HEAVINESS AND EXTRAPOSITION EFFECT ON THE PROCESSING OF SENTENTIAL SUBJECTS BY L1 AND L2 SPEAKERS

MA THESIS

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MA in English Language Teaching
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ÖZET

TÜMCESEL ÖZNELERİN ANA DİL VE İKİNCİ DİLDE İŞLENMESİNDE UZUNLUK VE DIŞA KAYDIRMA KURALININ ETKİSİ

Deniz Hande ÇAKMAK

Yabancı Dil Eğitimi Anabilim Dalı
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Danışman: Prof. Dr. Ümit Deniz TURAN

Bu tez, İngilizcede tümcecik olan öznelerin tümce işlemesine odaklanmaktadır. Özne uzunluğu ve bunun alternatifi olarak özneyi dışa kaydırma kuralının tümcesel öznelerin ikinci dilde işlemede rolü olup olmadığını ortaya çıkarmayı amaçlamaktadır. Bu amaçla yapılan kendi hızında okuma deneyine katılan katılımcılar ana dili Türkçe olan (S=13), ana dili Almanca olan (S=10) ve ana dili İngilizce olan (S=13) olmak üzere üç gruptan oluşmuştur. Deneyde kullanılan tümceler ve veri toplama süreci İngilizce olduğu için ilk iki grubun CEFR'a göre en az B2 düzeyinde İngilizce bildikleri TOEFL veya IELTS sonuçları ile kanıtlanmıştır. Çalışma için tasarlanmış olan kendi hızında okuma deneyi sırasında katılımcılara tümcesel öznelerin farklı uzunluklarda ve farklı konumlarda olduğu tümceler gösterilmiş ve katılımcıların özne ve yüklemi okuduktan sonraki okuma süreleri istatistiksel olarak incelenmiştir. Deneyin sonucunda elde edilen bulgular yüklemi işlemenin ana dili ve ikinci dili İngilizce olan kişiler arasında farklılık gösterdiğini ortaya koymaktadır. Bu çalışmanın sonuçları, önceki kuram ve araştırmaların ışığında da tümce işleme sürecinde ögelerin işlemesinde yüklemin önemli bir unsur olduğunu göstermiştir. Ayrıca, bellekte saklanan sözcük sayısının da tümce işlemede önemli bir etken olduğu gözlenmiştir.

Anahtar Sözcükler: Tümce işleme, Performans kuramı, Tümcesel özneler, Uzun özne, Dışa kaydırma kuralı.

ABSTRACT

HEAVINESS AND EXTRAPOSITION EFFECT ON THE PROCESSING OF SENTENTIAL SUBJECTS BY L1 AND L2 SPEAKERS

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This thesis focuses in the sentence processing of sentential subjects in English and tries to find out if the phenomenon "heavy-NP shift" and "extraposition" of sentential subjects in different sentential subject length and sentential subject position conditions play a role in sentence processing in L2. The participants were composed of three native-language groups, Turkish native speakers (N=13), German native speakers (N=10) and English native speakers (N=13). Since the data collection process was English, the first two groups showed their English proficiency, B2 at the lowest level due to the level of the experimental items according to CEFR. A self-paced reading experiment, during which sentences with sentential subjects in English at different lengths and in different positions, were shown to the participants and statistical analyses were applied to the reading times of the participants while they were processing the subject and the verb. The result yielded that verb processing was the one which different between L1 and L2 speakers of English and this thesis proposes in the light of the previous theories and studies that these results may have been observed as seeing the verb, as the head of a constituent, starts the attachment of the dependent constituents to the head, which is another stage in sentence processing after storing the previously seen words one by one.

Keywords: Sentence processing, Performance theory, Sentential subjects, Heavy-NP shift, Extraposition.

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Deniz Hande ÇAKMAK

2023

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ETİK İLKE VE KURALLARA UYGUNLUK BEYANNAMESİ

Bu tezin bana ait, özgün bir çalışma olduğunu; çalışmamın hazırlık, veri toplama, analiz ve bilgilerin sunumu olmak üzere tüm aşamalarında bilimsel etik ilke ve kurallara uygun davrandığımı; bu çalışma kapsamında elde edilen tüm veri ve bilgiler için kaynak gösterdiğimi ve bu kaynaklara kaynakçada yer verdiğimi; bu çalışmanın Anadolu Üniversitesi tarafından kullanılan "bilimsel intihal tespit programı"yla tarandığını ve hiçbir şekilde "intihal içermediğini" beyan ederim. Herhangi bir zamanda, çalışmamla ilgili yaptığım bu beyana aykırı bir durumun saptanması durumunda, ortaya çıkacak tüm ahlaki ve hukuki sonuçları kabul ettiğimi bildiririm.

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I hereby truthfully declare that this thesis is an original work prepared by me; that I have behaved in accordance with the scientific ethical principles and rules throughout the stages of preparation, data collection, analysis and presentation of my work; that I have cited the sources of all the data and information that could be obtained within the scope of this study, and included these sources in the references section; and that this study has been scanned for plagiarism with "scientific plagiarism detection program" used by Anadolu University, and that "it does not have any plagiarism" whatsoever. I also declare that, if a case contrary to my declaration is detected in my work at any time, I hereby express my consent to all the ethical and legal consequences that are involved.

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LIST OF ABBREVIATIONS

AH :Accessibility Hierarchy

CRD : Constituent Recognition Domain

DLT :Dependency Locality Theory

EIC : Early Immediate Constituents

IC : Immediate Constituent Attachment

MaOP : Maximize Online Processing

MiD : Minimize Domains

MiF : Minimize Forms

MNC : Mother Node Construction

NP : Noun Phrase

PCD : Phrasal Combination Domains

PP : Prepositional Phrase

PPP : Preliminary Phrase Packager

SPLT : Syntactic Prediction Locality Theory

S : Sentence

SSS : Sentence Structure Supervisor

VP : Verb Phrase

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1. INTRODUCTION

The aim of this thesis is to find out the details of sentence processing in L2 and this chapter introduces the previous studies, theories and models about this phenomenon in language processing, which inspired the researcher. It also briefly introduces the aim, methodology and findings.

1.1. Background of the Study

Language processing and comprehension are complex tasks because thinking, reasoning and working memory take part in the process (Just & Carpenter, 1992). This complexity has led various scholars (e.g. Frazier & Fodor, 1978; Lewis & Vasishth, 2005; Rayner, Sereno, Morris, Schmauder & Clifton, 1989) to focus on the details of this process in different forms of language processing, one of which is sentence processing as it includes immediate and on-line processing (Rayner et al, 1989) which requires working memory. Different studies have been carried out in order to answer the question "how are linguistic relations established in sentence processing –exactly what are the working-memory processes that bring prior linguistic material into contact with present material, and what are the constraints on those processes? (Lewis & Vasishth, 2005, p. 376)". While different theories and models have been proposed, they all agree that working memory is an important component in sentence processing. This is because a sequence of inputs have to be stored in working memory so that they can be processed as constituents at a later stage and the processors can make connections between earlier and later constituents. Different theories and models have been proposed but they all agreed that working memory is an important component in sentence processing as a sequence of inputs have to be stored in working memory so that they can be processed as constituents at a later stage and the processors can make connections between earlier and later constituents (Just & Carpenter, 1992). However, working memory has a limit and storing the inputs becomes more challenging as the number of the inputs increases, which results in working memory load (Frazier & Fodor, 1978) and this limit has been determined to be five to six words (Frazier & Fodor, 1978; Gibson, 1998; Hawkins, 1994). When the number of the words to be stored exceeds this limit, it becomes more challenging for the processors to retrieve the previously seen words.

Parsing the sentences into phrases is a method that processors apply while processing the sentences. This eases sentence processing (Hawkins, 1990) as it allows processors to attach the words to a higher node (Marcus, 1980). In this way, processors can process the previous inputs as an entire phrase which decreases working memory load. However, when the number of words in the phrase increases, this again creates difficulty in processing. The processors will need to retrieve more words in order to attach the words to a higher node when the processor has seen the entire phrase. The locality of constituents in a sentence is a factor which also plays a crucial role in sentence processing, as suggested by "locality theory" (Gibson, 1998). Sentence processing is a complex process which includes the understanding of the mechanism of the sentence structure, the storage of the previously seen words and the retrieval of the words in order to attach them to a higher node (the head of a constituent). The attachment of the words to a higher node provides the sentence processor with the integration of the words into an entire phrase structure and this results in comprehension. The position of the head and its dependents also play an important role in this process because of the limited working memory capacity (Gibson, 1998). That is why keeping the distance between the head and its dependents will contribute to processing ease. It is because the processors will not have to store as many words before seeing the head and its dependents in order to attach the dependents to the higher node and end the process.

Performance Theory proposed by Hawkins (1990, 1994, 2004), also highlights the importance of the position of the constituents in a sentence in order to ease the processing. Previous suggestions were made by several scholars (e.g. Bever, 1970; Fodor, 1978; 1983) in order to find an answer to the question if there is a correlation between performance and competence. In light of these suggestions, Hawkins (1990, 1994, 2004, 2014) claims in his theory that some alternatives to the canonical word orders are observed and it becomes easier to process the sentence, which he defines as "Early Immediate Constituent (EIC)"principle. This principle in "Performance Theory" highlights the importance of word order to ensure easier sentence processing. Namely that sentence processors prefer a word order where the constituents of a higher structure are seen immediately (Hawkins, 1990). This supports Hawkins' proposal (1990, 1994, 2004, 2014) which states that that performance actually has an impact on "the rules, principles and constraints on grammar" (Hawkins, 2014, p. 64) in order to ease the

processing of a sentence with the help of alternatives to the grammatical rules of the language; on the contrary to the assumption by Chomsky (1965), supporting the idea that performance and grammatical competence are independent from each other and competence is not shaped by performance.

According to EIC principle, this preference results from a decrease in the number of the words to be stored in working memory as a result of the short distance between the head and its immediate constituents. Examples (1) and (2) below are examples which show the different distances between the head and its dependent constituents.

(1) The man [$_{VP}$ looked [$_{PP1}$ for his son] [$_{PP2}$ in the dark and quite derelict building]]

1 2 3 4 5

(2) The man [$_{VP}$ looked [$_{PP2}$ in the dark and quite derelict building] [$_{PP1}$ for his son]]

1 2 3 4 5 6 7 8 9

(Hawkins, 2014, p. 12)

Both of the examples above are sentences with the same head and constituents in their verb phrases (VP). The only difference between these two sentences is the position of the constituents, namely their distance from the head. Distance is measured with the number of the words between the head and its dependents. While the constituent between the head and one of its dependent constituents is composed of 3 words –which is considered as the distance– in Example (1), this distance is longer in Example (2). The assumption of EIC about the processing and preference of these sentences is that processors prefer Example (1) as they see the immediate constituent earlier and keep the distance between the head and its dependent shorter. Additionally, in Example (2), processors have to see more words and store them in working memory until they see the second prepositional phrase (PP2), which makes it harder to retrieve the previous constituent and the head.

"Heavy-NP shift", as a specific case of EIC, occurs in sentences with heavier (longer) noun phrase (NP) and shorter prepositional phrase (PP) and NP, as the longer constituent moves to the end by "saving the hardest for the last" (Bever, 1970), as shown in Examples (3) and (4).

(3) I $_{VP}$[gave $_{NP}$[the valuable book that was extremely difficult to find] $_{PP}$[to Mary]

(4) I $_{VP}$[gave $_{PP}$[to Mary] $_{NP}$[the valuable book that was extremely difficult to find]]

(cf. Ross, 1967)

The canonical order of sentences with NP and PP in English is VP[V NP PP], as seen in Example (3). However, this order needs more words to be stored before seeing the other constituent PP, which affects the attachment process of the constituents to the higher node, verb, negatively because of the distance. However, in Example (4), it becomes easier for processors to process and attach both of the constituents to the verb thanks to the early appearance of the shorter constituent PP. This phenomenon, the movement of the heavier (longer) constituent to the end in order to ease sentence processing, is called "heavy-NP shift". The movement of the longer NP results in a change in the position of the shorter constituent in the sentence and it is called "extraposition" (Arnold, Losongco, Wasow & Ginstrom, 2000). In Example (4), for instance, the longer NP moves to the end of the sentence and it is extraposed with the shorter constituent PP in an earlier position. "Performance Theory", in light of this phenomenon, assumes that processors prefer the alternative word ordering short-before-long in English, like in Example (4) in order to ease processing.

Several scholars state that this short-before-long preference can be generalized to all the languages as this phenomenon is independent from languages (e.g. Behaghel, 1932; Gil, 1986) as the working memory load is the same among the speakers of different languages. However, Hawkins (1990, 1994, 2004, 2014) states that this approach is an overgeneralization due to the fact that the canonical position of the verb head affects constituent order preference in order to keep the distance between the head and its immediate constituent short. This assumption resulted in the consideration of another aspect in heavy-NP shift, the effect of "head-ordering" classification of languages according to their canonical word order: "head-initial" languages (e.g. English) and "head-final" languages (e.g. Japanese, Turkish, and German) (Hawkins & Cutler, 1988; Hawkins & Gilligan, 1988), which Hawkins (1990, 1994, 2004, 2014) took into consideration while proposing Performance Theory. The predictions of Early Immediate Constituents (EIC) in this theory shows that "the directionability of

movement in different language types"(Hawkins, 1990, p. 247) and preferred constituent order differs in languages as a result of the word order. In order to keep the distance between the verb head and its constituents short to decrease working memory load, long constituents have a tendency to move to an earlier position. This is known as long-before-short preference. The findings of several experimental and corpus studies yielded that Japanese, as a head-final language –which does not allow any change in the position of the verb head, shows this opposite tendency (long-before-short), which is discussed in Section 3 of Chapter 2. German, as another head-final language –which allows for a change in the position of the verb head, also showed long-before-short tendency, with an additional alternative head-initial ordering instead of the canonical head-final ordering. While Turkish, a head-final language with flexibility in word order due to its case markers, showed a weaker prediction of EIC in terms of long-before-short preference. The flexibility of the word order means that both opposite constituent orders are equally grammatical and acceptable. This is presented in Section 3 of Chapter 2, which focuses on the cross-linguistic variation in the phenomenon.

A specific case of heavy-NP shift is the movement of the sentential subject to the end of the sentence. When this occurs, the sentential subject is extraposed with the pronoun "it" in order to ease processing by locating the verb head in an earlier position (Dryer, 1980).

(5) That John is tall is obvious.

(6) It is obvious that John is tall.

(Dryer, 1980, p. 124)

Examples (5) and (6) are examples of "subject-it extraposition". In Example (5) the sentential subject is in a canonical position with the subject moved to the end of the sentence, where is extraposed with the pronoun. This alternative constituent order eases the processing in English, as the verb head appears earlier and processors can attach the upcoming words to the verb head without working memory load. Dryer (1980) also states that this tendency can be observed in unrelated languages and it is a universal grammar issue.

This specific phenomenon can be observed in other languages, one of which is Turkish (Dryer, 1980). Turkish has an extraposed word order as an alternative to the canonical position of the sentential subject with the usage of the Turkish morpheme "ki", as seen in Examples (7) and (8) below.

(7) Mehmet'in sarhoş olduğu belli.

Mehmet POSS drunk be nom-3sg, poss obvious

"That Mehmet is drunk is obvious".

(8) Belli ki Mehmet sarhoş-tur.

obvious comp Mehmet drunk-is

"It is obvious that Mehmet is drunk"

(Dryer, 1980, p. 36)

Turkish has the extraposition of the sentential subject in the same way as English, as a head-initial language. While the sentential subject in Example (7) is in canonical position, the same subject is extraposed with the use of "ki". This occurs as a result of the flexibility of Turkish in terms of constituent order and both sentences are equal in terms of preference and acceptance.

1.2. Statement of the Problem

The current literature highlights the importance of working memory load in sentence processing (Frazier & Fodor, 1978; Gibson, 1998; Hawkins, 1994). Some of the factors that affect working memory load are the length differences between the dependent constituents of a head (Gibson, 1998, 2000; Hawkins, 1990, 1994, 2004) and the movement of the heavier (longer) constituent is a phenomenon which occurs in order to ease processing (Hawkins, 1990, 1994, 2004) as well as extraposition, which is explained by Early Immediate Constituents (EIC) principle of Performance Theory proposed by Hawkins (1990, 1994, 2004). The theory suggests that for easier processing, sentence processors prefer seeing the head as early as possible. The aim of this preference is to shorten the distance between the head and its dependent as much as possible in order to decrease the working memory load. Generally, it results in

alternative word orders. (Hawkins, 1990, 1994, 2004), which is called “heavy-NP shift”. This phenomenon can be observed in many cases (e.g. object movement), and heavy-NP shift of sentential subjects is one of them. In order to avoid processing difficulty, there is an alternative word order for sentences with sentential subjects. In this alternative order, the sentential subject of a sentence is moved to a later location and it is extraposed by the pronoun “it” (Dryer, 1980). However, there is another factor, cross-linguistic variation according to head ordering, which should also be considered. Cross-linguistic variation, as another aspect of the phenomenon, has recently been studied in depth and these studies found out that the canonical head ordering of a language plays a role in the direction of the movement of the heavier constituents (Hawkins, 2014). The findings of various experimental and corpus studies (Dryer, 1980; Hawkins, 2014; Ueda, 1984; Yamashita & Chang, 2001) yielded that shorter constituents have a tendency to appear at an earlier position in head-initial languages while head-final languages have the opposite tendency.

Heaviness and extraposition have been the focus of many studies in terms of processing and production. However, these phenomena were investigated and observed in L1 context. Studies which aim to investigate the phenomenon and its role in sentence processing in L2 are also needed in the literature in accordance with the head-ordering differences between L1 and L2. These studies will have significant contributions to a better understanding of sentence processing in L2 as well as putting this understanding into practice and updating course design, course materials and evaluation processes in language learning context. Another point worthy to mention about the problem is that the current literature sheds light on the phenomenon in object movement. However, heavy-NP-shift occurs in more cases, one of which is sentences with sentential subjects. Aiming to observe the phenomenon in different cases will provide researchers a deeper understanding of the role of constituent length and position in sentence processing in L2.

In light of the previous studies and the problem in literature, the aim of this study is to investigate if the predictions of Early Immediate Constituents are observed in sentence processing in L2 and if there is a difference between the L1 and L2 speakers of a language during the processing performances of sentential subjects with different lengths and in different positions. The items used throughout the experiment were in English because it is a head-initial language which allows heavy-NP shift in sentential

subjects. In order to better observe the difference, non-native speakers of English whose L1 and L2 are in different head-ordering classification proposed by Hawkins and Cutler (1988) and Hawkins and Gilligan (1988) were determined as L2 speaker groups. This allowed the researcher to investigate the cross-linguistic variation effect on sentence processing in L2.

1.3. Significance of the Study

The significance of this thesis can be defined from theoretical and practical perspectives. As mentioned in the problem statement above, the effect of heaviness and extraposition on sentence processing by L2 speakers has not been thoroughly investigated and explained by processing ease theories. This thesis investigates the effect of the length and position of the sentential subjects has on the processing of sentences by L1 and L2 speakers. This thesis also contributes to the literature with an experimental study of sentence processing in L2 based on Performance Theory by Hawkins (1990, 1994, 2004) and locality theories by Gibson (1998, 2000), which are both processing ease theories. The inclusion of cross-linguistic variation aspect (Hawkins, 2014) in the investigation of the impact of length and position of sentential subjects is another factor making this study significant. It was found in different studies that head-ordering also plays a role in the word order preferences of sentence processors. However, the effect of word order preferences in L1 on sentence processing in L2 has not been studied thoroughly. This thesis contributes to the literature by investigating sentence processing from this aspect as well.

1.4. Aim and Scope of the Study

All the studies and theories about the importance of word order sentence processing discussed in the previous section in detail have been the main motivation of this thesis. Whether the effect of the position of longer or shorter constituents in a sentence has been argued for decades and there have been several different approaches claiming different proposals. “Locality-based theories” proposed by Gibson (1998, 2000) and Hawkins (1990, 1994, 2004) suggest that the position of the constituents depends on their length. Based on these theories, the shorter constituent has the tendency to be adjacent to the head in order to ease syntactic processing. In accordance

with the previous theories, Hawkins (2014), proposing Performance Theory, claimed that different languages have different tendencies of word order based on their canonical position and constituent length, and that this results in moving the long constituent to the end of a sentence. Hawkins (2014) supports his proposal by giving examples from head-initial languages (e.g. English) and head-final languages (e.g. Japanese) and by comparing their preferred word orders while considering constituents which vary in length. According to this theory, head-initial languages tend to place the long constituent at the end of the sentence while head-final languages tend to do the opposite. However, "probabilistic theories" and "information-based theories" propose that sentence processors prefer to see the new information in the sentence first in order to obtain a meaningful sense of the sentence. This automatically results in the appearance of the long constituent before the shorter one. Additionally, the longer a constituent is, the easier it becomes for the processor to predict the upcoming item as the number of the possibilities decreases as the processor sees items. When all these points are considered, this current thesis aims to find answers to several questions, which are listed below:

- Is there any difference between the processing of sentences with sentential subjects at different lengths between L1 and L2 speakers of English?
- Is there any difference between the processing of sentences with sentential subjects in situ and their extraposed counterparts between L1 and L2 speakers of English?
- Do the subject position and subject length of sentential subjects have any effect on the processing of sentences between L1 and L2 speakers?

Chapter 1, as the current chapter, introduces various theories and previous studies on sentence processing and the aim of the study with its research questions. Chapter 2 presents the importance of working memory in sentence processing and different approaches to the phenomenon in detail.

