing.
The actor in the movies is handsome.
The suggestions to the patient are important.
The idea of the expert is reasonable.
The rivers along the valley are beautiful.
The doctors of the baby are well-known.
The risks of the operation are trivial.
The answers to the question are complicated.
The plans of the enemies are cunning.
The sharks under the boats are frightening.
The payments to the managers are satisfactory.
The judges of the courts are retired.
The producer of the documentaries… I don't remember
The secretary of the directors is lazy.
The uncles of the girls is famous.
The study of the researcher is impressive.
The email to the secretaries is lazy.
The report by the doctor is serious.
The murderer of the victim is insane.

Participant 3
The ferry to the island is comfortable.
The risk of the operations is trivial.
The answers to the questions is complicated.
The murderers of the victim is insane were insane.
The promise of the minister is disappointing.
The email to the secretary was long.
The reports by the doctor I forgot
The rivers along the valley were beautiful.
The payment to the managers are satisfactory.
The plan of the enemies is cunning.
The actor in the movie is handsome.
The ideas of the expert are reasonable.
The producer of the documentary is young.
The doctors of the babies were well-known.
The studies of the researcher were impressive.
Unuttum..
The judge of the courts are retired.

The secretary of the director is lazy.
The uncle of the girl is famous.
The shark under the boats is frightening.

Transcriptions of the Question Formation Task

Native Speakers

Participant 1
Are the letters to the journalist confidential?
Are the side-effects of the medicine dangerous?
Is the computer with the viruses new?
Are the cakes for the guests delicious?
Is the signature on the forms fake?
Is the candy for the kids unhealthy?
Is the invoice for the computer expensive? I don't know
Are the protests in the street stressful?
Is the writer of the article young?
Are the brochures for the exhibition colorful?
Are the keys to the door rusty?
Are the hooligans in the game oh no.. I forgot what it was.. dangerous.. violent that's what it was.
Is the map of the sailors blurry?
Is the comment from the editor detailed?
Is the owner of the restaurant?
Are the benches under the tree red?
Are the reports by the officer subjective?
Are the coaches to the villages old?
Is the problem of the teenager important?

Participant 2
Was the letter to the journalists confidential?
Was the coach to the villages old?
Are the cakes for the guests delicious?
Are the owners of the restaurant rich?
Was the protest in the street stressful?
Is the side-effect of the medicine dangerous?
Is the candy for the kid unhealthy?
Was the map of the sailor blurry?
Are the comments from the editor detailed?
Are the reports by the officer subjective?
Is the brochure for the exhibitions colorful?
Are the keys to the doors rusty?
Are the benches under the trees red?
Is the hooligan in the games violent?
Are the doctors of the soccer-teams famous?

Are the problems of the teenager important?
Is the signature on the form fake?
Are the invoices for the customer original?
Is the computer with the virus new?
Are the writers of the article young?

Participant 2
Is the bench under the tree red?
Is the key to the door rusty?
Is the candy for the kids unhealthy?
Is the coaches to the village old?
Is the side-effects of the medicine dangerous?
Is the bro.. Are the brochures for the exhibition colorful?
Is the problem of the teenagers important?
Is the owner of the restaurants rich?
Is the signatures on the form fake? Are the signatures on the form fake?
Are the computers with the viruses new?
Are the maps of the sailors blurry?
Is the cake for the guest delicious?
Is the protest in the street stressful?
Is the writer of the articles young?
Are the hooligans in the game violent?
Is the doctor of the soccer-team successful?
I don't remember..
Are the letters to the journalist confidential?
Was the report by the officer confidential?
Is the comment from the editor detailed?

Participant 3
Is the computer with the viruses new?
Are the benches under the tree red?
Are the letters to the journalists confidential?
Is the comment from the editor detailed?
Was the owner of the restaurant rich?
Is candy unhealthy for kids?
Are the hooligans in the games dangerous?
Are the doctors of the soccer-team famous?
Were the side-effect of the medicines dangerous?
Are the protests in the streets stressful?
Was the invoice for the customer original?
Is the problem of the teenager important?
Were the signature was the signature on the forms fake?
Was the map of the sailors blurry?
Were the coaches to the villages old?
Are the cakes for the guest delicious?
Was the writer of the article young?
Are the reports by the officer subjective?

Are the keys to the door rusty?
Are the brochures for the exhibitions colorful?

L2 Speakers

Participant 1
Are the owners of the restaurant rich?
Is the signature on the form fake?
Is the side-effect of the medicine dangerous?
Is the map of the sailor blurry?
Is the letter to the journalists confidential?
Are the comments from the editor detailed?
Is the brochure for the exhibitions colorful?
Is the computer with the virus new?
Are the benches under the trees I don't remember.
Are the reports by the officers subjective?
Are the doctors of the soccer-teams famous?
Is the protest in the streets stressful?
Is the coach to the villages old?
Are the keys to the doors rusty?
Is the candy for the kid unhealthy?
Is the hooligan in the games violent?
Is are the invoices for the customer original?
Are the problems of the teenager important?
Are the cakes for the guests delicious?
Are the writers of the article young?