2. LITERATURE REVIEW

By reviewing and synthesizing the available literature, this chapter aims to establish a theoretical framework in order to emphasize the background, which the research questions and aim of the current study were inspired by, so that the aim and scope of the study can be thoroughly explained in Chapter 3. This current chapter firstly focuses on the notion of language processing and the role of working memory throughout the process. This section is followed by several approaches to sentence processing and the aspect of cross-linguistic variation.

2.1. The Basis of Language Processing

Language comprehension, in general, is among the most complex tasks such as thinking and reasoning for which working memory is important (Just & Carpenter, 1992). During the task, the processor needs to keep in mind "the theme of the text, the representation of the situation to which it refers, the major propositions from preceding sentences, and a running, multilevel representation of the sentence that is currently being read (Just & Carpenter, 1992, p. 122)". This makes language processing a very good example of a demanding working memory task.

As a specific phenomenon of language processing, sentence and text comprehension and the impact of immediate, on-line processes has on them have drawn the attention of many researchers over the last decades (Rayner et al., 1989). This is because it is well-known that the length of a sentence is not naturally or grammatically limited to a certain word amount (Yngve, 1960). In that case, predicting that the language user has to see the entire sentence before starting to process or form it is not very rational (Yngve, 1960) and the only method that processors apply was to store the items in working memory. Nevertheless, proper decisions about the structure of a sentence are not completely explained by the final representation of a sentence and the meaning of a sentence is based on a word-by-word representation (Rayner et al., 1989). This awareness led researchers to attempt to investigate several key questions about sentence processing such as "how and when does the parser make the decision to assign a word to the current constituent unit or not to begin a new unit? (Rayner et al., 1989, p. 1)".

Sentence processors tend to parse sentences into phrases in order to obtain a hierarchical structure so that they can ease the comprehension process (Hawkins, 1990).

Assumptions by different scholars were made intending to find out how this grouping takes place. Marcus (1980) suggested that the mother nodes are formed when the input determines the nodes. In accordance with this, the sentence processor will only stop looking ahead when they can make the inference of a higher constituent structure to some extent. Along the same lines, the assumption by Fodor (1983) claims that the human parser immediately starts the compulsory parsing process when they see the input triggering the process. These compatible assumptions explain the role of "preference for speed and constituency decision-making from contextual info (Hawkins, 1990, p. 6)" in sentence processing.

In accordance with the assumptions mentioned above, several scholars have conducted theoretical and empirical studies in order to investigate the details of sentence parsing, such as the work of Frazier and Fodor (1978), a sentence parsing model "The Sausage Machine" and the proposal by Bock (1982), three modes of processing, both of which will be mentioned in details below.

2.1.1. The Sausage Machine, as a sentence parsing model by Frazier and Fodor

Frazier and Fodor (1978, p. 291) proposed that "the human sentence parsing device assigns phrase structure to word strings in two steps". In the first stage, lexical and phrasal nodes are assigned to substrings of approximately six words, and as a result phrasal packages are formed. This is called the Preliminary "Phrase Packager (PPP)". In the second stage of the parsing process, higher nodes are included in order to connect the phrasal packages into a complete phrase marker. This is called the "Sentence Structure Supervisor (SSS)". The first step, PPP, is considered a more short-sighted device which computes several words at a time. The number of adjacent words which are viewed at a time are limited to five to six words (Frazier & Fodor, 1978). Although it is a short-sighted device, it provides the next stage, SSS, with phrase markers in order to be able to follow the phrases and dependencies spread throughout the sentence and analyze the sentence as a whole. Frazier and Fodor (1978) called the whole process "The Sausage Machine".

Frazier and Fodor (1978) formed this model in light of the two previous models proposed by Kimball (1973) and Fodor, Bever and Garrett (1974). Even though these two models were based on the two parsing stages, and are quite similar to The Sausage Machine, there is an important difference between them. Kimball (1973) suggested that

the human parser includes any lexical item into a phrase as soon as they see and change the location of the relevant item after the whole sentence is presented. While Fodor, Bever and Garrett (1974) proposed that the human parser first scans the whole sentence in order to catch some clues about the location of lexical items in different phrases and then tries to locate the items into the appropriate phrases (Frazier & Fodor, 1978). The difference between the two models is basically the time when the location of the items is changed, either before or after the phrases and items are attached. The Sausage Machine model was proposed by Frazier and Fodor (1978) who disagreed with the suggestions of the previous models. Frazier and Fodor (1978) stated that they focused on the size of the phrases instead of syntactic status. Also, Frazier and Fodor (1978) highlight that sentence complexity for a human parser cannot be well-predicted by sentence length. However, the number of units stored in working memory is relatively limited and it takes more time to retrieve previous information and attach it into a phrase in a sentence. At this point, it can be concluded that the operations of the parser are significantly affected by the limitation of working memory (Frazier & Fodor, 1978).

In order to be able to clarify this phenomenon, a proper explanation of sentence complexity is needed. Frazier and Fodor (1978) approached sentence complexity from two different perspectives, both of which were based on the restriction on working memory. The first explanation describes sentence complexity as the number of nodes of phrase markers which need to be stored at the same time. On the other hand, the second explanation focuses on the number of the mistakes made by the parser while processing the phrase marker as many nodes cannot be stored concurrently.

Restriction on working memory considerably affects how many lexical items can be stored. It also plays a role in keeping track of the following lexical items as well as retrieving the previous items before the relevant item (Frazier & Fodor, 1978). Since keeping track of the items and parsing or placing the items into the appropriate locations in a sentence will cause an excessive amount of memory load, PPP by itself will not be enough for parsing. That is why human parsers also need the second stage SSS in order to form the whole phrase marker (Frazier & Fodor, 1978).

2.1.2. The modes of processing by Bock (1982)

Bock (1982) approached sentence processing by focusing on the components and modes of processing. Bock (1982, p. 7) stated that there are three modes of processing, the "automaticity in processing", "the characteristics of controlled processing" and "flexible balancing of automatic and controlled processing to achieve optimal use of available processing resources". Automaticity in processing basically focuses on the three principles explained below:

- The process should not include any awareness
- The processing may occur without an intention
- The processing should overlap with other processes

Besides the fundamentals listed above, other "prerequisites of automatic processing" also have a significant impact on sentence processing. These are "phrase structure and alternative realizations" and "syntactic conventions and constituent ordering biases (Bock, 1982, pp. 8-9)". Bock considered these features as the explanation for the preference of the human parser for constituting mapping relationships during sentence processing. One striking example of this phenomenon was observed in the study of Svartvik (1966), findings revealed the prominent preference of active sentences in spoken English compared to passive use mostly in technical writing and psycholinguistics experiments. Controlled processing is another aspect of sentence processing, which was suggested by Bock (1982). Controlled processing includes a second task, during which the processor needs to perform in addition to the main task and strategies to cope with the process (Bock, 1982). This type of processing is more related to conversational language use and it includes purposeful involvement. Since controlled processing consists of a conversational purpose, the process results in the preference of different structures according to the goal of the communicative demand (Bock, 1977). As the last mode of processing, processing flexibility claims that when the task is not an automated one, the performance of language will also be shaped according to the purposeful conversational process, which requires capacity investment as the information to use changes and it occurs in a limited amount of time. (Bock, 1982).

2.2. Processing Ease Theories

In light of these sentence processing models and theories, several theories and hypotheses regarding what has an impact on processing ease were proposed by several researchers, and these different approaches will be presented under three main groups: "probabilistic approach", "information-based approach", "locality-based approach".

2.2.1. Probabilistic approach

Probabilistic approaches to language processing basically claim that longer sentences are more manageable and easier to process. They provide the sentence processor with more information and clues about the continuation of the sentences. The "Probabilistic Theory" by Miller and Chomsky (1963) established the basis of this approach and it was then advocated by Hale (2001), Lewis and Vasishth (2005), Levy (2008) and several other scholars, all of which are introduced below.

2.2.1.1. *Probabilistic Theory*

Miller and Chomsky (1963) provided the literature with one of the milestones of probabilistic theory for sentence processing, based on "Markov sources". Markov sources claimed that any kind of segment can be computed by considering all the probabilities before and after each item. However, Miller and Chomsky (1963) found it too simple for such a complex process. They developed a more detailed theory because they thought that human messages included more than just long strings and symbols, on the contrary to the suggestion of Markov sources. They suggested that language production and processing is a complex process which includes stages varying from the simplest responses to complex structures. Thus sentence processors should perform a computational process in order to be able to predict the following parts of the phrases or sentences. Considering these probabilities, sentence processing should be relatively easier because the processor sees more parts of the sentence, the number of probabilities decreases. Miller and Chomsky (1963) proposed this theory according to several probability measures, suggested in the literature. "Information and Redundancy" measurement (Frick & Miller, 1951; Miller & Frick, 1949) takes the sequences of behavior into consideration in order to measure and estimate the probabilities according to the complexity of the behavior. "Degree of Self-embedding" is another measurement

based on the complexity of the process outside the language and language-mediated behaviors, taking into account that non-linguistic contexts are also an important factor in sentence processing (Miller & Chomsky, 1963). “Depth of Postponement” by Yngve (1961) examines the capacity of the sentence processor to process complicated instructions and plans, which is another crucial aspect of processing to be considered. “Structural Complexity” and “Transformational Complexity” are the last two essential measurements. They focused on the effect that the number of nodes has in the hierarchy and the transformation of a previously seen structure into a similar structure, respectively (Miller & Chomsky, 1963). Based on these aspects of the different approaches and measurements, Miller and Chomsky (1963) stated that sentence processors are able to use previously seen structures as a guide in order to compute the probabilities and process sentences more rapidly and efficiently. Thus “repeated observations under many different conditions are required before a meaningful estimate is available”(Miller & Chomsky, 1963, p. 485), because it requires the involvement of all the measurement approaches mentioned above.

2.2.1.2. *Expectation-based Syntactic Theory*

In order to discuss “Expectation-based Syntactic Theory”, which was suggested by Levy (2008), it is important to understand “Surprisal Theory” by Hale (2001). This is because Levy (2008) proposed the relevant theory as an alternative to the one suggested by Hale (2001). Hale (2001) presented the other side of the probabilistic theory by suggesting Surprisal Theory, which approaches processing differently. The findings of the study indicated that the processor can predict what type of item is coming. However, the place of the item in a sentence and the time when it will appear are still uncertain. This results in a longer processing time.

In response to Hale’s approach (2001), Levy (2008) also developed another theory based on Probabilistic Theory. Although Levy (2008) did not ignore the impact sentence and phrase length has on memory, he presented a different perspective for sentence comprehension. He argued that sentence processors would be able to predict the upcoming word in the phrase or sentence as they obtain more information about the context. This would narrow down the probable words for the next lexical item (Levy, 2008). He also stated that this is especially observed in verb-final languages such as Japanese, German and Hindi. To support this perspective, he presented the study of

Konieczny (2000) and Konieczny and Döring (2003), experimental studies conducted in German.

(9) Er hat den Abgeordneten begleitet, und …

He has the delegate escorted, and …

"He escorted the delegate, and …"

(10) Er hat den Abgeordneten ans Rednerpult begleitet, und …

He has the delegate to the lectern escorted, and …

"He escorted the delegate to the lectern, and …"

(11) Er hat den Abgeordneten an das große Rednerpult begleitet, und …

He has the delegate to the big lectern escorted, and …

"He escorted the delegate to the large lectern, and …"

(Levy, 2008, p. 1145)

After each constituent, the expectation for the type of the following word increases, this will result in the sharpening of the location of the verb as the length of the clause increases (Levy, 2008). Levy (2008) also stated that this pattern was not only specific to verb-final languages and it can also be observed in verb-initial languages, such as English.

Lewis and Vasishth (2005) are also among the scholars who have explored the role working memory has on sentence processing. They proposed a theory similar to that suggested by Levy (2008), which advocated probabilistic theory, stating that reading time shortens as length increases and in light of the relevant theories, they suggested an activation-based model of sentence processing.

2.2.2. Information-based approach

Another approach that focused on identifying the factors affecting sentence processing namely on the new and given information presented in the sentence. This actually focused on why people utter sentences in different orders (Arnold, Kaiser, Kahn, Kim, 2013) and tried to understand how word order variation is affected by

information structure (Arnold et al., 2013). Chafe (1976) defined the information structure as the presentation of linguistically encoded information according to the prediction of the speaker for the temporary mental state of the receiver. Halliday (1967) and Vallduvi (1993), Prague School theorists, also highlighted the point that information structure is a sentence level structure, which relates the information to the prior context with the help of the parameters modulating the presentation of the information included in the sentence.

According to an information-based approach, the messenger decides on how to produce an utterance according to what the receiver should focus on. They make the decisions according to what is considered background information and new information (Gattei, París, Shalom, 2021). These two different parts of a sentence are named "given" (already existing information) and "new". However, other scholars have also named them "topic" (as background information) and "focus" (as the new information). They form the information status of a word or referent (Gattei et al., 2021).

As Arnold et al. (2013) also pointed out, it is widely argued that the purpose of a word order variation is to indicate information structure, in which given information, as a more accessible one, precedes the new information, as the less accessible one. This is due to the fact that given is already in the working memory and the retrieval of the new information in long-term memory has not occurred (Arnold et al., 2013). As a result, the earlier position of accessible information allows the processor to put off the difficult part and have more planning time.

While the presentation of new information results in longer sentence processing, Kaiser and Truewell (2004) also found that using a non-canonical word order alteration, in order to leave the new information for the last, makes the sentence processing longer. In accordance with Kaiser and Truewell, it can also be concluded from the results of the study carried out by Lamers and De Swart (2011) that processors prefer the word order from most to least important. Along with the previous studies, Gattei et al. (2021) also found and emphasized the importance of the information status of the phrase.

The findings of a study conducted by Lamers and De Swart (2011) yielded that individuals tend to consider the first constituent as the actor and the they compute arguments in the order of their importance; from the most to least important Additionally, Schumacher and Hung (2012) also claimed that in language processing individuals approach the information presented at the beginning of the sentence

differently than the information presented in other positions. The results of the study conducted by Burmester et al. (2014) were also highly compatible with the claim that in word order the topic-first tendency, which leads to a non-canonical preference, eases the processing of the sentence in German (Gattei et al., 2021).

2.2.3. Locality-based approaches

In addition to the previous approaches to sentence processing and the factors playing an important role in it, numerous studies investigating the various aspects of locality theory in sentence processing have been conducted. In recent years these studies have examined how it affects word order preferences and cross-linguistic differences in sentence processing. The finding and theories (e.g. Dependency Locality Theory (DLT) by Gibson (2000), Syntactic Prediction Locality Theory (SPLT) by Gibson (1998), and Performance Theory by Hawkins (1990; 1994 & 2004)) suggest that alternatives to canonical word order may occur in order to ease sentence processing. Based on this suggestion, Gibson (1998, 2000) and Hawkins (1990, 1994, 2004) advocate that performance plays a role in shaping the competence of grammar. This is a counter argument to the proposal by Chomsky (1965). Chomsky (1965) stated that performance does not have an impact on grammar and the two concepts are totally independent. This section will provide an overview of locality theory and its key concepts as opposed to the proposal by Chomsky (1965), as well as the discussion of some of the major findings and debates in the field.

2.2.3.1. *Locality theories by Gibson (1998, 2000)*

Different aspects of sentence processing –working memory, parsing strategies and modes of sentence processing– have been the focus of different scholars. Despite having distinctly different focus, the aspects of sentence processing are actually both compatible and often intertwined with each other. Gibson (1998, 2000) brings another perspective to sentence processing by suggesting "locality theories". Gibson (1998) emphasized that reaching a representation of a sentence's meaning requires the syntactic and semantic ordering of words in a sentence, which is an essential step in sentence processing and comprehension. While this process is taking place, memory resources – as computational resources– are also activated in order to follow the syntactic and

conceptual structures. It is quite an important aspect of sentence processing, since it is important to understand the link between the process and the mechanism of the sentence as well as the computational resources used during the process (Gibson, 1998). The whole process is significantly affected by the distance between the two elements of a sentence (e.g. a head and its dependent phrase), which Gibson (2000) defines as "locality".

One issue related to locality is "nested dependency". This deals with the components affecting sentence processing in terms of the processing complexity in unambiguous sentences (Gibson, 2000). "Nested Complexity Theory" states that the higher the number of nestings in a sentence, the more unprocessable the sentence becomes. This is because more resources are required while processing the sentence (Chomsky, 1957, 1965; Chomsky and Miller, 1963; Miller and Chomsky, 1963; Miller and Isard, 1964; Yngve, 1960). Nesting complexity is a well-formed theory in literature. However, different scholars approach the reasons for this phenomenon and what features of language cause it from different perspectives (Gibson, 1998). One perspective is the hypothesis that complexity depends on how many phrase structures a human parser needs to keep in memory, advocated by Abney and Johnson (1991), Miller and Chomsky (1963), Miller and Isard (1964) and Yngve (1960). The examples below illustrate the gradually increasing complexity of sentences and shows how the difficulty of processing them increases accordingly. This can be seen as the intervention between the verb "disliked" and the subject "the reporter", depending on the verb increases (Gibson, 2000).

(12) The reporter disliked the editor.

(13) The senator [who the senator attacked] disliked the editor.

(14) The senator [who the senator [who John met] attacked] disliked the editor.

(Gibson, 2000, p. 96)

However, Gibson (2000) claims that the impact nested dependency has on processing difficulty differs depending on the canonical word order and syntactic features of a language. For instance, since objects can occur before subjects in Japanese, a head-final language, there will be less intervention between the subject and the verb. Since the subject depends on the verb, this will contribute to the processing ease of nested structures.

2.2.3.1.1. *Dependency Locality Theory (DLT)*

Contrary to the Nested Complexity Theory mentioned above, the grammatical judgment study conducted by Warren and Gibson (1999) revealed that complexity theories cannot fully predict the difficulty of processing. This led Gibson (2000) to find a better explanation for the phenomenon. He suggested "Dependency Locality Theory (DLT)", which proposes that computational resources, such as "syntactic prediction", are used during sentence processing. The basic idea of this theory is that sentence comprehension has two aspects that require resources. These are the "storage of the structure" and the "integration of the current word into the structure built so far". Both of these have a close relationship with cognitive domains in sentence processing (Gibson, 2000, p. 102). As mentioned in Hawkins (1990, 1994), Joshi (1990), Rambow and Joshi (1994) and Wanner and Maratsos (1978), distance and locality between the two dependent phrases in a sentence have a significant impact on sentence complexity.

While there is also a lexical aspect of the theory, it will not be discussed in this study as this current study focuses on the syntactic structure. Nevertheless, it is worth mentioning that Gibson (2000) also provided cross-linguistic support for the current theory by investigating the phenomenon in Japanese. However, Gibson explicitly expressed that he had not focused on the heaviness effect, which will be the main focus of Hawkins' Performance Theory –the theory which this thesis is based on– mentioned in the next section.

2.2.3.1.2. *Syntactic Prediction Locality Theory (SPLT)*

In accordance with the (DLT), Gibson also suggested "Syntactic Prediction Locality Theory (SPLT)". This theory mainly focuses on the sentence comprehension mechanism and its relationship with the available computational resources. He

emphasizes that syntactic predictions, which means sentence processors can predict the following word after the word and phrase they see during reading, is one of the fundamentals of sentence comprehension and it helps sentence processors to comprehend the sentence in a more efficient way. According to this theory, there are basically two factors which affect the process, "integration cost" and "memory cost". These two concepts are mentioned in detail below.

Integration cost

Integration cost is a concept which focuses on the process of the integration of new words into the sentence structure (Gibson, 1998). Distance also plays a crucial role in the integration of new words in sentence processing. Additionally, computational resources are important since more resources are required for longer-distance integrations (Gibson, 1998). It is estimated that each word has their own activation level regardless of the structure they are in and that the amount of activation for each lexical item diminishes as more words are integrated. Integration performance starts by determining the type of the lexical item that the sentence processor sees. Then it provides the processor with a couple of possibilities for what kind of word might come next This leads to the reactivation of lexical head/dependent associates so that the processor can predict the possibilities syntactically in order to evaluate the prediction semantically before the processing ends. An important factor which affects the process is the distance between the head and its dependent. The more words that are integrated between them, the less lexical activation occurs. This means a longer distance between the head and its dependent. As a result there is an increase in integration cost, which means it takes more time for a processor to process the sentence.

Memory cost

Memory cost focuses on "what quantity of computational resources are required to store a partial input sentence (Gibson, 1998, p. 8)". Completing the already formed input as a grammatically correct sentence means remembering the type of each lexical item. This requires memory (Gibson, 1998). Gibson claims that a theory of phrase structure –such as "Head-driven Phrase Structure Grammar" by Pollard and Sag (1994) or "Lexical Functional Grammar" by Bresnan (1982)– is needed in order to support the

phenomenon of the role of memory cost. Both theories claim that a sentence has at least two syntactic head categories: a head noun for the subject and a head verb for the predicate (Gibson, 1998). When the number of syntactic head categories increases, there will be more words to predict which causes additional memory load (Gibson, 1998).

The theories and details of sentence processing, in terms of memory, raise another issue to discuss, "discourse-based locality function". This also creates another challenge for the memory. Since it is harder to store the syntactic predictions in mind while reading, more effort is needed to keep the predictions in the memory. Thus, it causes a higher memory cost for the earlier syntactically-predicted lexical items as they need to be stored for a longer time until the relevant phrase ends (Hawkins, 1990, 1994; Joshi, 1990; Kaplan, 1974; Rambow and Joshi, 1994; Wanner and Maratsos, 1978). This explains why it is more challenging to retain items in short memory as the number of the words between head and its dependent increases (Gibson, 1998).

Considering memory cost and integration cost as two separate concepts is impractical, as the quantity of available resources for integration decreases as the memory cost increases (Gibson, 1998). The reason is explained by Gibson (1998) by highlighting the point that resources for integration process and memory cost actually use the same working memory resource. This assumption is also supported by the psycholinguistic study, during which the reading times of participants were analyzed, conducted by King and Just (1991).

Length and heaviness effect

Considering the integration and memory costs, SPLT predicts that it will be more difficult to process heads and dependents with a longer distance between each other when compared to those with a shorter distance since it affects ordering complexity. The assumptions of several other scholars were also compatible with the assumptions and basis of the DLT and SPLT. "Psychological reality" of the forms and rules in transformative grammars has garnered attention, and experiments have indicated that internal syntactic structures are crucial throughout the sentence comprehension process (Mehler, 1963; Mehler & Bever, 1968). The sequence of the segments in a sentence is one of the factors which affect the sentence comprehension process as the complexity and length of the sequence as well as any intervention in the sequences exhaust immediate memory (Bever, 1970). All of the discussions about the complexity and

efficiency of sentence structure for processing has directed the attention of researchers to the weight of phrases in a sentence. Hawkins (1994) stated that syntactic weight or length, which is a crucial factor in sentence processing, is not appreciated as much as it needs to be. Furthermore, there should be more studies on it in order to understand the whole process. He also added that Early Immediate Constituents (EIC), which suggests that sentence processors prefer to see the immediate constituents of a mother node in order to process the entire sentence as fast as possible (Hawkins, 1990), is a good principle to use in order to focus on the ordering of elements and its relationship with syntactic weight or length. The details of EIC are mentioned in the following section.

2.2.3.2. *Performance Theory by Hawkins (1990, 1994, 2004)*

While observing sentence processing, several researchers realized that there is more than one grammatical structure of some sentences although all of them are not formed according to the canonical word order of the language. The combination of this observation plus the previously suggested theories led Fodor (1978; 1984) to try to find an answer to the question "does performance shape the competence of grammar? If so, to what extent?" A new principle of language performance was introduced in order to understand if there was any correlation between performance and competence (Fodor, 1983). This started the discussion on "performance-grammar correspondence". The proposal by Bever (1970) is also similar to the ones proposed by Fodor and Frazier (1978) in terms of working on parsing preference. He claimed that processors determine their preferences according to the avoidance of the misanalysis of the main clause and subordinate clauses. However, before diving into the details of this correspondence, it is important to emphasize that this suggestion and relevant theories originated from a counter argument proposed by Chomsky (1965), which was briefly discussed in the beginning of this section. Chomsky, as the advocate of the Standard Theory of Generative Grammar, supported the idea of "pure accessibility", meaning that the accessibility status of sentences, not their grammaticality as Universal Grammar is innate. Chomsky's theory of syntax, in this sense, suggests competence in grammar is what has an impact on performance. However, according to Chomsky, performance does not shape the rules, structures on grammar (Hawkins, 2014). In accordance with this assumption, Chomsky (1965) highlights that grammar is totally independent from performance and it is not affected by performance. In order to understand both sides

thoroughly, it is necessary to mention the relationship between performance and grammar proposed by several scholars.

The whole discussion on sentence processing and the existence or absence of correspondence between grammar and performance motivated several researchers to focus on finding the answer to the question asked by Fodor (1978, 1984). The first theory of the possible correspondence between performance and grammar was presented by Keenan and Comrie (1977), named "Accessibility Hierarchy". This study was conducted by collecting data from various languages. The results indicated that the less easy the processing is, the more power positions the units take on the hierarchy. The evidence for this assumption is provided by corpus, from which it was observed that the frequency declined down the hierarchy as working memory and processing load rose. Hawkins (1994) and Gibson (1998) also obtained parallel results indicating that the frequency of nominative cause before accusative case in a canonical sentence is higher in languages in which Subject-Object and Object-Subject word order are grammatical.

In light of these previous studies on performance-grammar correspondences and their results, Hawkins (1994, 2004) criticizes Chomsky's approach to sentence processing. He proposed Performance Theory, which basically tried to investigate what results in processing ease or difficulty and asked the following question in order to find a rational explanation for his disagreement: "Are the sentences which are unacceptable in performance are also ungrammatical or unacceptable but still grammatical?" (Hawkins, 1994, p. 7).

In order to find a scientifically convincing answer, Hawkins (1990) started by defining the principles of constituency, which are "Mother Node Construction", "Immediate Constituent Attachment" and "Constituent Recognition Domain" explained exactly with the definition of Hawkins (1990, p. 7) below.

> Mother Node Construction (MNC)
>
> In the left-to-right parsing of a sentence, if any syntactic category uniquely determines a mother node (or nodes) in accordance with the phrase structure rules of the language, then this mother node is constructed over the category in question, immediately and obligatorily. (Hawkins, 1990, p. 7)

Immediate Constituent Attachment (IC)

An IC that can be attached to a mother node in accordance with the phrase structure rules of the grammar will be attached, as rapidly as possible. ICs may be encountered after the category that constructs the mother node in the left-to-right parse, or they may be encountered before it, being placed in a look- ahead buffer for ICs that do not uniquely determine a mother node. In either event the attachment of all sister ICs to a mother node, either backward or forward, proceeds as fast as possible. (Hawkins, 1990, p. 7)

Constituent Recognition Domain (CRD)

The constituent recognition domain for a node X is the ordered set of words in a parse string that must be parsed in order to recognize all ICs of X, proceeding from the word that constructs the first IC on the left, to the word that constructs the last IC on the right, and including all intervening words. (Hawkins, 1990, p. 7)

These principles form a syntactic representation of a sentence with the help of "immediacy", "mandatoriness" and "determinism", which means that syntactic processing is likely a very rapid and dynamic process (Hawkins, 1990). However, Hawkins (1990) also claims that sentence processing must be both efficient and rapid as it includes not just recognition but comprehension. That is why he also introduces the principles of efficiency in sentence processing, which are explained below.

Maximize Online Processing (MaOP)

The human processor prefers to maximize the set of properties that are assignable to each item X as X is processed, thereby increasing O(nline) P(roperty) to U(ltimate) P(roperty) ratios. The maximization difference between competing orders and structures will be a function of the number of properties that are unassigned or misassigned to X in a structure/sequence S, compared with the number in an alternative. (Hawkins, 2014, p. 28)

As well as the timing of the introduction of linguistic properties in online processing, this principle mainly focuses on the preference of the sentence processor in order to select and arrange the linguistic forms in order to access the earliest-completed syntactic and semantic representation (Hawkins, 2014). In this case, the unwanted case is any kind of misassignment or unassignment (Hawkins, 2004), which will affect sentence processing negatively. The famous example given by Hawkins (2014) "the horse raced past the barn fell" is a to-the-point representation of this situation. The sentence processor continues recognition, parsing and comprehending the sentence until they see "fell", which breaks the whole parsing and flow.

> Minimize Forms (MiF)
>
> The human processor prefers to minimize the formal complexity of each linguistic form F (its phoneme, morpheme, word, or phrasal units) and the number of forms with unique conventionalized property assignments, thereby assigning more properties to fewer forms. These minimizations apply in proportion to the ease with which a given property P can be assigned in processing to a given F. (Hawkins, 2014, p. 15)

This principle is mainly based on minimizing the linguistic forms in a sentence in order to decrease the amount of effort required to process the sentence. Doing this will result in using less effort in order to use the already active information in processing, which will prevent repetition and provide more efficient communication.

> Minimize Domains (MiD)
>
> The human processor prefers to minimize the connected sequences of linguistic forms and their conventionally associated syntactic and semantic properties in which relations of combination and/or dependency are processed. The degree of this preference is proportional to the number of relations whose domains can be minimized in competing sequences or structures, and to the extent of the minimization difference in each domain. (Hawkins, 2004, p. 11)

The main issue with MiD is the length of the syntactic domain in which the sentence processor can process a given grammatical relation. This theory tries to answer the question "how great is the distance separating interrelated items and how much other material needs to be processed simultaneously as this relation is processed? (Hawkins, 2014, p. 11)". Hawkins (2014) predicted that the sentence processor needs to assemble and group words and phrases in the way that they are represented by tree structure diagrams, and some orderings help the sentence processor recognize a mother phrase and its immediate constituent daughters by decreasing the number of words required for the process, which will contribute the sentence processor to combine the phrases more rapidly. Examples (15) and (16) are a good representation of the assumption proposed by Hawkins (2014).

(15) The man [$_{VP}$ looked [$_{PP1}$ for his son] [$_{PP2}$ in the dark and quite derelict building]]

1 2 3 4 5

(16) The man [$_{VP}$ looked [$_{PP2}$ in the dark and quite derelict building] [$_{PP1}$ for his son]]

1 2 3 4 5 6 7 8 9

(Hawkins, 2014, p. 12)

While both of the sentences have the same items V, PP1 and PP2, they differ in the number of the words recognized in order to parse and process them. Example (15) includes the recognition of five words, unlike Example (16), which requires nine words in order to determine the head categories, form and recognize them. MiD principle assumes that "Phrasal Combination Domains (PCD)" should avoid long units as much as possible, the degree of preference of which needs to be compatible with the minimization discrepancy between the two alternative orderings. Hawkins named this principle Early Immediate Constituents (EIC)– a specific phenomenon of MiD–, which is one of the main concepts of this study. Hawkins (2014) specifically expressed this particular principle as:

> Early Immediate Constituents (EIC) [Hawkins 1994: 69–83] The human processor prefers linear orders that minimize PCDs (by maximizing their IC-to-word ratios), in proportion to the minimization difference between competing orders. (Hawkins, 2014, p. 94)

The main point of this preference is that sentence processors prefer the word order which enables them to see and process all of the immediate constituents of a mother node as fast as possible (Hawkins, 1990). To specify, EIC suggests that head-initial languages such as English have a tendency to constitute sentences according to short-before-long word order (e.g. the appearance of short PP before long PP in (15)) (Hawkins, 2014), which have higher 'IC-to-word ratios' than the ones whose word order formed in long-before-short. When the two examples above are compared according to their IC-to-word ratios, Example (15) has the higher ratio as it requires fewer words in order to recognize and process the VP –five words are needed for the recognition of the three ICs–. That is why the ratio for the VP of Example (15) is 3/5, namely 60 percent. On the contrary, nine words are needed for Example (16) in order to

be able to recognize the three ICs and the ratio is 3/9, namely 33 percent, lower than the first example as it can be seen.

Based on the principles and previous studies mentioned above, Hawkins (1990) answered the question if the sentences which are unacceptable in performance are also ungrammatical or unacceptable but still grammatical. Besides, he proposes Performance Theory by emphasizing that the increase in the distance between the verb and its particle causes less acceptability.

2.2.3.2.1. *Heavy-NP shift and extraposition*

Before continuing with the details of Heavy NP-Shift and its details, it is worth summarizing the two locality-based theories, Syntactic Prediction Locality Theory (SPLT) by Gibson (1998) and Performance Theory by Hawkins (1994). Both theories predict that more working memory is needed as the distance increases between the constituents that the processor needs in order to integrate linguistic information. It results in longer and more difficult sentence processing. That is why the heavy phrase shows a tendency to appear later in order to ease the sentence processing for the listener or reader. There have been a significant number of experimental and corpus studies based on the alternative word orders and processor preferences supporting the locality-based theories. The experimental study of Francis (2010) is also one of them which support the theory of Hawkins (2004). Kimball (1973) also claimed that NP length is the fundamental of the alternative word order and structure preference.

Heavy NP-shift is a specific case of Early Immediate Constituents (EIC), which recognizes that weight plays an essential role in forming sentence structure. Heavy NP-shift has been defined by various scholars who accept the importance of the position of heavier (longer) phrases in sentence processing. Basically, phrases are located according to the order of increasing weight (Quirk et al., 1972; Wasow, 2002), which lets both listeners and readers process sentences in a more efficient way. It also allows for more rapid recognition of the constituents of the relevant sentence (Hawkins, 1994). Similarly, Richards and Schmidt (2013) also emphasized that placing the heavy structure at the end of the sentence is better for sentence processing as dominant clauses are “encoded” and “decoded” better when they are at the end of the sentence. Bever (1970) described the entire process as “save the hardest for the last”. Gibson (1998) also

discovered that integration cost (Example (18)) decreases when the heavy constituent is located at the end of the sentence.

(17) I $_{VP}$[gave $_{NP}$[the valuable book that was extremely difficult to find] $_{PP}$[to Mary]

(18) I $_{VP}$[gave $_{PP}$[to Mary] $_{NP}$[the valuable book that was extremely difficult to find]]

(cf. Ross, 1967)

The examples above are a good representation of Heavy NP Shift. Both of the sentences basically include the same phrases and the NP is obviously longer than the PP. While the order of the phrases in Example (17) is canonical, Example (18) indicates an alternative –and another grammatically acceptable– order. Hawkins (1994) suggested that the grammatical acceptability of Example (18) is due to the need of a more easily processable sentence structure.

When the heavy constituent is positioned at the end of the sentence, it also means the position of the shorter constituent automatically changes its location in the sentence. The principle "save the hardest for the last" results in the existence of non-canonical word order according to the grammatical weight of the constituents (Arnold et al., 2000). When the longer constituent moves to a later position, the position of the shorter one also changes. It moves to an earlier position in the sentence. This is called "extraposition" (Arnold et al., 2000). There have been a variety of studies on extraposition, mostly in English and Germanic languages. Uszkoreit et al. (1998) and Konieczyn (2000) tested the theory of Hawkins by focusing on extraposition in relative clause structures in German and the acceptability judgment, corpus study and self-paced reading experiment results yielded that there is a similar tendency as Examples (17) and (18) presented above. However, as a head-final language, which has the main verb at the end of the verb phrase (Francis, 2010), German forms extraposed sentences in a different way than English does.

(19) Er hat gestern das Buch das der alte Professor verloren hatte gefunden.

he has {yesterday [the book] that the old professor lost had found}.

“He found the book yesterday that the old professor had lost.”

(20) Er hat gestern das Buch gefunden das der alte Professor verloren hatte.

he has {yesterday [the book found} that] the old professor lost had.

“He found the book yesterday that the old professor had lost.”

(Francis, 2010, p. 13)

As it can be seen in Examples (19) and (20) above, German locates the heavy constituent at the very end of the sentence and the verb appears in the middle of the sentence. This actually changes the canonical position of the verb, as the head. It changes the syntactic structure from SOV into SVO. Dryer (1980) suggested that Turkish, as another head-final language, makes a similar change in heavy NP shift and extraposition.

(21) Adam ban-a Ayşe-nin kitab-ı- oku-duğ-u-nu söyle-di-∅.

man I-DAT Ayşe GEN book-DEF, ACC read-NOM-3SG, POSS-ACC tell-PAST-SG

“The man told me that Ayşe read the book.”

(22) Adam ban-a söyle-di-0 ki Ayşe kitab-ı oku-du-∅.

man I-DAT tell-PAST-SG COMP Ayşe book-DEF, ACC read-PAST – 3SG

“The man told me that Ayşe read the book.”

(23) *Adam ban-a ki Ayşe kitab-ı- oku-du- söyle-past-3SG

man I-DAT COMP Ayşe book-DEF,ACC read-PAST-SG tell-PAST-3SG

“The man told me that Ayşe read the book.”

(Dryer, 1980, p. 131)

Examples (21) and (22) above present the canonical and extraposed sentences in Turkish, respectively. Both are grammatically acceptable. The heavy constituent is linked to the verb, which is moved to the middle of the sentence, with the help of the Turkish morpheme “ki”; just like in Example (20) in German. Yet, an extraposed sentence structure as shown in Example (23), which can be seen in head-initial languages like English, is not acceptable. The examples showing the difference between the extraposed sentences in head-initial languages and head-final languages indicate that the extraposition in different languages can be generalized according to cross-linguistic variation, proposed by Hawkins (2014). This will be discussed in Section 3.

2.2.3.2.2. *Heavy NP shift and extraposition in sentential subjects*

Heavy NP-shift can also occur in sentences with sentential subjects (Dryer, 1980). In order to be able to move the heavy sentential subject to the end of the sentence to “save it for the last”, the subject needs to be extraposed with a pronoun (Dryer, 1980). Dryer (1980) also claimed that this phenomenon is a universal grammar issue as the same tendency was observed in many unrelated languages.

(24) That John is tall is obvious.

(25) It is obvious that John is tall.

(Dryer, 1980, p. 124)

Example (24) has the sentential subject in the canonical position while (25) extraposes the sentential subject replacing it with the pronoun “it”, which allows the processor to reach the verb as the head sooner. Dryer (1980) highlighted the point that this rule applies when the subject is sentential. Simple NPs do not show the same tendency to move to the clause-final position when they are the subject of a sentence. Instead, they appear in clause-initial position.

Based on these observations, Dryer (1980) suggested that there is a specific hierarchy of sentential NP position, “clause-final > clause-initial > clause-internal”. Dryer (1980) proposed that the more complex an NP subject is, the more likely it is to appear at the end of the sentence. Similarly, simple NP objects appear in clause-internal position while sentential objects have a greater tendency to occur at clause-final position.

Before Dryer (1980), Kuno (1974) also proposed the same phenomenon. However, Dryer (1980) found the proposal to be very limited as Kuno (1974) only cited examples from English, French and German and claimed that extraposition was a rule. Dryer (1980), on the other hand, stated that it was not possible to call it a rule due to the lack of evidence.

Dryer (1980) proposed the general tendency of sentential subject extraposition based on the text frequency. Although Dryer (1980) claimed that the extraposition of the sentential subject with the pronoun "it" is a universal grammar phenomenon, there are also several languages which do not show this tendency no matter how complex the NP subject is. Japanese, as a head-final language which will be discussed in detail in Section 3, does not allow the sentential subject to be positioned at the end of the sentence. However, it does not contradict with the existence of extraposition in languages and sentential NP hierarchy because Japanese also has the same limitation for simple NP subjects.

Although it is considered another canonically head-final language, it can be briefly said that Turkish has flexibility in word order, which will be discussed in detail in Section 3. Turkish also has the extraposition alternative to the canonical position of the sentential subjects.

(26) Mehmet'in sarhoş olduğu belli.

Mehmet POSS drunk be nom-3sg, poss obvious

"That Mehmet is drunk is obvious."

(27) Belli ki Mehmet sarhoş-tur.

obvious comp Mehmet drunk-is

"It is obvious that Mehmet is drunk."

(Dryer, 1980, p. 36)

As it can be seen in Examples (26) and (27) there are two possible positions for the sentential subject. While the sentential subject is in the canonical position in Example (26), it is extraposed by using the Turkish morpheme "ki" in Example (27). Both of the sentences are equally acceptable.

2.2.3.2.3. *Relative length of the phrases by Stallings and MacDonald (2011)*

However, another debate about whether NP length is the only reason for Heavy NP-shift or if the effect is combined with other factors was triggered by several researches, two of whom are Stallings and MacDonald. Their detailed experimental studies had two important findings. They observed that phrase length has a significant impact on the heavy-NP shift, as well as other syntactic structure preferences based on length unlike world-internal length (e.g. the number of syllables) (MacDonald et al., 1993; Stallings et al., 1998). The second finding was that NP length itself is not the only cause for heavy-NP shift. The experimental studies by Stallings et al. (1998) and corpus studies by Wasow (1997) both indicate that there are more factors in Heavy NP-Shift such as the type of verb and its properties (Staub et al., 2006).

Besides the previous predictions above, Stallings and MacDonald (2011) had two more important motivations to carry out their study, two proposals by Hawkins (1994). The first one emphasizes, according to the small text corpus analysis, that "the relative length of the NP and the other material in the verb phrase (such as PP) was a better predictor of structure choice than properties of the NP alone" (Stallings and MacDonald, 1998, p. 178). Hawkins (1994) also claimed that NPs do not have a tendency to shift until the word difference between NP and the other material is not at least four words regardless of NP length and complexity. Besides, Frazier and Fodor (1978) also pointed out in their The Sausage Machine model, which was introduced in Section 1.1, that the first stage of the processing is limited to five to six words because of the limited capacity of working memory. Stallings and MacDonald (2011) conducted an experimental study based on heavy-NP shift and the role of relative length –the length difference between the two phrases– on the tendency of the shift. Since the current study is also considerably based on the study of Stallings and MacDonald (2010), the details of the methodology will be discussed in the further chapters. However, the results, which support the proposal of Hawkins (1994) in that relative length of the constituents NP and PP in the verb phrase restricts the preference for heavy-NP shift.

Arnold et al. (2000) approach the discussion from a different perspective, claiming that both of the competing theories, Performance Theory and information-based approach, should be studied together. In their study, they emphasized that Hawkins (1994) did not apply any significance tests to the data, or did not focus on the

informational factors while working on the theory. Siewierska (1993) aimed to apply the informational-based and structural-based measurements to Polish in order to compare the two opposite theories and it was done by applying statistical analysis to the data in Polish. While it seems from the results that information factors are the dominant ones, Siewierska (1993) suggested that a more detailed observation is necessary in order to understand the two cases and their predictions thoroughly. These results led Arnold et al. (2000) to observe and measure both of the opposite predictions simultaneously in an intertwined study. In the study, they focused on the dative alternation by collecting corpus and experimental data. The results basically indicated that heaviness and newness both influence sentence processing and syntactic preference. That is why they suggest that both measurements and theories should be taken into consideration instead of choosing one of them. The experimental study results revealed that heavy phrases have more tendency to be shifted when both phrases have "given information", which supports the effect of heaviness. On the other hand, the corpus data results yielded that givenness is the factor which has the biggest effect on syntactic structure preference. Arnold et al. (2000) claimed that this difference was probably due to the fact that the measurements of heaviness and newness used in the relevant study were the simplified version of the implementation of real psychological aspects.