Participant 2
Are the doctors of the soccer-team famous?
Is the comment for the editor important?
Is the map of the sailors blurry?
Are the brochures for the exhibitions colorful?
Are the is the candy for the kids colorful?
Are the protests in the streets stressful?
Are the BRANCHES under the tree red?
Are the hooligans in the games violent?
Are the letter to the journalists confidential?
Are the cakes for the guest delicious?
Are the reports by the officer …important?
Is the signature on the forms fake?
Is the side of the effect of the medicines danger?
Is the writer of the article young?
Are the coaches to the villages old?
Is the computer with the viruses new?
Is the problem of the teenager important?

Participant 3
Is the coach to the village old?
Is the protest in the street stressful?
Is the report by the officers objective?
Are the candies for the kid unhealthy?
Are the maps of the sailor blurry?
Are the side-effects of the medicine dangerous?
Are the comments of the editor detailed?
Is the cake for the guest delicious?
Is the doctor of the soccer-teams famous?
Are the owners of the restaurants rich?
Is the letter to the journalist confidential?
Are the invoices for the customers original?
Is the key to the doors rusty?
Is the brochure for the exhibition colorful?
Are the problems of the teenagers important?
Is the bench under the trees red?
Are the signatures on the form fake?
Are the computers with the virus new?
Are the writers of the articles young?
Is the hooligan in the game violent?

APPENDIX I

EXPERIMENTAL ITEMS IN THE OFFLINE GRAMMAR TASK

Which one of the following sentences in each pair sounds correct?

1. a) The reason for the delay has not been announced.
   b) The reason for the delay have not been announced.

2. a) The network of the computers were not working all day.
   b) The network of the computers was not working all day.

3. a) The textbooks for the teachers were supplied by the publisher.
   b) The textbooks for the teachers was supplied by the publisher.

4. a) The symptoms of the disease has to be observed carefully.
   b) The symptoms of the disease have to be observed carefully.

5. a) The painting in the auction was the most precious piece of art.
   b) The painting in the auction were the most precious piece of art.

6. a) The boy with the roses have been waiting for hours.
   b) The boy with the roses has been waiting for hours.

7. a)The books on the shelves were damaged because of humidity.
   b) The books on the shelves was damaged because of humidity.

8. a) The murders in the metro has not yet been solved.
   b) The murders in the metro have not yet been solved.

9. a) The beach in the town is overcrowded at this time of the year.
   b) The beach in the town are overcrowded at this time of the year.

10. a) The thief of the cars were caught red-handed.
    b) The thief of the cars was caught red-handed.

11. a) The footballers in the team is not motivated enough to win.
    b) The footballers in the team are not motivated enough to win.

12. a) The complaints about the products were discussed in the meeting yesterday.
    b) The complaints about the products was discussed in the meeting yesterday.

13. a) The computers in the laboratory is upgraded every year.
    b) The computers in the laboratory are upgraded every year.

14. a) The headline in the newspaper are about the embezzlement by the president.
    b) The headline in the newspaper is about the embezzlement by the president.

15. a) The trench for the soldiers was dug in ten days.
    b) The trench for the soldiers were dug in ten days.

16. a) The leader of the rebels were sentenced to death.
    b) The leader of the rebels was sentenced to death.

17. a) The fountains in the park is cleaned once in two months.
    b) The fountains in the park are cleaned once in two months.

18. a) The results of the tests are going to be announced on our website.
    b) The results of the tests is going to be announced on our website.

19. a) The signature on the form is claimed to be fake.
    b) The signature on the form are claimed to be fake.

20. a) The decision about the refugees have to be taken urgently.
    b) The decision about the refugees has to be taken urgently.

21. a) The guards in the garden are always armed.
    b) The guards in the garden is always armed.

22. a) The documentary about the war were directed by a famous actor.
    b) The documentary about the war was directed by a famous actor.

23. a) The resignation of the minister have led to chaos in the cabinet.
    b) The resignation of the minister has led to chaos in the cabinet.

24. a) The names of the participants are ordered alphabetically.
    b) The names of the participants is ordered alphabetically.

25. a) The reason for the demonstrations are the dramatic increase in tax rates.
    b) The reason for the demonstrations is the dramatic increase in tax rates.

26. a) The buildings in the city were restored after the earthquake.
    b) The buildings in the city was restored after the earthquake.

27. a) The titles of the chapters is listed in the content page.
    b) The titles of the chapters are listed in the content page.

28. a) The passports of the passengers are checked by the police.
    b) The passports of the passengers is checked by the police.

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