2.3. Cross-Linguistic Variation

Different scholars (Corbett et al., 1993; Dryer, 1992; Greenberg, 1963; Hawkins, 1983, Newmeyer, 2005) advocated that the cross-linguistic typology and grammar of different languages can be grouped according to "head-ordering" and that languages in the world were classified in two basic groups according to their canonical word order: "head-initial" (e.g. English) and "head-final languages" (e.g. Japanese, Turkish, German) (Hawkins & Cutler, 1988; Hawkins & Gilligan, 1988).

There have been several studies which support the theory of Hawkins (1994), one of which is the "Accessibility Hierarchy (AH)" proposed by Keenan and Comrie (1977). They claimed that if a phrase is located in a lower position on the AH, it gets more challenging to combine the phrase with the rest of the sentence and process the whole sentence. Moreover, the decrease in the frequency of these sentences in the language is compatible with processing difficulty. However, they only observed English and it resulted in overgeneralization. Hawkins (1994) suggested that it was also

necessary to take cross-linguistic variations into consideration as languages significantly differ in canonical word order rules. That was the reason why "Minimal Structural Domains (MiD)" was actually proposed by Hawkins (1994). Its purpose was to be able to explain this variation and he advocated the idea that the main point of syntax is about the linear ordering rules of the words and particles in a sentence, which affects or causes processing ease and grammaticalization. The easily processed structures and their preferences are also affected by the differences between syntactic types of languages (e.g. head-initial and head-final languages) (Hawkins, 1994).

As mentioned in the previous sections, Hawkins (1990) argued that all languages possess transformational rules in order to rearrange canonical word orders –such as heavy NP shift and extraposition– for easier sentence processing, namely performance. The application of extraposition in performance has been observed to occur according to the weight of the constituents in a sentence (Erdmann, 1988), and researchers have tried to find out a generalized pattern of this phenomenon. For instance, Behaghel (1932) proposed that the application of the short-before-long principle can also be applied to other languages in addition to English. This is named the "Language-Independent Preferred order of Constituents". Gil (1986) took this proposal a bit further and claimed that this principle was valid for all languages, which Hawkins (1994) found as overgeneralization. However, he also emphasized that the differences between languages in terms of syntactic structures should also be taken into consideration.

The EIC principle by Hawkins (1990) provides efficient prediction for "the directionability of movement in different language types (Hawkins, 1990, p. 247)". In light of the classification of languages Hawkins (1990, 1994) worked on the details of Performance Theory. Newmeyer (2005) specifically emphasized that the "Minimize Domains (MiD)" principle of the theory (which was mentioned in Section 2.3.2) can motivate the principle of "Head Adjacency" and "Head Ordering" in generative grammar. He also highlighted the point that MiD can also explain the reason why two mirror-image language types, namely head-initial and head-final, languages exist. MiD principle predicts that there are systematic preferences in performance and these preferences are the opposite in mirror-image ones, long-before-short preference in head-final languages while the opposite is observed in head-initial languages. The reason for this is that there are two rational possible word orders in which the heads can be

adjacent and in order to minimize the process of recognition and production (Hawkins, 2014).

Psycholinguistics studies were conducted based on European languages while little attention was paid to other languages and cross-linguistic variation (Hawkins, 2014). Over the last few decades, though, cross-linguistic variation has drawn the attention of researchers. It is important to remember Examples (28) and (29) in English before making comparisons with other languages.

(28) $_{S}$[$_{S1}$[That Bill was frightened] $_{VP}$[surprised $_{NP}$[Mary]]]

(29) $_{S}$[It $_{VP}$[surprised $_{NP}$[Mary] $_{S1}$[that Bill was frightened]]]

(Hawkins, 2014, p. 65)

In Example (30) the verb head "surprised" appears after a long particle belonging to the head, which results in forming the entire phrase later and processing difficulty because of the fact that English is a head-initial language. Example (31), on the other hand, indicates the head sooner than the previous sentence, which provides the sentence processor with easier sentence processing. These differences were studied and observed in the eye-movement study of Frazier and Rayner (1988) as well as the text-frequency study of Erdmann (1988). However, head-final languages have the opposite tendency in this case. The examples below are from Japanese, which is a head-final language and has consistent word order rules and the verb is always at the end of a sentence.

(30) $_{S1}$[$_{NP}$[Mary-ga $_{VP}$[$_{S}$[$_{S2}$[kinoo° John-ga kekkonsi-ta] to] it-ta]]

(31) $_{S2}$[$_{S}$[$_{S1}$[Kinoo John-ga kekkonsi-ta] to] $_{NP}$[Mary-ga] $_{VP}$[it-ta]]

(Hawkins, 1994, p. 66).

Examples (30) and (31) indicate the long-before-short preference. When the sentence processor sees Example (30), they cannot form the structure in their head until they see the end of sentence (S). They start constructing S1 without being able to predict if S1 is the main or subordinate clause. This causes a delay in the processing of the whole sentence. However, the main clause S starts earlier in Example (31) and the short particle with its verb head, respectively, are saved for the last; which automatically locates the longer particle before the others in the sentence.

Dryer (1980), among the researchers studying this difference between the head-initial and head-final languages, emphasized that the difference is closely related to the opposite direction of branching and processing of the mother node-constructing categories. As it can be seen in Examples (28) and (29), head-initial languages indicate right-branching while head-final languages, as seen in Example (30) and Example (31), have the opposite direction of branching. This results in the bottom-up parsing and processing of Example (31), unlike Example (29), which requires top-down parsing and processing (Ueda, 1984). As a result, while a heavy constituent is located before a sentence in Japanese, it is the opposite in English (Dryer, 1980). In this way the VP is formed as early as possible in English, as opposed to Japanese, which constructs VP as late as possible.

Another essential study on Japanese is the research by Yamashita and Chang (2001), who were motivated by the proposal by Arnold et al. (2000) stating that long phrases are more difficult to access and process than short phrases. However, it was not specifically proven that the length in number of words is directly linked to accessibility. It can be concluded from this proposal that short-before-long preference might be universal as a result of the nature of the sentence processor (Yamashita & Chang, 2001). However, Yamashita and Chang (2001) suggested a counter argument for the idea above in light of the study they conducted in Japanese. They did two different experiments with Japanese native speakers, which are the restatement of the sentences the participants see and a grammatical judgment test. The results led the researchers to question the universality of syntax processing and motivated researchers to focus more on differences of languages instead of universality in terms of syntax and sentence processing. This is the main inclination of this thesis.

There are also some other languages sharing the same property as Japanese, such as Korean, Persian and German. Turkish is also among these languages and it also has case markers (e.g. accusative, dative and instrumental). These case markers also play a role in preference because they provide flexibility in word order (Hawkins, 1994). Since there are more factors to consider in the case of Turkish because of case markers, the prediction by EIC in terms of long-before-short preference is weaker although it is observed (Hawkins, 1994).

(32) $_{NPm}$[Salon-da-ki bütün biblo-lar-I] $_{mNP}$[camekan-a] kaldlr-dlm

living room-LOC-GER all trinket-PLUR-ACC showcase-DAT

stay-CAUS-PAST, i.e.

"X kept all the trinkets that were in the living room in a showcase."

(33) $_{mNP}$[Camekan-a] $_{NPm}$[salon-da-ki bütün biblo-lar-I] kaldlr-dlm

(Hawkins, 1994, p. 160)

The canonical word order in Turkish is SOV, which is why Example (32) is considered the canonical order while Example (33) is also equally acceptable. According to the prediction of EIC for head-final languages, NPm should always appear on the left of the sentence as the [NPmNP V] sentence structures, such as Example (32), have a shorter domain between NPm and V in order to reach V. However, case markers let Turkish have more flexibility in syntactic structure. That is why Example (33) is also considered grammatical and acceptable; which shows EIC has a weaker prediction for Turkish.

Like Turkish German is classified as a head-final language, it has a flexible word order, and it is a morphologically rich language (Bahlmann, et al., 2007), and the case-marking of an argument plays an important role in German (Kamide, Scheepers & Altmann, 2003). This shows the language has a variety of different constituent ordering (Kamide et al., 2003; Beck, 1998). Besides its morphological features, flexible word order in German is caused by the morphosyntactic features of the verb in a sentence. The finiteness of the verb determines its position within the sentence. Additionally finite verbs, which show tense, mood and subject-verb agreement in German (Weyerts, Penke, Münte, Heinze & Clahsen, 2002) "may occur in the initial, second or final position of the clause: depending on the type of clause (Weyerts et al., 2002, p. 212)." Finite verbs occur in the initial position in yes/no questions and imperatives. Declarative main clauses, however, have the finite verbs in the second position and finite verbs of embedded clauses occur in the final position (Weyerts et al., 2002). Non-finite verbs (e.g. to-infinitive, gerund and particles) occur in the final position of main clauses or just before the finite verb in embedded clauses (Schulz & Schwarze, 2017).

German locates the non-subject pronouns before PPs and NPs. These pronouns appear in the left-peripheral position, independent from the case of the pronoun and NP (Hawkins, 1994) and German does not let constituent movement in a sentence.

(34) Ich habe $_{VP}$[es $_{PP}$[an die Frau] geschickt]

I have it to the woman sent, i.e.

"I have sent it to the woman."

(35) *Ich habe $_{VP}$[$_{PP}$[an die Frau] es geschickt]

(Hawkins, 1994, p. 280)

As seen in the examples above, Example (34) is the canonical order or phrases and the longer phrase is adjacent to the verb head, which is located at the end of a sentence and Example (35) is just considered ungrammatical. However, this postpones the parsing and processing of the sentence until the human parser sees the verb head. In order to ease the processing, extraposition is needed and Example (36) and (37) shown below present an alternative to using extraposition by making another change in German sentences (Hawkins, 2014).

(36) Ich habe [[$_{NP}$ den Lehrer [$_{CP}$ der das Buch geschrieben hat]] gesehen $_{VP}$]

I have the teacher who the book written has seen

"I have seen the teacher who wrote the book."

(37) Ich habe [[$_{NP}$ den Lehrer] gesehen $_{VP}$] [$_{CP}$ der das Buch geschrieben hat]

(Hawkins, 2014, p. 108)

Example (37) is considered grammatically correct and it provides processing ease for the sentence processor. With the help of the rightward movement of the longer constituent to the end, the sentence processor will be able to see the verb before and parse the whole sentence more rapidly and efficiently.

This chapter presented a thorough review of the relevant literature on the topic of this study and Chapter 3 will build on that foundation and outline the specific aim and methodology of the research project. By drawing on the insights and perspectives gained from the literature review, the following chapter will provide a clear and

comprehensive understanding of the research design and methods employed in this study. The following sections of the relevant chapter will outline the research design, data collection, and analysis techniques in detail, highlighting how they are informed by the existing scholarship in the field.

3. METHODOLOGY

This study was conducted by designing and carrying out an experimental study (self-paced-reading experiment) on a computer. The experiment provided the researcher with the reading times of the participants and the application of statistical analyses to the data obtained. In this chapter, the details of the methods and tools used to gather and analyze the data are presented. By explaining the research design, how the profile of the participants was determined, and the procedures for collecting and analyzing data, a solid framework for conducting the study has been established. This chapter includes a comprehensive presentation of the methodology and statistical analysis procedure.

3.1. Participants

The aim of this study was to observe the effect the position and length of sentential subjects has on sentence processing in L2 and the cross-linguistic variation impact. This investigation included the L1 and L2 speakers of a language. The sampling technique was purposeful, as it considered the participants' native language as the main criterion. That is why the sampling technique for selecting the participants was purposeful. English, Turkish and German were determined as the native speakers of the participants. Native German and Turkish speakers, who speak English as their L2 were chosen for this study because German and Turkish are both SOV (head-final) languages, unlike English which is an SVO (head initial) language (Hawkins, 2014). Native speakers of English were also included in the study in order to make a comparison of sentence processing by English native speakers and second language speakers. Another criterion for the study was that the German and Turkish native speakers needed to have a good command of English –B2 or above. No second language was expected from the English native speakers. B2 was identified as the minimum acceptable language because the focus of the study - sentential subjects (e.g. That Jack visited us surprised everybody)- is recognized by CEFR (A Common Framework of Reference for Languages) as a structure B2 level English speakers need to know. (Council of Europe, 2001).

10 German, 13 Turkish and 13 English native speakers participated in the study. The participants between the ages of 18-40 were invited to participate in the study (*M=19,4* for German native speakers, *M=27,46* for Turkish native speakers and *M=24,4* for English native speakers). The levels of the non-native speakers were

determined according to their recent TOEFL or IELTS scores; with the lowest scores 72 and 5.5, respectively. The scores confirmed that the English levels were B2 and above. All of the participants were graduate (N=18) or undergraduate (N=18) students of the University of California, Santa Barbara or Santa Barbara City College. The German native speakers were mostly exchange students of these universities, and had been for 2 or 3 quarters.

3.2. Data Collection Materials

The data gathering instruments were composed of 40 experimental items and 80 filler items in English. 20 experimental items were sentences with sentential subjects in canonical position whereas the other 20 items were sentences with extraposed subjects. In addition to the position of the sentential subjects, the length of the subjects also differed –based on the study conducted by Stallings and MacDonald (2011). The different subject lengths were used in order to observe the effect of relative length on sentence processing as well as the impact of the syntactic differences between the native and second language. Therefore, both sentences with canonical word order and extraposed word order were generated by the researcher according to the difference of the length between the constituents. Both experimental items included an equal number of sentences with a 2-word, 5-word, 7-word and 10-word difference between the constituents of the verb head. This meant that each situation had 5 instances. Since this study was also influenced by the study of Stallings and MacDonald (2011), the item design of the relevant study was used. The examples shown below are taken from the list of experimental items of this study. The rest of the items used throughout the experiment can be seen in Appendix-1.

(38) It is amazing that you came.

(39) It was unfortunate that his favorite mug was broken.

(40) That you have been misled by the consultant is obvious.

(41) That he has always supported my sister whenever she feels useless is undeniable.

Examples (38) and (39) above are examples of extraposed sentences, in which the pronoun “it” extraposes the sentential subject while Example (40) and (41) have their

sentential subjects in their canonical order. When all the sentences are examined one by one, it is seen that the difference in the relative length of the two constituents gradually increases. In Example (38) the extraposed sentential subject "that you came" is composed of 3 words while the extraposing subject pronoun "it" is only one word, thus it has 2-word difference between these two constituents. The extraposed sentential subject in Example (39), another sentence with an extraposed sentential subject, has 6 words, which makes it a longer sentential subject. In this case, the length difference between the two constituents is 6-word. Although these two examples differ in their sentential subject length, they both place the sentential subject at the end of the sentence and extrapose them with the pronoun "it" in order for the processor to see the verb head as early as possible. Examples (40) and (41), on the other hand, have their sentential subjects in their canonical positions, which results in the late appearance of the verb head. The sentential subject in Example (40) is formed by 8 words and the other constituent after the verb is only one word. This shows a sentence which has a 7-word difference between the two constituents. Similarly, the subject in Example (41) has 11 words and it shows a 10-word difference between the other constituent after the verb.

After mentioning the experimental items in detail, it is also worth mentioning how the filler items were designed. While designing the experiment and generating the items, it was also important to decide how many noncritical items ("distractors" or "fillers") to include so that the actual experimental items or the focus of the study could not be noticeable (Keating & Jegerski, 2015). It is commonly suggested that more than 50% of all of the items should be formed of noncritical items in order to not make the purpose of the study obvious to the participants. Additionally, more noncritical items provide the researchers with better predictions (Keating & Jegerski, 2015). However, it is also important to consider fatigue and boredom throughout the experiment, as it may affect the performance of the participants and thus the results of the study (Keating & Jegerski, 2015). Keating and Jegerski (2015) suggest that the percentage of the noncritical items for an experiment should be 75%. Hence, the entire data included 80 filler items, twice as many as the experimental items. For the purpose of presenting a homogenous list of data to the participants, the filler items included 15 complex, 20 simple and 45 compound sentences, 30 of which were relative clause sentences. 15 of these relative clause sentences consisted of subject relativization and the other 15 sentences included object relativization in order to display sentences with longer and

shorter subjects other than sentential subjects. The reason why various types of sentences were used as filler items is to discourage participants from perseverating on a single phrase order pattern (Stallings & MacDonald, 2011).

Even though the reading times for each stimulus are used as the primary measure, a poststimulus task is also required in the design of the experiment. This motivates participants to be on task throughout the experiment as this task gives them an obvious purpose to keep their attention (Keating & Jegerski, 2015). In this way, participants can pay attention to each and every item of the experiment during the entire process (Keating & Jegerski, 2015). Acceptability judgment task items and meaning-based comprehension questions are the most common two types of poststimulus distractors (Keating & Jegerski, 2015), and the latter type of stimulus was included into the current study. Hence, there were also 30 yes/no comprehension questions related to one-fourth of the sentences and they were asked to the participants every 3, 4 or 5 sentences. The purpose of asking these questions was to keep their focus on the process throughout the experiment and obtain as reliable results as possible.

(42) Was the mug broken?

Example (42) is one of the comprehension questions taken from the items and it was shown to the participants just after Example (39).

3.3. Experimental Procedure

The self-paced reading (SPR) method was adopted for this study. SPR, invented by psycholinguists in the 1970s (Aaranson & Scarborough, 1976; Mitchell & Green, 1978), is a simple method which prompted the researchers to develop modern eye-tracking experiment design (Jegerski, 2014). It is a computerized method of recording a reading time for each designated segment (i.e., a word or a phrase) of a sentence or series of sentences. Participants who take part in an experiment designed as a self-paced-reading task see the segments as words or phrases on a computer screen. They need to press a key, previously assigned by the researcher while designing the experiment, in order to see the following segment after reading the one on screen. The recorded time that the participant spends on each segment is used in the statistical analysis (Keating & Jegerski, 2015).

SPR method is really important in psycholinguistic studies as it provides researchers data on which to conduct language comprehension experiments by designing "tasks that are as similar as possible to normal reading" (Mitchell & Green, 1978: 610) since language comprehension process is observed and measured in real time (Jegerski, 2014) and moment by moment (Keating & Jegerski, 2015). Hence, the SPR method is an efficient way to measure linguistic skills, processing and performance in order to compare the performances of native and non-native speakers (Jegerski, 2014). This motivated the researcher of this thesis to conduct a self-paced reading experiment.

The experiment of the current study was also designed in accordance with this method. The sentences were typed in a way that they would appear word by word and the participants would not be able to see the preceding and upcoming word, as indicated in Example (43) below.

(43a) It ___ ___ ___ ___ ___

(43b) ___ is ___ ___ ___ ___

(43c) ___ ___ amazing ___ ___ ___

(43d) ___ ___ ___ that ___ ___

(43e) ___ ___ ___ ___ you ___

(43f) ___ ___ ___ ___ ___ came

Example (43) above is an example of the items and the participants see the following word just after pressing the relevant key on the keyboard. Another crucial factor to consider in this process is the presentation of the end of the sentence. The symbols "***" were placed after the last word of each sentence in order to inform the participants about the upcoming sentence. Another purpose of placing these symbols is to fix the eyes of the participants to the middle of the screen in order to avoid any negative effect of free eye movement on the sentence processing performance of the participants.

"Psychopy", a psychological experiment tool developed by Peirce (2007) and Peirce et al. (2011), was used in order to design and conduct the experiment. It is an open source software package which enables researchers to design every detail and step of the experiment (e.g. the duration of on-screen appearance of the items, the keys that the participants need to use) which will be conducted on a computer. The researcher

scheduled a specific time with each participant and the time of the day was taken into consideration in order to avoid any kind of fatigue and attention loss during the experiment. Therefore, the participants were invited to the sessions from noon to the afternoon (4 pm). They were provided with a silent and private room so that they could be on task throughout the process. During the experiment, the sentences were presented on a computer screen randomly and word-by-word. The participants were asked to move on to the next word by pressing the `spacebar`, the key previously designated by the researcher while designing the experiment. However; when participants saw the yes/no comprehension question related to one of the sentences, they were required to respond by pressing `y` for yes or `n` for no. The entire process lasted for around 25 minutes for each participant.

3.4. Statistical Analysis

The reading times for the experimental items –sentences with sentential and extraposed subjects– were the only ones included in the statistical analysis as the purpose of the comprehension questions and filler items was to keep the attention of the participants on the task and avoid making the purpose of the study as concealed as possible. However, preventing any kind of miscalculation or misinterpretation of the results was not less important than using the appropriate data since it was also possible that participants could have lost their attention or started reacting automatically. Thus, a data trimming process was needed before the statistical analysis. Even though there is not only one acceptable way of trimming data, Keating and Jegerski (2015) suggest that values between 100-200 ms and 2000-6000 ms are reliable and commonly accepted. With reference to these values, the reading times between 200 and 2000 ms were included in the statistical analysis process. SPSS was used to run the statistical analysis. Before going into the details of the types of the analyses, it is important to mention which values were used. To begin with, the reading times for the sentential noun clauses –as sentential subjects or extraposed subjects– were the primary target of the analysis. In order to be able to conduct the analysis, the mean values of each item in the sentential noun clause were obtained and used during the entire analysis process –which was considered "subject reading time". Another type of data used was the "verb reading time" as the presentation time of the verb automatically changes as the length of the preceding constituent varies. Kruscal-Wallis H and two-way ANOVA tests were

applied to the data in order to observe the results in detail from different perspectives. Kruscal-Wallis H tests were applied in order to examine the effect of sentential subject position (canonical vs. extraposed) and sentential subject length independently. This test was applied to the reading times of the groups to compare the processing times of each different group. The relationship between the effect of sentential subject position and length were observed by the application of two-way ANOVA to the reading times.

This chapter has provided an in-depth explanation of the research design, data collection procedures, and analysis techniques employed in this study. It has offered a comprehensive understanding of the steps taken to address the research objectives and gather relevant data. Chapter 4, as the following chapter, will present the results obtained from the statistical analyses of the experiment in detail.

4. RESULTS

This chapter presents the results of a variety of statistical analyses applied to the sentence processing performances of the participants. As mentioned in the previous chapter, inferential statistics were not applied to the data due to the low number of participants in each group. This chapter, therefore, presents the descriptive statistics results of the data collected from the participants. The first section of the chapter focuses on the reading times of the participants depending on the length of the subject. It also shows the descriptive statistics results of the statistical analyses applied to the reading times. This section is followed by another one displaying the descriptive statistics results applied to the reading times in order to examine the impact of subject position (canonical or extraposed) on sentence processing. While the first two sections focus on the two factors –"subject position" and "subject length"– separately, the last section presents the interaction between them by showing the descriptive statistics results. Each section consists of two parts, which present subject reading times and verb reading times.

4.1. Sentence Processing Performance According to Subject Length

Descriptive statistics results applied to the reading times of the three groups for the subjects with different length are shown in this section. As mentioned above, the first part of the section focuses on the results of the reading times for the subject while the second part displays the reading times for the verb of the sentence.

4.1.1. The reading times for the subject

Descriptive statistics were conducted in order to observe if there was a statistically significant difference between the processing times of the subject in different subject length conditions. The results are displayed in Table 4.1.

Table 4.1. *Descriptive statistics results of subject reading times according to subject length*

		N	Mean	Std. Deviation	Std. Error
English	**2-word-longer**	10	501,92	93,30	29,50
	5-word-longer	10	418,76	49,74	15,73
	7-word-longer	10	460,93	85,89	27,16
	10-word-longer	10	444,00	73,99	23,40
Turkish	**2-word-longer**	10	434,50	62,06	19,63
	5-word-longer	10	392,02	29,63	9,37
	7-word-longer	10	440,99	82,65	26,14
	10-word-longer	10	409,22	76,76	24,28
German	**2-word-longer**	10	497,81	141,57	44,77
	5-word-longer	10	421,57	33,33	10,54
	7-word-longer	10	506,38	105,41	33,33
	10-word-longer	10	476,94	127,48	40,31

According to the results presented in Table 4.1, 2-word-longer subjects were processed more slowly than the others in the English-native-speaker group (M=501.92, SD=93,30) while the 7-word-longer subjects were processed slightly more slowly than the 2-word-longer subjects and they were also processed the slowest in the Turkish-native-speaker (M=440.99, SD=82.65) group and the German-native-speaker group (M=506.38, SD=105.41). The 5-word longer subjects were processed the most rapidly in all of the native language groups. (M=418.76, SD=49.74 for English-native-speaker group, M=392.02, SD=29.63 for Turkish-native-speaker group and M=421.57, SD=33.33 for German-native-speaker group). Figure 4.1, which displays the trends during sentence processing, is worth being presented as it shows a similarity in the trends between Turkish-native-speaker group and German-native-speaker group as well as the difference of the trend occurring in English-native-speaker group.

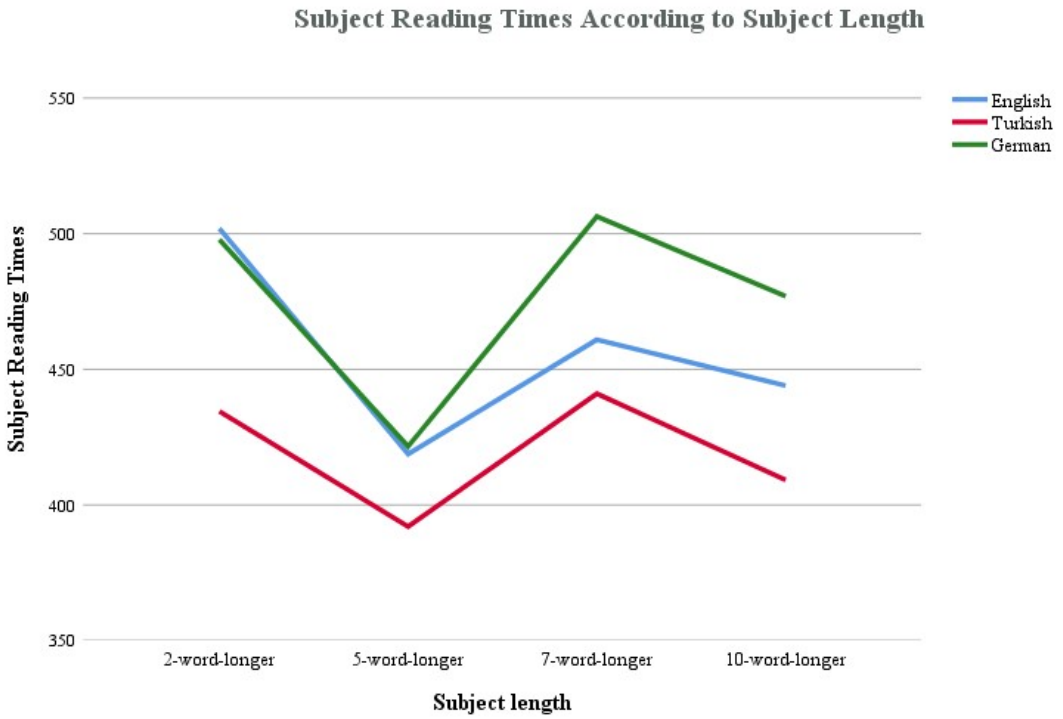

Figure 4.1. *Subject reading times according to subject length*

Figure 4.1 indicates that all the native-language groups show a parallel performance while processing the sentences with sentential subjects in different subject-length conditions despite several differences. As it can be seen in the line chart, the processing of 2-word-longer subjects, as the shortest sentential subject group, was the slowest in the English-native-speaker group. It was one of the slowest in the other two groups, followed by a sharp decrease in the processing of 5-word-longer subjects by all groups. The performances of the English-native-speaker group and the German-native-speaker group show quite a similar trend, almost an overlapping one. However, the subject processing performances of Turkish-native-speaker group were more rapidly and the difference between processing speed of 2-word-longer and 5-word-longer subjects was not as sharp as in the other group. An increase in the processing speed of 7-word-longer in all groups was observed but this increase is steeper in non-native groups, with a similar performance as the processing of 2-word-longer subjects. However, the processing performance of the English-native-speaker group did not show the same amount of increase in processing time as the other groups. Additionally, the processing of 7-word-longer subjects was still more rapid than the processing of 2-word-longer subjects in this group. When it comes to the processing performances in 10-word-longer subjects, there was a decrease in the processing time of each group when compared to the processing of 7-word-longer subjects. This decrease is, however,

sharper in non-native groups than in the native speakers of the English group. The general trends presented in the line chart show that the Turkish-native-speaker group processed all the subjects in different subject length conditions more rapidly than the other two groups. However, they do show a similar pattern with the German-native-speaker group. Table 4.2 shows Kruscal-Wallis H results, which was applied in order to examine if there was any significant difference among the subject reading times of the three groups in different subject length conditions.

Table 4.2. *The comparison of subject reading times of the groups according to subject length*

		Kruskal-Wallis H	**df**	**Asymp. Sig.**
All the groups	**2-word-longer**	3,455	2	,18
	5-word-longer	3,579	2	,17
	7-word-longer	2,841	2	,24
	10-word-longer	3,455	2	,18
English-German	**2-word-longer**	,366	1	,55
	5-word-longer	,143	1	,71
	7-word-longer	1,120	1	,29
	10-word-longer	0,206	1	,65
English-Turkish	**2-word-longer**	4,166	1	,04
	5-word-longer	1,851	1	,17
	7-word-longer	,571	1	,45
	10-word-longer	3,023	1	,08
German-Turkish	**2-word-longer**	,691	1	,04
	5-word-longer	3,291	1	,07
	7-word-longer	2,520	1	,11
	10-word-longer	2,063	1	,15

The results shown in Table 4.2 yield that there is not any significant difference between the subject reading performances of three native language groups in different subject length conditions. However, there is a significant difference between the English-native-speaker group and the Turkish-native-speaker group in 2-word-longer subject length conditions (H(1)=4.166, *p*=.04). A similar result was also observed between the German-native-speaker group and the Turkish-native-speaker group (H(1)=.691, *p*=.04).

4.1.2. The reading times for the verb

The first part of this section presents the results of descriptive statistics applied to the data according to the reading time for the verb of the sentences with different subject lengths.

Table 4.3. *Descriptive statistics results of verb reading times according to subject length*

		N	Mean	Std. Deviation	Std. Error
English	**2-word-longer**	10	428,56	85,56	27,06
	5-word-longer	10	401,54	69,50	21,98
	7-word-longer	10	402,93	58,71	18,57
	10-word-longer	10	399,86	35,057	11,09
Turkish	**2-word-longer**	10	373,78	110,94	35,08
	5-word-longer	10	367,24	66,60	21,06
	7-word-longer	10	422,06	78,34	24,77
	10-word-longer	10	420,91	78,45	24,81
German	**2-word-longer**	10	445,35	94,557	29,90
	5-word-longer	10	434,39	84,52	26,73
	7-word-longer	10	472,42	126,34	39,95
	10-word-longer	10	462,46	76,41	24,16

Table 4.3 presents the verb reading times of the three groups of participants in different sentence length conditions. As can be seen in Table 4.3, the verb reading times in the condition of 2-word-longer subjects were the second fastest in the Turkish-native-speaker group (*M*=373.78, *SD*=110.94) and the German-native-speaker group (*M*=445.35, *SD*=94.55). Unlike the English-native-speaker group, whose verb reading times in the same sentence length condition were the slowest (*M*=428.56, *SD*=85.56). The verb processing times of the three groups were the rapidest (*M*=367.24, *SD*=66.60 in Turkish-native-speaker group and *M*=434.39, *SD*=84.52 in German-native-speaker group) or the second rapidest (*M*=401.54, *SD*=69.50 in English-native-speaker group) in 5-word-longer subject length condition. However, the reading times differed in the native-speaker and nonnative-speaker groups in 7-word-longer subject length condition. The verbs of the sentences with 7-word-longer subjects were processed the most slowly in the Turkish-native-speaker group (*M*=422.06, *SD*=78.34) and the German-native-speaker group (*M*=472.42, *SD*=126.34) while the verb processing times were among the rapidest ones in English-native-speaker group (*M*=402.93, *SD*=58.71). Similar results were also observed in 10-word-longer subject length condition. The trends shown in Figure 4.2, indicate the details of the differences in verb reading times. This is of great value to emphasize as the verb reading times of English native speakers show the opposite trend compared to the other two groups.

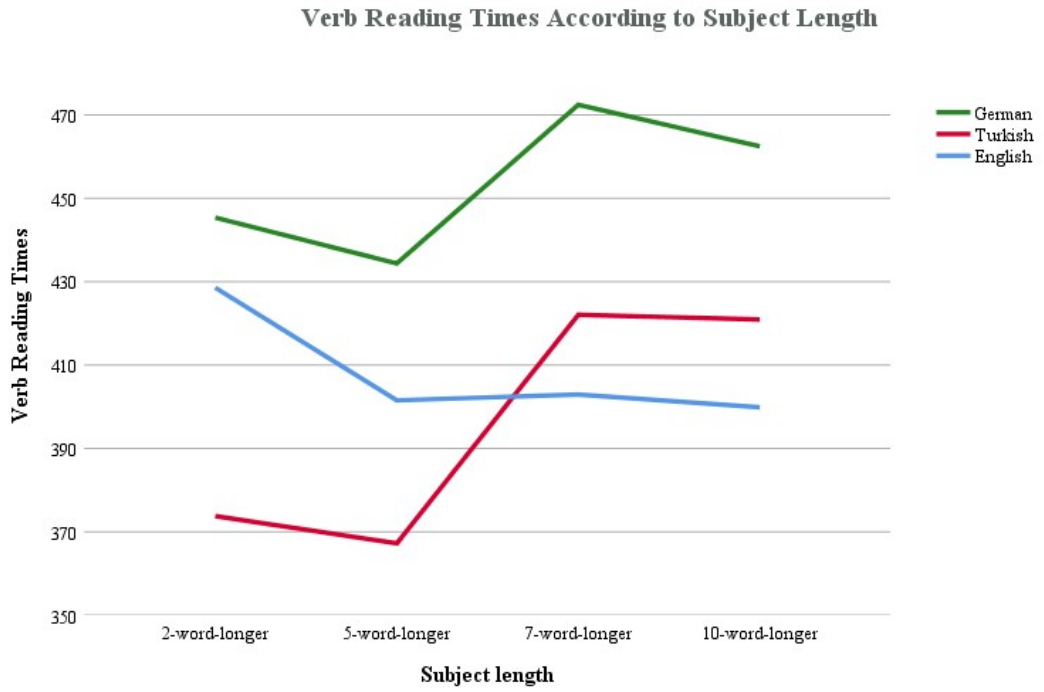

Figure 4.2. *Verb reading times according to subject length*

Figure 4.2 above shows a sharp decrease in the verb reading times of English native speakers as the length of the sentential subject increases and this decrease is followed by slight fluctuations. Unlike the declining trend in the verb reading times of the English native speakers, there is an obvious difference between the verb reading times of the sentences with two shorter subjects (2-word-longer and 5-word-longer) and two longer subjects (7-word-longer and 10-word-longer) in the Turkish and German native speaker group, as the non-native speakers of English. It can be seen in the line graph that the processing of verbs with 7-word-longer and 10-word-longer subjects was slower than the processing of verbs in sentences with 2-word-longer and 5-word-longer subjects. In these groups, there was a slight difference between the verb reading times for sentences with 2-word-longer and 5-word-longer subjects. When the reading times for 7-word-longer subjects and 10-word-longer subjects are compared, it can be seen that the times are almost the same. However, the graph shows that the verb reading time in longer subject conditions is noticeably higher in the two groups of non-native speakers of English, which is an opposite trend when compared to the verb reading times of English native speakers. However, a difference between the Turkish-native-speaker group and the German-native-speaker group was also observed, and the verb processing times of the German-native-speaker group in all subject length conditions were slower than the other group despite the parallel trend they indicated. Table 4.4 shows the results of the Kruscal-Wallis H test applied to verb reading times in different subject length conditions.

Table 4.4. *The comparison of verb reading times of the groups according to subject length*

		Kruskal-Wallis H	df	Asymp. Sig.
All the groups	**2-word-longer**	5,964	2	,52
	5-word-longer	,244	2	,24
	7-word-longer	2,248	2	,33
	10-word-longer	5,128	2	,77
English-German	**2-word-longer**	,206	1	,65
	5-word-longer	1,120	1	,29
	7-word-longer	2,766	1	,05
	10-word-longer	6,606	1	,01
English-Turkish	**2-word-longer**	4,166	1	,4
	5-word-longer	,823	1	,37
	7-word-longer	,280	1	,6
	10-word-longer	,463	1	,47
German-Turkish	**2-word-longer**	4,480	1	,03
	5-word-longer	2,286	1	,03
	7-word-longer	,366	1	,55
	10-word-longer	,823	1	,37

According to the findings presented in Table 4.4, there is a significant difference between the verb processing performances of the three native-speaker groups in the shortest subject length condition (H(2)=5.964, p=.05). When the test results between two groups are observed, it is seen that the verb processing performances of the English-native-speaker group and the Turkish-native-speaker group in 2-word-longer subject length condition differ significantly (H(1)=4.166, p=.04). Similarly, a significant difference between the verb processing performances of the German-native-speaker group and the Turkish-native-speaker group in the same subject length condition is also

observed (H(1)=4.480, *p*=.03). The results also yield that the verb processing performances of the Turkish-native-speaker group are significantly different from the German-native-speaker group when the subject is 5-word-longer (H(1)=2.286, *p*=.03). A significant difference between the verb processing times of the English-native-speaker group and the German-native-speaker group was also observed in longer subjects ((H(1)=2.766, *p*=.05 in 7-word-longer subject length condition and (H(1)=6.606, *p*=.01 in 10-word-longer subject length condition).

4.2. Sentence Processing According to Subject Position

This section presents the results of descriptive statistics applied to the reading times of the three groups for the subjects in different positions, namely canonical and extraposed positions. This section follows the same order as the previous one while displaying the results. The first part of the section focuses on the results of the reading times for the subject while the second part displays the reading times for the verb of the sentence.

4.2.1. The reading times for the subject

This part displays the processing performances of the three groups when the subject is taken into consideration and the descriptive statistics results are shown in Table 4.5.

Table 4.5. *Descriptive statistics results of subject reading times according to subject position*

		N	Mean	Std. Deviation	Std. Error
English	**Extraposed**	20	464,69	76,58	17,12
	Canonical	20	448,12	85,46	19,11
Turkish	**Extraposed**	20	421,55	58,11	12,99
	Canonical	20	416,81	75,45	16,87
German	**Extraposed**	20	441,97	68,36	15,27
	Canonical	20	509,38	134,95	30,18

The descriptive results in Table 4.5 show the processing times of subjects in different subject positions, “extraposed” and “canonical”. The results indicate that in the German-native-speaker group, the processing of sentences with canonical subjects (*M*=509.38, *SD*=134.95) was slower when compared to the ones with extraposed subjects (*M*=441.97, *SD*=68.36). In contrast, the subject processing times showed an opposite tendency in the English-native-speaker group. Namely, a slower processing in extraposed subjects (*M*=446.69, *SD*=76.58) compared to canonical subjects (*M*=448.12, *SD*=85.46). When it comes to the Turkish-native-speaker group, the processing time difference between two subject position conditions did not differ noticeably. Figure 4.3 displays the details of the trends of subject processing times according to subject position in three native-speaker groups.

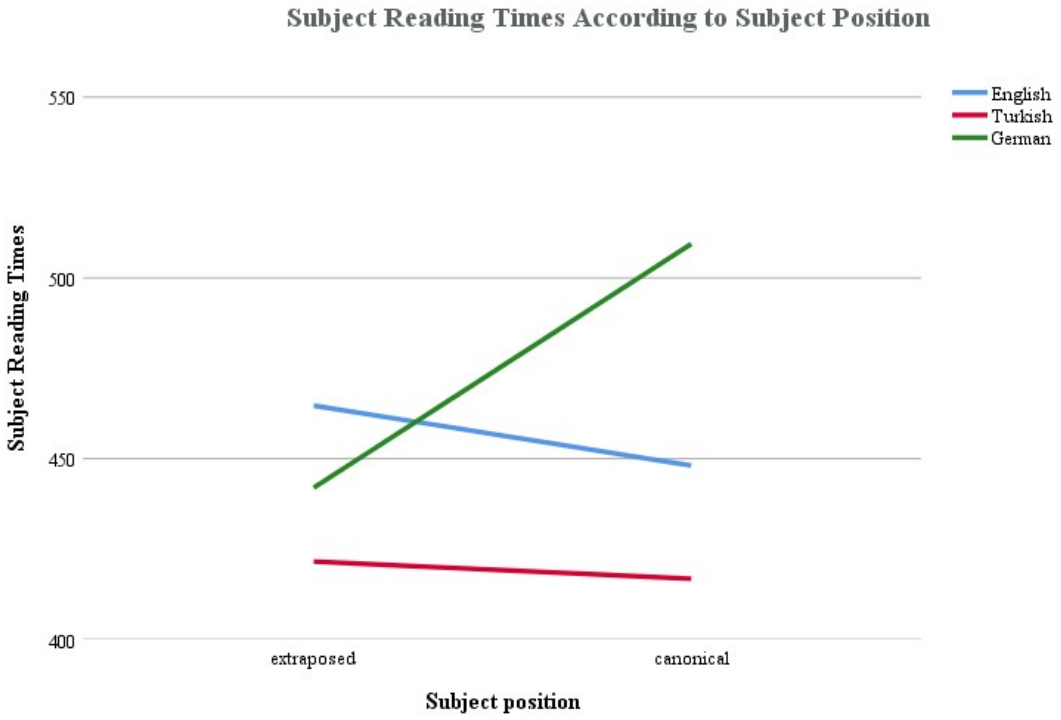

Figure 4.3. *Subject reading times according to subject position*

Figure 4.3 presents the differences in the subject reading times performed by all of the native-speaker groups in two different subject positions regardless of different subject length. According to this trend, the English-native-speaker group and the Turkish-native-speaker group tend to process extraposed subjects slightly more slowly than canonical subjects. This processing time difference is slightly slower in the English-native-speaker group. On the contrary to the trend of the processing performances of the English-native-speaker group and the Turkish-native-speaker

group, the German native speakers show an opposite tendency, which is a slower subject processing when the subject is in canonical position and a more rapid processing time when the subject is extraposed. As seen in the line graph, the difference between the processing performances of German-native-speaker is more noticeable than the performances of the other two groups. The Kruscal-Wallis H results of subject reading times in two subject position conditions are presented in Table 4.6.

Table 4.6. *The comparison of subject reading times of the groups according to subject position*

		Kruskal-Wallis H	df	Asymp. Sig.
All the groups	**Extraposed**	,591	2	,74
	Canonical	8,968	2	,01
English-German	**Extraposed**	1,757	1	,19
	Canonical	2,813	1	,03
English-Turkish	**Extraposed**	,691	1	,41
	Canonical	7,406	1	,07
German-Turkish	**Extraposed**	,650	1	,65
	Canonical	,290	1	,00

The results indicate that the subject reading times among the three native-speaker groups are significantly different when the sentential subjects are in an extraposed position (H(2)=8.968, *p*=.01). When the groups are compared separately, significant results were observed between the German-native-speaker group and the other two groups when the subjects are in extraposed position (H(1)=2.813, *p*=.03 for the comparison between English-native-speaker group and German-native-speaker group and H(1)=,290, *p*=.00 for the comparison between German-native-speaker and Turkish-native-speaker group). The differences between the subject performances of the Turkish-native-speaker group and the English-native-speaker group were found to be non-significant.

4.2.2. The reading times for the verb

The verb processing time differences in the three native speaker groups are presented in this section, separately. Table 4.7 includes the descriptive statistics results of verb reading times of the English native speakers, the Turkish native speakers and the German native speakers, respectively.

Table 4.7. *Descriptive statistics results verb reading times according to subject position*

		N	Mean	Std. Deviation	Std. Error
English	**Extraposed**	20	399,76	67,42	15,08
	Canonical	20	416,69	59,72	13,35
Turkish	**Extraposed**	20	369,25	85,11	19,03
	Canonical	20	422,75	79,89	17,86
German	**Extraposed**	20	453,85	108,97	24,37
	Canonical	20	453,46	80,80	18,07

The descriptive statistics results indicate that the verb processing time in the German-native-speaker group, in different subject length conditions, were almost the same (*M*=453.85, *SD*=108.97 in extraposed subjects and *M*=453.46, *SD*=80.80 in canonical subjects). Conversely, a decrease is seen in the verb processing times for extraposed subjects in the English-native-speaker group (*M*=399.76, *SD*=67.42) and the Turkish-native-speaker group (*M*=369.25, *SD*=85.11) compared to canonical subjects (*M*=416.69, *SD*=59.72 in English-native-speaker group and *M*=422.75, *SD*=79.89). Figure 4.4 shows the trends in the verb reading times in three native-speaker groups.

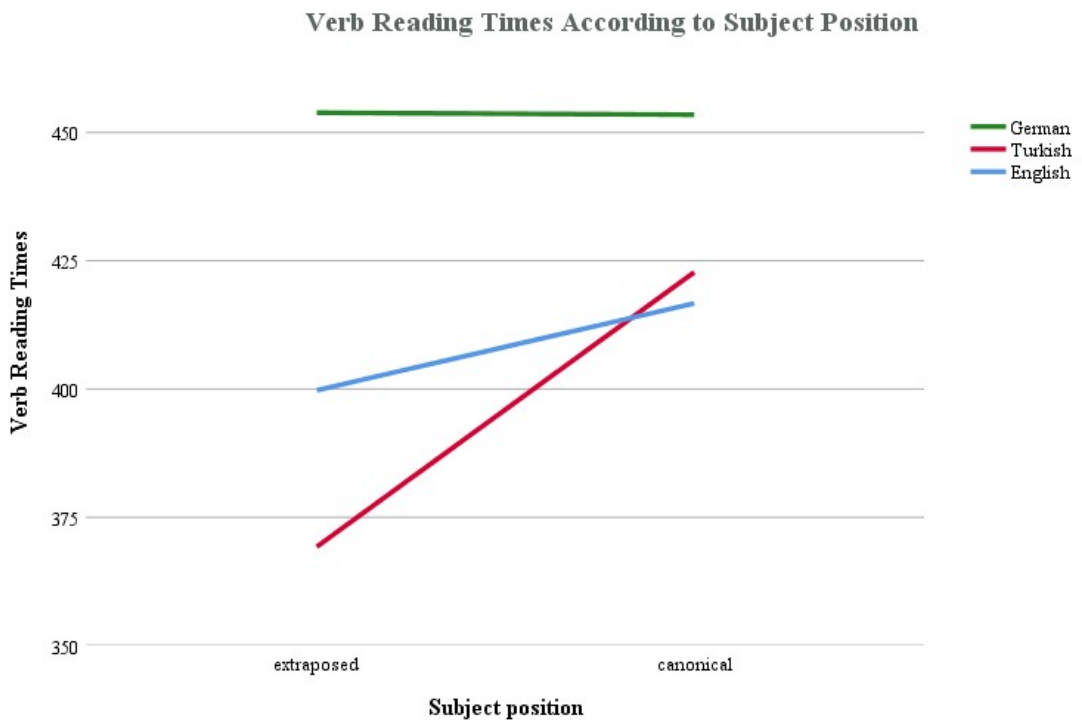

Figure 4.4. *Verb reading times according to subject position*

Figure 4.4 presents the verb reading times of the three native-speaker groups in the two subject position conditions. As it can be seen in the graph, it takes more time for English native speakers to process the verb of a sentence when the subject is in the canonical position. The verb processing time of the Turkish-native-speaker group was also slower when the sentential subject was in the canonical position. This difference is more noticeable than the one observed in the English-native-speaker group. When it comes to the German-native-speaker group, no statistically significant difference between the verb processing was observed and the processing time of the verb in two different subject position conditions was almost the same. Table 4.8 presents the Kruscal-Wallis H results for the verb reading times in different subject position conditions.

Table 4.8. *The comparison of verb reading times of the groups according to subject position*

		Kruskal-Wallis H	df	Asymp. Sig.
All the groups	**Extraposed**	15,068	2	,00
	Canonical	2,996	2	,25
English-German	**Extraposed**	3,484	1	,00
	Canonical	2,213	1	,19
English-Turkish	**Extraposed**	3,689	1	,00
	Canonical	,003	1	,96
German-Turkish	**Extraposed**	7,763	1	,00
	Canonical	,160	1	,29

The results shown in Table 4.8 yield that the verb processing times differ significantly among all the groups (H(2)=15.068, *p*=.00) when the subject is extraposed. The verb processing times of the English-native-speaker group and the German-native-speaker group are significantly different (H(1)=3.484, *p*=.00). Similarly, a significant difference between the verb processing performances of the English-native-speaker group and the Turkish-native-speaker group was also observed in the extraposed subject condition (H(1)=3.689, *p*=.00). When the verb processing performances of the non-native speaker groups were compared, they also significantly differed when the subjects were extraposed (H(1)=7.763, *p*=.00).

4.3. Sentence Processing According to the Interactive Effect of Length and Position

While the previous two sections of this chapter focus on the processing performances of the three groups according to different subject length and subject position independently, this section presents the interaction between these independent variables of the study: subject length and position in the processing of sentences with sentential subjects. This section follows the same order as the previous ones and first presents the results of the descriptive statistics results in terms of subject reading time. It then continues with verb reading time. However, in this section three different native language groups are presented in the tables and line graphs independently.

4.3.1. The reading times for the subject

This section presents the two-way ANOVA results of the subject processing times of the three native language groups by considering the interaction of the two factors, subject length and subject position.

Table 4.9. *Two-way ANOVA results of subject reading times in the English-native-speaker group*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	52906,80[a]	7	7558,11	1,209	,32
Intercept	8332167,08	1	8332167,08	1333,024	,00
Subject length	36636,60	3	12212,20	1,954	,14
Subject position	2745,70	1	2745,70	,439	,51
Subject length * Subject position	13524,51	3	4508,17	,721	,54
Error	200018,34	32	6250,57		
Total	8585092,22	40			
Corrected Total	252925,14	39			

a. R Squared = ,209 (Adjusted R Squared = ,036)

Table 4.9 shows the two-way ANOVA results of the subject processing performances for the English-native speaker group. The results indicate that there is no interaction between the factors, subject length and position, during the subject processing in the English-native-speaker group ($F(3,32)=.721$, $p=.54$). However, the presentation of the trend occurring in the interaction of these factors is important to examine, as it allows for a better comparison of the different groups. This trend can be seen in Figure 4.5.

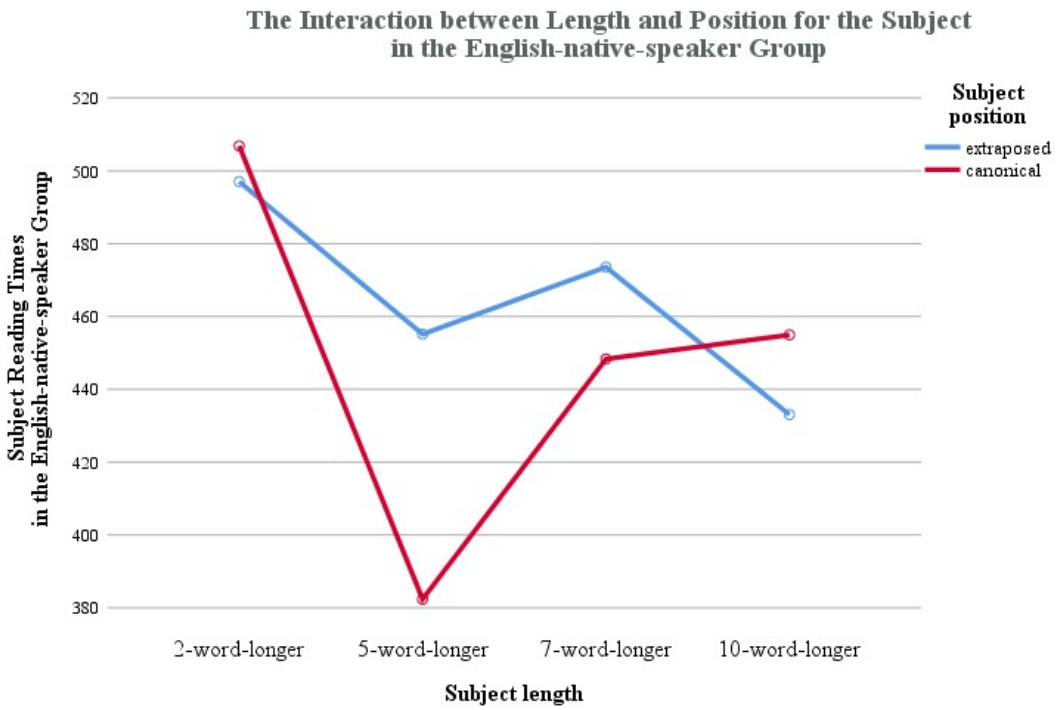

Figure 4.5. *The interaction between length and position for the subject in the English-native-speaker group*

Figure 4.5 presents the subject processing performances of the English-native-speaker group, and there is not a dramatic change in the subject processing when the sentential subject was in the extraposed position. This is unlike the condition in which the sentential subject was in canonical position. In both conditions, the processing of the subject which is composed of the fewest number of words was almost the same and it took the longest. This was followed by a decrease in the processing time of 5-word-longer subjects. This change was a more obvious one in subjects in canonical position. The results of the two longer subject groups are approximately at the same level despite the different trends that they show. While the subject processing of 7-word-longer and 10-word-longer sentential subjects remained almost the same when the subjects were in canonical position, 7-word-longer subjects were processed more slowly than the ones which were composed of 10 words-longer in extraposition condition. Overall, it can be concluded that subjects in extraposed positions were processed more slowly.

Table 4.10. *Two-way ANOVA results of subject reading times in the Turkish-native-speaker group*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	19950,96[a]	7	2850,13	,598	,75
Intercept	7028641,76	1	7028641,76	1473,904	,00
Subject length	15474,92	3	5158,31	1,082	,38
Subject position	224,51	1	224,51	,047	,83
Subject length * Subject position	4251,53	3	1417,18	,297	,83
Error	152599,21	32	4768,72		
Total	7201191,93	40			
Corrected Total	172550,17	39			

a. R Squared = ,116 (Adjusted R Squared = -,078)

The subject processing performance results of the Turkish-native-speaker group are presented in Table 4.10. The two-way ANOVA results indicate that the interaction between the two factors, subject length and position, does not considerably affect the sentence processing ($F(3,32)=.297$, $p=.83$). Nonetheless, examining the trends in Figure 4.6 indicate the details of the tendencies and preferences of the Turkish-native-speaker group.

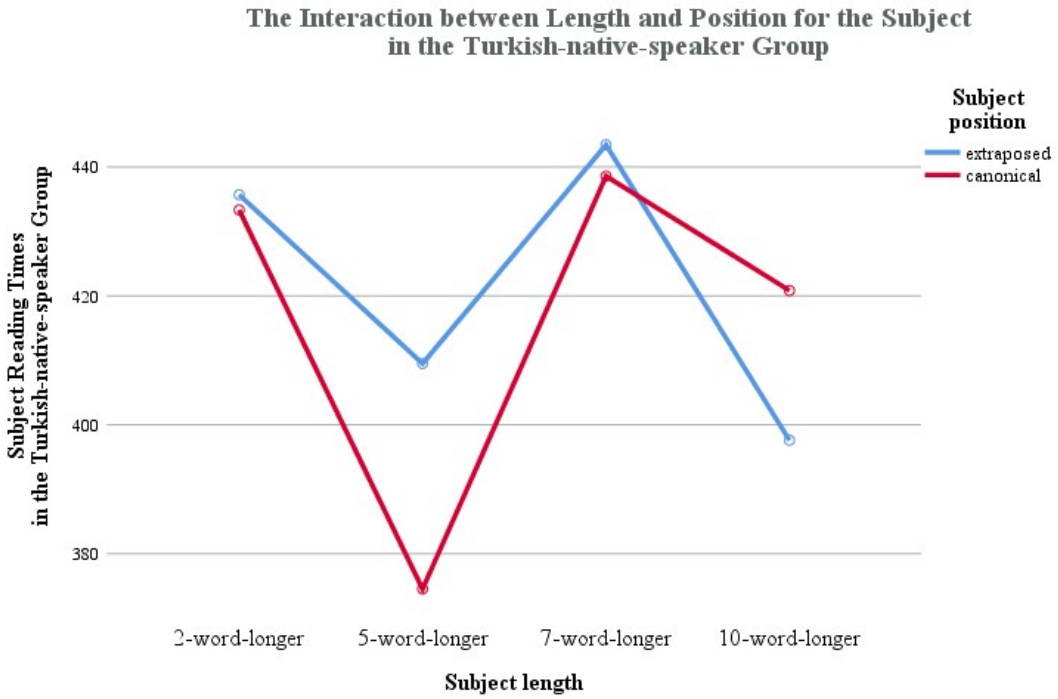

Figure 4.6. *The interaction between length and position for the subject in the Turkish-native-speaker group*

Figure 4.6 indicates that the subject processing performances were similar to the English-native-speaker group in that the difference between the processing of 2-word-longer and 5-word-longer subjects were alike in the two subject position conditions. However, a sharper increase in both subject position conditions of 7-word-longer and this increase was sharper when the subject was in canonical position. Although a decline was observed when the subject processing of 10-word-longer subjects when compared to 7-word-longer ones, the processing of 10-word-longer subjects was faster when the subject was in the extraposed position.

Table 4.11. *Two-way ANOVA results of subject reading times in the German-native-speaker group*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	105790,6[a]	7	15112,94	1,292	,29
Intercept	9050701,8	1	9050701,8	773,442	,00
Subject length	43615,26	3	14538,42	1,242	,31
Subject position	45440,96	1	45440,96	3,883	,06
Subject length * Subject position	16734,39	3	5578,13	,477	,70
Error	374459,1	32	11701,85		
Total	9530951,46	40			
Corrected Total	480249,66	39			

a. R Squared = ,220 (Adjusted R Squared = ,050)

The results of two-way ANOVA analysis for the subject processing of the German-native-speaker group are presented in Table 4.11. It can be concluded from the results that the effect of the interaction between subject length and subject position on the processing of sentential subjects is not considerable ($F(3,32)=.477$, $p=.70$). Figure 4.7 shows the tendencies of the German-native-speaker group in the different conditions.

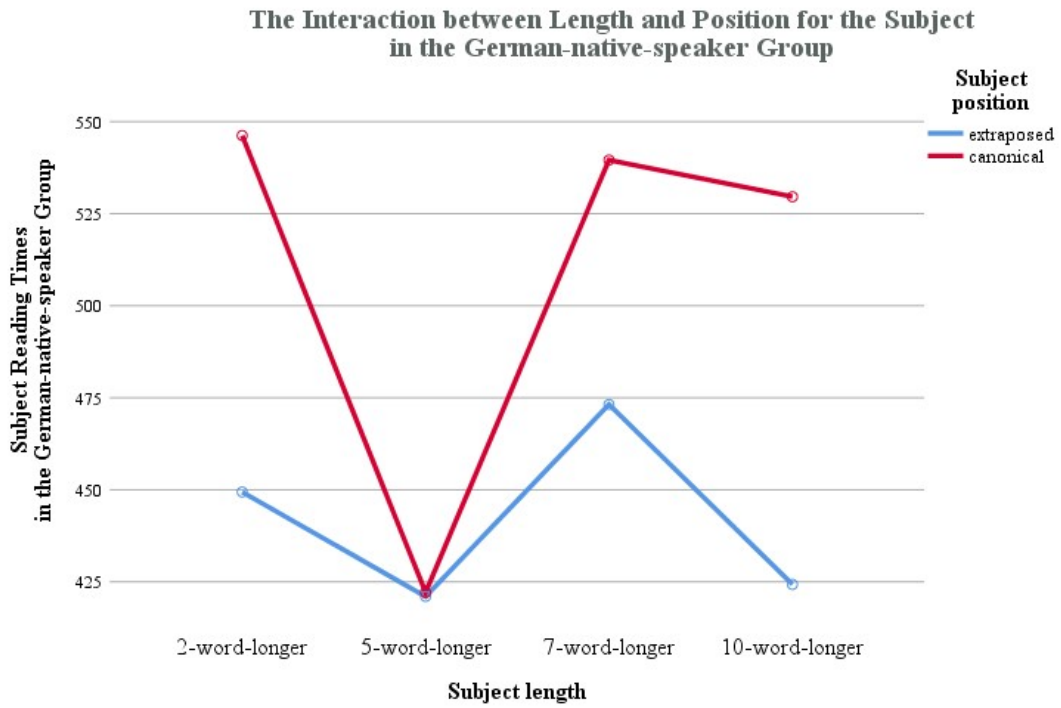

Figure 4.7. *The interaction between length and position for the subject in the German-native-speaker group*

According to Figure 4.7, the processing of sentences at different lengths followed a parallel trend although the extraposed subjects were all processed faster. With the exception of the 5-word-longer ones, the processing time of which was almost the same in two subject position conditions. In the canonical position, however, the processing of the same-length subjects was longer when compared to the ones in extraposed position.

Verb reading times, as well as subject reading times, were also observed in order to better understand and find out if the interaction between the two factors made a noticeable difference between the processing of sentences with sentential subjects, the following section presents the results regarding this observation.

4.3.2. The reading times for the verb

The second part of the section focuses on the presentation of the verb reading times of the three native-language groups in terms of the interaction between the two independent factors subject length and subject position. Table 4.12 presents the descriptive statistics results of the verb reading times of the English-native-speaker group.

Table 4.12. *Two-way ANOVA results of verb reading times in the English-native-speaker group*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	18581,5[a]	7	2654,5	,614	,74
Intercept	6665924,9	1	6665924,9	1540,947	,00
Subject length	5562,12	3	1854,04	,429	,73
Subject position	2868,92	1	2868,92	,663	,42
Subject length * Subject position	10150,44	3	3383,48	,782	,51
Error	138427,56	32	4325,86		
Total	6822933,96	40			
Corrected Total	157009,05	39			

a. R Squared = ,118 (Adjusted R Squared = -,075)

As it can be seen in Table 4.12, there is no dramatic effect of the interaction between subject length and subject position on the verb reading time in the English-native-speaker group ($F(3,32)=.782$, $p=.51$). Yet, it is better to present the tendencies of the English-native-speaker group while reacting to the verb in order to be able to compare the performances of the group with the other native-language groups, and these trends are shown in Figure 4.8.

Figure 4.8. *The interaction between subject length and position for verb in the English-native-speaker group*

Figure 4.8 indicates that the processing of the verb in the sentences with shorter sentential subjects was slower when compared to the ones in the sentences with longer sentential subjects when the subject was in the canonical position. It can be concluded that verb processing in sentences with canonical word order follows a declining trend despite slight fluctuations. When it comes to the extraposed sentential subjects, there is an increasing trend in the condition in which the sentential subject becomes longer. However, the reading time shortens when the subject consists of the highest number of words, when compared to 7-word-longer subjects. It is also important to highlight that the verb processing in the sentences with the shortest subjects was the second slowest and verbs in the sentences with 5-word-longer subjects were the most rapid ones to be processed.

Table 4.13 shows the results of descriptive statistics applied to the verb reading times of Turkish-native-speaker group.

Table 4.13. *Two-way ANOVA results of verb reading times in the Turkish-native-speaker group*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	100771,054[a]	7	14395,87	2,467	,04
Intercept	6272625,942	1	6272625,94	1074,894	,00
Subject length	26210,236	3	8736,75	1,497	,23
Subject position	28617,726	1	28617,73	4,904	,03
Subject length * Subject position	45943,092	3	15314,36	2,624	,07
Error	186738,484	32	5835,58		
Total	6560135,480	40			
Corrected Total	287509,538	39			

a. R Squared = ,209 (Adjusted R Squared = ,036)

The results presented in Table 4.13 indicate a non-significant effect of the interaction between the two factors, but the p value of the analysis is close to .05, a significant value ($F(3,32)=2.624$, $p=.07$). In order to observe the details of this interaction, the data in Figure 4.9 should also be considered.

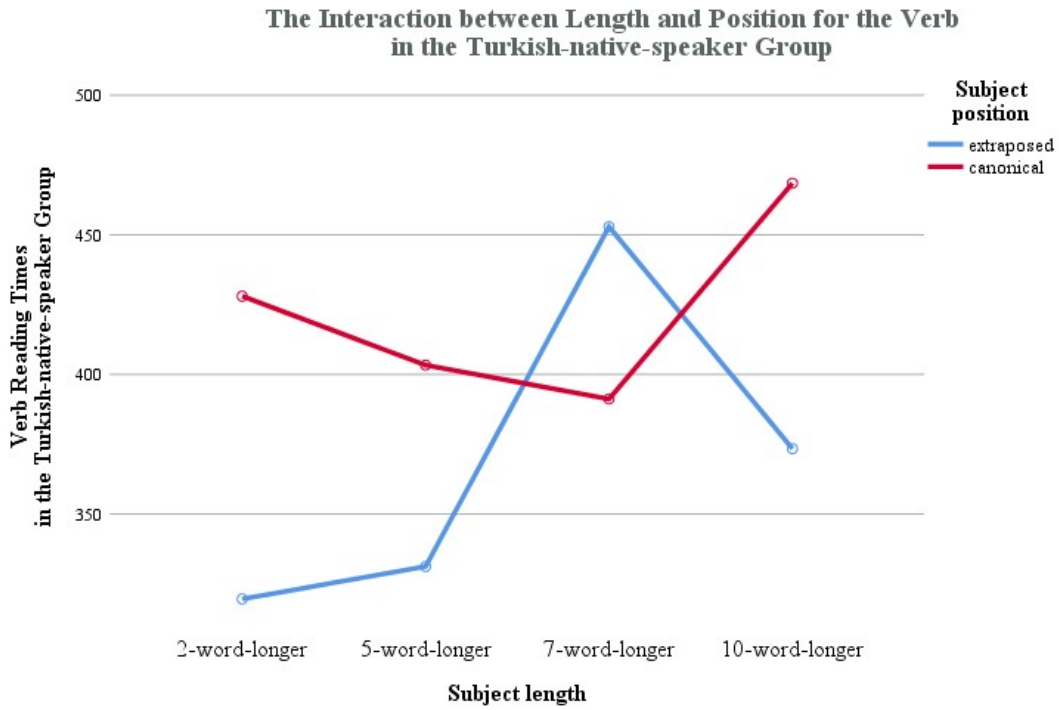

Figure 4.9. *The interaction between length and position for the verb in the Turkish-native-speaker group*

Figure 4.9 displays the details of the verb processing times of the Turkish-native-speaker group when both factors were taken into consideration. As it can be seen in the figure, the verb processing performances were generally slower when the sentences were in canonical position. Although the verb processing times were almost the same – with a slight decrease– in sentences with 2-word-longer, 5-word-longer and 7-word-longer subjects, the verb processing of the sentences with the 10-word-longer subjects was the slowest. Unlike verbs in the sentences mentioned before, the verbs in sentences with the two shortest subjects were processed faster in extraposed sentences. This processing time showed a sudden increase in the 7-word-longer subject condition. Even though the verb processing times in sentences with 10-word-longer subjects were shorter, they were still much higher than those in sentences with shorter subjects.

The verb reading results of the German-native-speaker group, as the last group in this study, are shown in Table 4.14.

Table4.14. *Two-way ANOVA results of verb reading times in the German-native-speaker group*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	89966,45[a]	7	12852,35	1,584	,18
Intercept	8232161,76	1	8232161,76	1014,403	,00
Subject length	8703,87	3	2901,29	,358	,78
Subject position	1,48	1	1,48	,000	,99
Subject length * Subject position	81261,1	3	27087,03	3,338	,03
Error	259688,88	32	8115,28		
Total	8581817,09	40			
Corrected Total	349655,33	39			

a. R Squared = ,257 (Adjusted R Squared = ,095)

The impact of interaction between subject length and subject position on the verb processing of the German-native-language group was found to be significant, as seen in Table 4.14 ($F(3,32)=3.338$, $p=.03$). However, the multiple comparison analysis applied to the data did not show any significant difference between the specific sentence conditions. Figure 4.10 indicates the details of the verb processing performances in the German-native-speaker group.

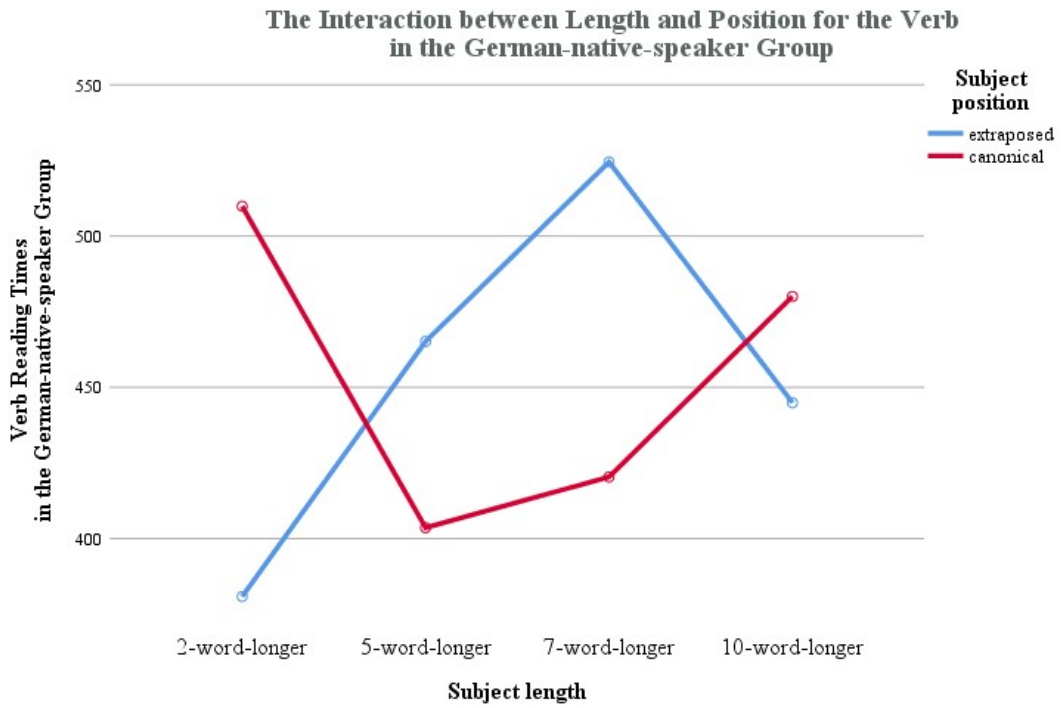

Figure 4.10. *The interaction between length and position for the verb in the German-native-speaker group*

According to Figure 4.10, which displays the verb processing performances of the German-native-speaker group by considering the interaction between the two conditions, the verb reading times of sentences with subjects at different lengths shows an opposite trend when the subject positions are compared. When the verb processing performed in canonical-positioned subjects was observed, the shortest subjects were the ones which were processed more slowly than the others. Also, the processing time increased as the length of the subject increased. However, the processing of each one of them was still shorter than 2-word-longer subjects. Figure 4.10 above indicates that the verb processing in extraposed sentences occurred in an opposite way in the German-native-speaker group. The processing in extraposed sentences was the fastest in 2-word-longer subjects followed by an increasing trend as the subject length increased and reached a peak in the processing of 7-word-longer subjects. This was followed by another sharp decrease in the verb processing time of the sentences with the longest subjects.

In this chapter, the results obtained from the analysis of the collected data have been presented. These findings provide valuable insights into the research questions and contribute to the overall understanding of the subject matter. However, the discussion and interpretation of these results in light of the theoretical framework will be elaborated in Chapter 5.

5. DISCUSSION

The focus of this thesis is the sentence processing of sentential subjects in English and it investigates whether the position and length of the sentential subject has an impact on the processing of the sentence. The study examines the processing performances of native speakers and non-native speakers of English, whose native languages have syntactically different features from their second language (Turkish and German in this thesis). The comparative aspect of the study focuses on the comparison of the performances of three native-language groups. This chapter analyzes and discusses the results presented in the previous chapter. It consists of two sections, each one of which has three parts. The first section presents and discusses the processing performances of the three groups separately. It discusses the effect of subject length and position independently and later the interaction between these two factors. While the first section focuses on the effects of subject length and position in the groups separately, the second section aims to discuss the results based on the comparison between the performances of these groups.

5.1. The Processing Performances of the Groups

This section discusses the results obtained after the statistical analyses by focusing on the two factors, “subject length” and “subject position”, independently. The first part of the section consists of the discussion of the processing performances of the groups in different subject length conditions. It continues with the discussion of the processing performances in two different subject position conditions. Both parts focus on the subject reading times first and then discuss verb reading times.

5.1.1. Sentence processing performance according to subject length

Subject length was observed in this study in order to focus on the functioning of the memory cost. Specifically in terms of the length of an entire phrase to be processed as storing the items of an entire constituent requires memory cost in order to process and understand it (Just & Carpenter, 1992).

Both the statistical analysis results and the line graphs present the trends of sentence processing in different subject length conditions. An examination of the subject processing trends show a sharp increase in the performances of the Turkish and

German groups, a sharp increase from the processing of 5-word-longer subjects to 7-word-longer and 10-word-longer subjects. This is despite an observed slight decrease in the processing of 10-word-longer subjects. The English-native-speaker group also shows the same processing performance, but with a slighter difference in the three different length conditions. These results can be explained by both the first stage of the parsing model, The Sausage Machine, by Frazier and Fodor (1978) and Syntactic Prediction Theory by Gibson (1998). To begin with, the results comply with the Preliminary Phrase Packager (PPP) –the first stage of the parsing model, The Sausage Machine (1978)– and it suggests that the limited capacity of working memory allows to the storage of five to six words in order to continue with the second stage. In the second stage, the human parser approaches the sentence as a whole, the importance of which will be discussed later in this section. In accordance with this parsing model, the memory cost aspect of Syntactic Prediction Theory suggested by Gibson (1998), focuses on the number of the resources required to store a constituent. It claims that it gets more challenging for the human parser to process the constituent and predict the upcoming words, especially when the number of words exceeds the limit declared by Frazier and Fodor (1978). Gibson (1998) also claimed that memory cost prepares the sentence processor for a more complicated stage of the sentence processing, the integration of the words syntactically and semantically, known as integration cost. During this phenomenon, the sentence processor is able to predict the upcoming word with the help of the lexical features of the current lexical item. Then, the processor thinks of several possibilities according to the syntactic continuation. However, when the constituent gets longer and the distance between the head and its dependent increases, it results in more load in working memory and a longer processing time. In light of these suggestions, an increase in the word number of the subject may have caused the increase in the processing time from 5-word-longer subjects to 7-word-longer ones.

Although it still took a longer time to process the 10-word-longer subjects compared to the 5-word-longer ones, there is only a slight decrease in the processing time when compared to the 7-word-longer. This may have resulted from the ability to predict more than just the length, but also the upcoming word in a constituent, based on the approach proposed by Levy (2008). In this approach, he did not ignore the effect that sentence and constituent lengths have on working memory. Levy (2008)

highlighted the word prediction aspect of sentence processing by claiming that it becomes easier for the sentence processor to predict the upcoming word as the constituent continues and the number of possibilities decreases. In this case, it takes a shorter time to process the rest of the constituent as the sentence processor may make a decision among the decreasing number of possibilities. This could be the reason why the processing of 10-word-longer subjects occurred in a shorter time than the 7-word-longer because there are fewer possibilities as the subject gets longer. This provides more input for the sentence processor. It may also be concluded that there might be a threshold between 7-word-longer and 10-word-longer subjects, which results in an increase in the number of possibilities for the upcoming word. This also means spending less time predicting the following words and processing the entire constituent. The non-significant results between the three native language groups in the processing of 5-word-longer, 7-word-longer and 10-word-longer subjects indicate that the processing of sentential subjects occur in a similar way in L1 and L2.

Contrary to the prediction based on the Sausage Machine by Frazier and Fodor (1978) and Syntactic Prediction Theory by (Gibson, 1998), 2-word-longer subjects were the ones which were processed more slowly. It might be because the sentence processor starts reading and thinking about the possibilities for the upcoming words without sufficient input. This results in difficulty predicting the following words and thus a longer processing time. Also, when it is possible to narrow down the possibilities, the subject is completed and the other constituent or the next sentence appears. Another possible cause for the longer processing of 2-word-longer subjects may be the appearance of unexpected word types. 2-word-longer subjects ended with the verb of the sentential subject and then the verb of the main clause appeared. Seeing two verbs one after another might have surprised the processors as they might not have expected to see a verb after seeing another verb. It can be concluded from these results and predictions that the longer processing time of 2-word-longer subjects may be explained with Expectation-based Syntactic Theory by Levy (2008). Based on a decrease in the reading times of 5-word-longer subjects, it can also be suggested that in all the three groups there might be a threshold between 2-word-longer and 5-word-longer subjects where enough predictions are made and the processing time changes. Although lack of input might have caused a longer processing time for all groups, it is also important to highlight the significant difference between the processing of subjects which are 2-word

longer for the Turkish-native-speaker group and the other two groups. The processing of the Turkish-native-speaker group was found to be significantly faster. This might be the flexibility in word order in Turkish, because it provides Turkish native speakers with a familiarity with alternative word orders. Additionally, the head-initial structure of English may be the reason for a longer processing time of these subjects by the English-native-speaker group. The German-native-speaker group also performed similarly. In addition to the lack of input, the variety in the word order of German might have affected the processing performances of the German-native-speaker group.

However, sentence processing does not only refer to the processing and storage of the words one by one. Frazier and Fodor (1978) and Gibson (1998, 2000) included another level of processing into their models and theories. In this level, sentence processors attach the words to a higher node, the head of the constituent. The Preliminary Phrase Packager (PPP), the first stage of The Sausage Machine suggested by Frazier and Fodor (1978), leads to the processing of the constituents and sentences as a whole. It does this by including the higher nodes, which is called Sentence Structure Supervisor (SSS). It is also important to remember the integration cost aspect of the Syntactic Prediction Theory by Gibson (1998, 2000) as seeing the verb means the completion of the constituents and the start of another one. As a result of this, the sentence processor can process the entire constituent semantically and the process of that part is completed. That is why observing only the subject reading time may not give all the details about the processing performances as the sentence processors have not seen the verb, as the head, yet. When the sentence processor sees the verb, the constituent is completed. The sentence processor has seen all the input and can process the entire constituent, the subject in this case. That is why verb reading time includes the processing time of not only the verb but also the subject preceding the verb.

The statistical analysis results and the line graph presenting verb reading times indicate that all three groups performed differently in different subject length conditions. When the line graphs presenting the verb reading times of the Turkish and German groups are studied closely, it can be seen that their performance trends show visible similarities. While the verb processing time of both groups was the shortest when the subject was the shortest, this is followed by a sharp increase when the subject was 5-word longer. The verb processing times of 7-word-longer and 10-word-longer subjects were close to the ones of 5-word-longer subjects. These results show

compatibility with The Sausage Machine by Frazier and Fodor (1978) as well as the Syntactic Prediction Theory by Gibson (1998, 2000) in terms of the verb processing. This also includes the processing time of the subject after seeing the entire constituent, which takes longer as the length of the subject increases. This phenomenon occurs because long subjects result in an increasing distance between the verb and the dependent constituents causing more working memory load in order to process the entire sentence. In contrast to the non-native speakers of English, native speakers of English showed the opposite performance trend. In other words, a sharply decrease in verb processing time from 2-word-longer to 5-word-longer subjects was observed and there was almost no noticeable difference afterwards. These results may be a result of the high predictability of the upcoming words as the constituents get longer, according to the Expectation-based Syntactic Theory by Levy (2008). However, these findings arise another question about the reason why there is such an opposite trend between the native and non-native speakers of English. In this case, it is also worth discussing the position of the subject and the cross-linguistic differences between the native languages of non-native English speakers and English, especially in light of Performance Theory by Hawkins (1990, 1994, 2004).

Although the non-native speaker groups showed similarities, the processing of the shorter subject by the Turkish-native-speaker and the German-native-speaker groups significantly differed. Despite the flexibility in the word orders of both languages, German has different canonical word orders which might be the cause of the significantly longer verb processing times for sentences with shorter subjects. The significant difference between the verb processing times of the longer subjects by the English-native-speaker and the German-native-speaker group might also be because of the variety of canonical sentence structures in German. The combination of the variety of structures, working memory load, verb processing and the attachments of the longer subjects to the head might have been more challenging for the German-native-speaker group. Another factor which might have affected this group might be the orthographic difference between languages. Unlike English and Turkish, embedded structures in German start with a comma and the German-native-speaker group might have expected to see a comma before seeing sentential subjects.

5.1.2. Sentence processing performance according to subject position

In order to understand the effect of subject position on the processing of sentential subjects, the reading times of the three groups in two different subject position conditions, namely "canonical" and "extraposed" positions. This section of the chapter discusses the statistical analysis results of the reading times of the participants in these conditions. This section, just like the previous one, focuses on the issue in terms of subject reading time and verb reading time, respectively.

This aspect of the study can be explained by Performance Theory suggested by Hawkins (1990, 1994, 2004, 2014) where he claimed that sentence processors tend to prefer alternative word order to ease processing. However, this phenomenon is overgeneralized when there is only one alternative or preference because the typological variation of languages should also be taken into consideration. That is why Hawkins (2014) included a cross-linguistic variation aspect. Performance theory was inspired by the classification of languages in terms of their syntactic structures ("head-initial" vs. "head-final") and alternative word orders by Dryer (1980). In light of this classification, Hawkins (1994, 2014) claimed that head-initial languages, such as English, show a short-before-long preference in order to keep the shorter constituent adjacent to the verb, as the head. On the contrary, head-final languages such as Japanese show an opposite tendency, which is long-before-short preference in order to ease the sentence processing. This phenomenon is called "Early Immediate Constituents (EIC)*"* by Hawkins (1990, 1994, 2004, 2014), which was explained in Chapter 2. However, there is a specific point of EIC that needs to be mentioned more closely. There may be several exceptions for this phenomenon as a result of the flexibility in the syntactic structure of the language, one of which is Turkish (Hawkins, 2014). It is because case markers in Turkish allow the language to have a more flexible word order although the canonical word order is SOV. According to EIC, this situation results in a weaker predictability of the preferred sentence structures.

Performance Theory also claims that this preference has an impact on the occurrence of alternative word order and "heavy-NP shift" and "extraposition", which refers to the principle "saving the hardest for the last" (Bever, 1970). This resulted in the existence of the phenomenon "subject-it extraposition" (e.g. "It is obvious that John is tall" (Dryer, 1980: 124) as an alternative to "That John is tall is obvious" in English (Dryer, 1980: 124)). When this phenomenon is observed in head-initial languages, head-

final languages do the extraposition in a different way by turning the canonical SOV syntactic structure into SVO. (e.g. “Er hat gestern das Buch gefunden das der alte Professor verloren hatte.” (Francis, 2010: 13) as an alternative to “Er hat gestern das Buch das der alte Professor verloren hatte gefunden” (Francis, 2010: 13)).

It can be seen in the statistical analysis results and in the line graphs presented in the previous chapter that the English-native-speaker group and the Turkish-native-speaker group processed the sentential subjects in the canonical position more rapidly than the ones in extraposed position. In contrast, the processing of sentential subjects in the canonical position was significantly slower in the German native-speaker group. It can be concluded from the results that subject position itself may not have a dramatic impact on the processing of the sentential subjects in the English-native-speaker and the Turkish-native-speaker group. However, a tendency to process the subjects in canonical position slightly faster is observed. In particular, the results of the first group do not provide evidence for the Performance Theory and Early Immediate Constituents (EIC) as it was predicted that the processing of sentential subjects in canonical order would take longer. This may be because the sentence processors in the English-native-speaker and Turkish-native-speaker groups tended to reach the verb head as soon as possible in order to be able to enact the “Immediate Constituent Attachment” principle. This part of Performance Theory refers to the attachment of the parts of a constituent to the head as fast as possible, so that they can see the entire constituent. This allows the processor to process it semantically as well. By doing that, the processors may have bypassed the working memory load limitation by shortening the time required to reach the head in order to complete the constituent. The subject processing performances of the Turkish-native-speaker group also followed the same trend as the English-native-speaker group. There may be two explanations for this. It may be the result of the flexibility of syntactic structure in Turkish, as they are accustomed to alternative word orders the grammaticality of which are equally acceptable. Another explanation might be the possibility that they may have used their L2 knowledge while processing a sentence in L2, instead of their L1 knowledge. However, the subject processing performance in the German-native-speaker group was the opposite. Actually, according to the Performance Theory and Early Immediate Constituents (EIC) these results were predicted for the English-native-speaker group, because of the head-initial feature of the language. However, this was observed in the German-native-speaker group. For this group, the

existence of various sentence structures depending on the type of the main clause and finiteness of the verb might have had an impact on the processing of sentential subjects in different subject conditions. Another reason might be the location of the verb in sentential subjects. Unlike in English, verbs of embedded structures are placed at the end of the structure in German. However, the German-native-speaker group saw the verb of the sentential subject at an earlier location. This resulted in the need to store more words in working memory and adopting a different approach to attachment of the words to the verb head. The significant differences between the subject processing by the German-native-speaker group and the other two groups might have been caused by these factors. It can be explained by the principle suggested by Hawkins (1994) stating that placing the constituents in a sentence according to the increasing heaviness contributes to faster processing. Gibson (1998) also claimed that applying the "saving the hardest for the last (Bever, 1970)" principle decreases the integration cost and working memory load, which allows better processing.

The verb processing times of sentences with sentential subjects in two subject position conditions also show us several important points about sentence processing. This is because for the processor, seeing the verb means that the constituent has finished and it is ready to be attached to the head. This is the principle "Mother Node Construction (MNC)" in Performance Theory as constructing a higher node leads to the syntactic and semantic processing of an entire constituent and the sentence. In this case, the verb reading times of processors do not only show the processing time of the verb independently but also include the entire processing of the constituent preceding the verb. The line graph results of the three groups indicate that the English-native-speaker and the Turkish-native-speaker groups show a similar tendency in the verb processing time. This similarity is also in line with the results for the subject processing time. However, for verb processing, this trend moves in the opposite way. The verb processing takes longer when the subject is in canonical position and the difference between the verb processing times in extraposed sentences and canonical sentences is noticeable in the Turkish-native-speaker group. The results of these groups can be explained by the Performance Theory and "Early Immediate Constituents (EIC)" as a delay in seeing the verb in a head-initial language results in a longer processing time as it causes more working memory load until seeing the head. While this result was expected for the English native speakers because of the head-initial feature of their

native language, it is also observed for the Turkish native speakers. The statistical analysis results also showed that the difference in verb processing times between these groups is non-significant. It shows us that this group used their L2 knowledge and preferred to see the verb as soon as possible although the canonical word order in their native language is SOV, despite the different head-ordering and flexibility in L1. However, the verb processing times were almost the same in both subject position groups in the German-native-language group. The variety in head-ordering in German might have led to the slower verb processing in both subject position conditions when compared to the other two groups. Neither any effect of the canonical sentence structure of the native language nor the predictions of the Performance Theory was observed. Nevertheless, the differences were found to be non-significant.

Although The Turkish-native-speaker group and the English-native speaker group showed similar trends, the verb processing times between these groups in extraposed subject condition were significantly different. The significantly faster processing by the Turkish-native-speaker group when the subject is extraposed might have been because of the familiarity with alternative word orders in L1. The verb processing times of extraposed subjects by the German-speaker were significantly slower than the other two groups, which may be explained by the existence of different head-ordering features of German. The orthographic differences between German and the other two languages might have also played a role in differences in processing by the groups. Seeing a comma before the beginning of an embedded structure may be a clue for the German-native-speaker group. When they were directly presented the sentential subjects without a comma, the processing might have been slightly challenging due to an unexpected start of the sentential subjects.

5.2. The Effect of the Interaction between the Subject Length and Subject Position on Processing Performances

In addition to focusing on the two factors of syntactic processing, it is important to observe the impact of the interaction between subject length and subject position. Therefore, this section of the chapter discusses the results of this interaction. The first point to be discussed is the sentential subject processing, followed by verb processing.

This aspect of the study was mainly inspired by the study conducted by Stallings and MacDonald (2011) which showed that not only the length of the constituent itself but also the relative length between the two constituents of a sentence has a significant effect on the heavy-NP shift preference of the sentence processors. To elaborate, when the difference between the word number of the two constitutions increases, it becomes more likely that the sentence processor will prefer an extraposed sentence. Their study was also based on the sentence processing model, The Sausage Machine, by Frazier and Fodor (1978) and the proposal by Hawkins (1994), which support parallel ideas. As mentioned in the previous chapters, Frazier and Fodor (1978) highlighted the importance of the limited capacity of the working memory in order to store the words. That capacity was identified as five to seven. Similarly, Hawkins (1994) also claimed that the tendency to shift a longer constituent to the end does not occur until the word number difference between the two constituents is greater than four regardless of the complexity of the constituents. The corpus study carried out by Wasow (1997) also yielded that the extraposed sentences became more common as the length difference between the constituents increased. In light of these findings, this study was designed to observe if there was such an effect of relative constituent length on syntactic processing depending on the canonical word order in a language as well as the difference between the canonical word order in the native language and second language.

When the subject reading times are evaluated, all of the groups followed parallel patterns when the subject was in the extraposed position. Although, there are several obvious differences in the entire pattern, the processing of the sentences with extraposed subjects was faster in the German-native-speaker group than the ones whose subjects were in canonical position. However, there was an exception of the processing of sentences with a 5-word difference between the constituents. The processing of these subjects took almost the same amount of time. However, the processing of the other sentences was slower when the subject was in canonical position. While the Turkish-

native-speaker group also showed a compatible performance with the German-native-speaker group when the subject was in canonical position, the processing of sentences with extraposed subjects was slower than the other two groups. While the reading times of subjects which have 2-word and 7-word differences between the constituents were almost the same –which were also the slowest processing time–, the processing of subjects 5-word longer than the other constituent was faster when the subject was in canonical position. When it comes to the English-native-speaker group, the subjects which have the fewest word differences from the other constituent were the ones processed the slowest in both subject position conditions. No considerable difference was observed in the processing of the sentences with same-length subjects in different subject position conditions, except the ones which have 5-word difference between its constituents.

The processing performances of English-native-speaker group, as the only native speaker group of the study, also showed some interesting results. To begin with, the processing of the shortest subject, the ones processed the slowest, did not differ in different subject positions. However, when it comes to the subjects which were 5-word longer than the other constituent were processed faster when they were in canonical position. This part of the results does not actually support the proposal by Hawkins (1994) and the implications of the study conducted by Stallings and MacDonald (2010). That is why other theories about sentence processing in this sense may also be included in order to understand the rationale behind this observation. The reason why subjects which are 2-word longer than the other constituent in the sentence were processed more slowly may be because there were not enough words in order to make a prediction and the sentence processors had to spend more time on each word, which takes us to the Expectation-based Syntactic Theory by Levy (2008). A decline in the processing speed of the 5-word-longer subjects may have also occurred as a result of the increasing predictability of the upcoming words. Additionally, the length of the subject is still below the working memory limit in order to store and integrate the words into a higher node. However, as opposed to the prediction of Hawkins (1994) the canonical subjects were processed faster in this subject length condition. When it comes to the longer subjects, no dramatic difference between the processing of them in different subject conditions was observed despite slight fluctuations. Nevertheless, the processing times in each subject length condition were higher than the ones of 5-word-longer subjects in

canonical position. This implication supports the prediction of the working memory limit suggested by Frazier and Fodor (1978) and Hawkins (1994) but the increasing tendency of heavy-NP shift along with the increasing length difference between the constituents was not observed in this group. It may be because this group processed the sentences in their language and it may not have made an important difference as they were used to both word orders. However, it would be important to support these results with a further experiment such as a grammatical acceptability judgment test in order to see which structure English native speakers prefer to use.

While the subject processing performances of the Turkish-native-speaker group showed a similar trend to the English-native-speaker group, especially in extraposed subject condition, there are several differences between the two groups. This can be seen in terms of the comparison of the processing of subjects 2-word longer and the ones 7-word longer than the other constituent. While the processing times of 2-word-longer and 7-word-longer subjects in the Turkish-native-speaker group were almost the same in both subject position conditions, the processing of the latter group was slightly faster in the English-native-speaker group. When it comes to the 5-word-longer subjects, they were the ones that were processed the fastest in the canonical position. However, a decline in the processing time in the canonical position was also observed when compared to 2-word-longer subjects and 7-word longer subjects. A decrease in the processing of 10-word-longer subjects in both subject position conditions was observed. However, the decrease was sharper in extraposed subjects. One finding that was unexpected was that the subject processing of the shorter sentential subjects was the slowest, according to the predictions of Hawkins (1994) and Stallings and MacDonald (2011). This unexpected result may be explained by the Expectation-based Syntactic Theory by Levy (2008) as shorter subjects did not provide a sufficient number of words so that the upcoming word could be predicted and be used for integrating the words into a higher node. The process was suggested by Levy (2008). This may also explain the decrease in the processing of 5-word-longer sentential subjects as the predictability of the upcoming word increased thanks to the increase in the number of the words which were seen. However, another point worth mentioning is the difference between the processing of 5-word-longer subjects in different positions. As it can be seen in Figure 4.6, the processing of the relevant subjects in the extraposed position was slower compared to the ones in the canonical position. This implication supports the long-

before-short tendency suggested by Hawkins (1990, 1994, 2004, 2014) in head-final languages. Furthermore, the length of these subjects does not exceed the storage limit of working memory, as suggested by Frazier and Fodor (1978) and Gibson (1998, 2000). The increase in the processing of 7-word-longer subjects was observed in both subject position groups but this increase was sharper in subjects in canonical position. This was not supported by the Early Immediate Constituents (EIC) and Performance Theory according to cross-language variation by Hawkins (1990, 1994, 2004, 2014) as a faster processing of canonical subjects would be accepted in that case. However, approximately the same amount of processing time may have been caused by the working memory limit suggested by Frazier and Fodor (1978) and Gibson (1998, 2000) as in both subject position cases the sentence processors had to store the words in order to integrate them into the higher node. When it comes to the lengthiest subjects, a decrease was observed in both positions with a steeper decrease in the extraposed subjects. It can be concluded from these results that sentence processors may have used the upcoming word strategy, which would be more beneficial as the number of the alternatives decline as the constituent continues. By doing so, it was possible for them to ease the word storage in working memory because the number of the words in the subjects had exceeded the working memory capacity limit. As mentioned in the previous chapters, Turkish is a head-final language and its case markers provide this language with various types of flexibility in word order. This may have resulted in the slight difference in the processing of sentences in different conditions as Turkish native speakers are used to alternative word orders that are equally acceptable. Just like in the English-speaker-group, further studies might be needed in order to better understand the process in this group and compare the results of the study with another type of experiment.

The German-native-speaker group was the one whose subject processing performance in different subject position conditions showed an obvious difference in Figure 4.7.The processing of subjects in the canonical position, except 5-word-longer subjects –the processing of which was the same in both conditions–, was slower than the extraposed ones. Even though there were also slight fluctuations in the processing of extraposed subjects. These results may be explained by the heavy-NP shift as a specific phenomenon of Early Immediate Constituents (EIC) by Hawkins (1990, 1994, 2004, 2014) and they support the results of the study conducted by Stallings and MacDonald

(2010). As mentioned before, sentence processors prefer to see the longer constituents later in order to ease processing and the German-native-speaker group showed this tendency by showing a slower performance in processing the canonical sentential subjects. Although German is a head-final language, which leads to the assumption that the native speakers of German prefer long-before-short order in order to decrease the distance between the verb head and its dependent in German, this group performed in the opposite way. Their performance was in accordance with the assumption for head-initial languages –short-before-long preference–. This might have occurred as a result of the variety in canonical word order in German. It shows that the German-native-speaker group performed better in extraposed ones because they could see the verb head as early as possible and it was easier for them to integrate the subject into the higher node of the sentence, on the contrary to their native language. It can be concluded from these results that this group used their L2 knowledge in order to better process the sentences and they did not retrieve knowledge from L1, which was syntactically different from L2.

The verb processing times of the three native-speaker groups were also examined so that the processing of sentential subjects in the relevant conditions could be better identified. As mentioned before, the aim to include verb processing time into the study is that seeing the verb means that the preceding constituent ends. When sentence processors see the verb, they attach the preceding constituent to a higher node in order to complete the processing of the phrase. The results of verb processing in the groups yielded worthy results in terms of sentential subject processing in different subject length and subject position conditions. Additionally, there is a considerable difference between the processing of native speakers and non-native speakers in terms of the subject position preference in processing.

The descriptive statistics results and line graph show notable results of the effect of the interaction between subject length and subject position on sentence processing in the English-native-speaker group. The line graph (Figure 4.8) indicates that the processing of the verb of sentential subjects in canonical position was slower in 2-word-longer and 5-word-longer subjects. This can be explained by the insufficient number of words in order to integrate them into the rest of the constituent or the capacity of the working memory as it was still possible for the sentence processors to store the words. However, a decrease in the processing of the verb of 7-word-longer and 10-word-longer subjects in canonical position and the difference between the verb processing time of

extraposed and canonical subjects declined. Such a visible decline was not observed in extraposed subjects. The reason for the decline in the verb processing in canonical position could be because of the possibility that sentence processors might have wanted to see the verb in order to integrate the preceding words into the higher node, claimed by Hawkins' (1990, 1994, 2004, 2014) Mother Node Construction (MNC) principle of Performance Theory and Gibson's (1998, 2004) "integration cost" concept in Syntactic Prediction Locality Theory. The need for seeing the verb may have arisen as a result of the increase in the number of words to be integrated into the constituent because this number exceeded the working memory limit suggested by Frazier and Fodor (1978) and Gibson (1998, 2000).

Turkish-native-speakers, on the contrary, showed an opposite performance when the two factors were taken into consideration. While the verbs of the sentences with shorter sentential subjects were processed faster when they were in the extraposed position, there was a considerable increase in the processing of 7-word-longer sentential subjects in extraposition. This is unlike the ones in canonical position –which were processed slightly slower. When the verb processing times of 2-word-longer subjects, 5-word-longer subjects and 7-word-longer subjects, the ones when the subjects was in canonical position showed a slight decrease while the verb processing time of extraposed sentential subjects showed a sharp increase. This increase was especially evident when the subject was a 7-word-longer one. This can be explained by the assumptions of Hawkins (1990, 1994, 2004, 2014) in terms of the cross-linguistic variation of Performance Theory and the experimental study conducted by Yamashita and Chang (2001) as we can see that there is only a slight decline in the verb processing of sentential subjects in canonical position. To elaborate, Turkish native speakers are used to the SOV word order, which results in long-before-short preference in order to be able to decrease the amount of distance between the verb head and its dependent. However, the distance between the end of the constituent and its verb head increases as the number of the words increases in extraposed subject position. Since SVO is not the canonical word order in Turkish, the increasing number of the words in the following constituent may have resulted in a slower verb processing as it may have become harder to integrate the new words into the verb, which appeared very soon when it was in extraposed position. However, the same assumption cannot be made for the verb processing of sentences with 10-word-longer sentential subjects. The verb processing of

this subject length group was slower when the sentence was in the canonical position. This is the opposite of the assumption for Turkish native speakers. The number of the words exceeding the working memory limit and the need for integrating the upcoming words into the constituent to form a higher node may have caused this result. The sentence processors had to see all of the words in the constituent preceding the verb in order to integrate it into the higher node and the length of the sentential subject was a higher number than working memory can store. That is why sentence processors may have tried to recall all of the previous words in order to form this higher node once they saw the verb, which resulted in a longer processing time. However, since the verb head appeared before the dependent the sentence processors had already seen the verb. This means that there was not a working memory requirement because they could integrate the upcoming word into the word head. Although the tendency to process one sentence condition more rapidly was not found to be significant, the statistical analysis results were close to significant values. It can be concluded from the results that the interaction between subject length and subject position may have an impact on the processing of sentences with sentential subjects. Additionally, sentence processors in this group may have used their L1 knowledge while processing the sentences in L2 which is different from L1 in terms of canonical sentence structure. The insignificance of the results may have resulted from the syntactic flexibility of Turkish thanks to the case markers although the canonical sentence structure is SOV. It is because this flexibility of the native language may contribute to the similar performances of sentence processors in various sentence structures.

The results of verb processing performed by the German-native-speaker group were compatible with the ones by the Turkish-native-speaker group, in terms of the generally lower trend in the verb processing of sentences with sentential subjects in canonical positions and a generally increasing one in the other subject position condition. To begin with, the verb processing of sentences with 2-word-longer sentential subjects was more rapid when the subject was in the canonical position. Just like in the other two groups, this may have occurred because of the insufficient number of words in order to integrate the constituent into the verb head, unlike the other subjects. However, when it comes to the verb processing of 5-word-longer and 7-word-longer subjects, the processing of the ones in canonical position were processed faster than the others although an increase in the verb processing time of 7-word-longer ones

was observed in both subject position conditions. However, this increase was slighter in canonical position. These results are highly compatible with Performance Theory by Hawkins (1990, 1994, 2004, 2014), especially with the consideration of the cross-linguistic variation. The long-before-short preference in SOV languages can obviously be seen in these results and this shows that the German-native-speaker group retrieved their L1 knowledge while processing the sentences on L2, which is syntactically different from L1. However, the performances in the processing of the lengthiest subjects in two different subject positions were similar, with a slight difference. In addition to this, there was a decrease in the verb processing time of subjects in extraposed positions as opposed to the ones in canonical position. This may be the result of the same assumption made for the Turkish-native-speaker group as it might have been more challenging for the sentence processors to store the words of the lengthiest subjects and they may have had difficulty in integrating the words into the constituent and the verb head because of this working memory load when the subject was in canonical position. However, seeing the verb before the long constituent may have been advantageous in this subject length condition as it might have eased the integration of the upcoming words into the already seen higher node. The interaction between the two factors discussed above was found to be significant according to the statistical analysis.

All these results indicate that there may be more than one or two factors to be taken into consideration, such as the working memory load, the sufficiency of the number of the words in order to be able to predict the upcoming word for faster processing and integrating the words into the head. These possible additional factors may have also affected subject processing performances, which led to insignificant results even though several noticeable differences in the performances in various conditions were observed. On the other hand, verb processing performances showed differences compared to subject processing times of the groups. The verb processing times showed a decreasing trend in the canonical position in the native language group and the verb processing times of the longer subjects were similar. Since both sentence structures are grammatical, it may not have made a big difference for the native speakers of English to see the subjects in different positions. However, the predictability of the upcoming words, the need to see the verb head in order to better process and the working memory load may have resulted in the differences in the verb processing of sentences with sentential subject instead of Performance Theory itself. However, this

experiment observed not only the processing of the sentences but sentence processor preferences while forming sentences might differ according to the factors taken into consideration. In the non-native groups whose native language is syntactically different from L2, it was observed that proficient speakers of English retrieved their L1 knowledge while processing the sentences with sentential subjects. Sentential subjects in the canonical position were processed faster in 5-word-longer and 7-word-longer subjects in both groups, which shows that these non-native groups performed better in long-before-short order. This is the preferred order among the native speakers of head-final languages according to Performance Theory, instead of short-before-long order in head-initial languages. While both non-native language groups performed similarly in these sentence conditions, the performance results of the German-native-speaker group were significant, unlike the ones of Turkish-native-speaker, whose performance results were close to a significant value. This difference can be explained by emphasizing the fact that Turkish does not have a rigid SOV order as it has case markers, which provides flexibility in word order. However, German does not have case markers and the word order is more rigid than Turkish. It may be concluded from this point that Turkish native speakers may be able to adapt to various word orders more easily. The verb processing of 2-word-longer subjects was higher in both non-native language groups when the subject was in canonical position. It may not be because of the working memory load or the position of the subject as it would have followed an increasing trend in longer subjects in that case. These results may be explained by the Expectation-based Syntactic Theory by Levy (2008) as shorter subjects could not give enough information to the sentence processors in order to be able to predict the upcoming word and they immediately saw the verb, which means that the preceding constituent ended and it is time to integrate it into a higher node. However, this situation was not observed in extraposed subjects as the sentence processors had already seen the verb head and it was easier for them to attach the following constituent to the verb. When it comes to the lengthiest subject, a noticeable increase in the verb processing in canonical position and an opposite one in canonical position was observed in both groups. It may have occurred because 10-word-longer subjects exceed the working memory limit and storing the words and integrating them into the constituent until seeing the verb –and attaching them to the verb head– requires a lot of working memory. That is why it might have been challenging for the sentence processors to complete all these processes. In contrast,

seeing the verb sooner may have made it easier to attach the upcoming words to the verb, which decreased the working memory load.

This chapter discussed the interpretation of the findings in the light of the previous approaches and models. The following chapter is the Conclusion.

6. CONCLUSION

The conclusion chapter of this thesis provides a summary and reflection on the findings, as well as the implications, and contributions of the research study. Drawing upon the results obtained from the data analysis and interpretation, this chapter aims to summarize the background, aim and results of the study. Furthermore, it discusses the limitations of the research and suggests areas for further investigation.

6.1. The Background and Aim of the Study

The complexity of language comprehension is caused by the inclusion of thinking, reasoning and working memory throughout the process (Just & Carpenter, 1992). This is because components such as "the theme of the text, the representation of the situation to which it refers, the major propositions from preceding sentences, and a running, multilevel representation of the sentence that is currently being read" (Just & Carpenter, 1992, p. 122) need to be stored by the processor during language comprehension and processing. By storing these components in working memory, the processor can construct the relationship between the earlier and later constituents in order to process and comprehend the entire sentence (Just & Carpenter, 1992). This indicates the importance of working memory in this process. However, storing the input word-by-word until the processor sees the entire sentence is not practical or rational (Rayner et al., 1989; Yngve, 1960). This is because while the length of a sentence is not limited to a certain number of words (Yngve, 1960) the working memory capacity is limited to approximately six words (Frazier and Fodor, 1978). This led the researchers to investigate how sentences are processed and several scholars (e.g. Fodor, 1983; Frazier and Fodor, 1978; Hawkins, 1990; Marcus, 1980) suggested that it becomes possible by grouping the words as phrases, known as parsing. By parsing the sentence into phrases, processors can obtain a hierarchical structure and ease the processing of the entire sentence (Hawkins, 1990). The impact of the tendency to ease sentence processing led Hawkins (1990, 1994, 2004) to investigate the preferences of processors during sentence processing in order to ease the processing.

In order to better understand the proposal of Hawkins, introducing the other approaches is necessary and the approaches were discussed in three categories in this thesis. According to the probabilistic approaches suggested by several scholars such as Chomsky and Miller (1963) and Miller and Chomsky (1963) and Levy (2008), language

processing and production are so complex and human processors need to go through a computational process in order to measure and estimate all the probabilities about the upcoming words. It is claimed that this process eases sentence processing as the number of the probabilities decrease as the sentence goes on (Levy, 2008). Another approach, the information-based approach and the theories focusing on the importance of information in word order, suggests that the more-easily-processed word order is the one which has the given information first and leaves the new information to the end of the sentence in order to decrease the memory load and ease the processing (Arnold et al., 2013). This works because the given information is already in the working memory and attaching the new information to it makes processing easier (Arnold et al., 2013). There are also several other scholars who claim that processing is affected by the length and heaviness of the constituent because the place where the constituents are located in a sentence changes according to the length and heaviness (Gibson, 1998; 2000). Gibson (1998, 2000) explains this situation with increasing memory cost in order to process the constituent as a result of the increasing distance between the head and its constituent. Similarly, Hawkins (1990, 1994, 2004, 2014) also claims that length of constituents plays an important role in the word order preferred by the processors and he proposed Performance Theory, mentioned in Section 2.2.3.2. in detail. Hawkins (1990, 1994, 2004) suggests by proposing Performance Theory with its principles and the specific phenomenon and heavy-NP shift, as a specific case of Early Immediate Constituents (EIC) that sentence processors prefer sentences which are easier to process. Hence, they prefer to see the immediate constituent of a mother head as early as possible so that they can attach the constituent to the head and maximize sentence processing performance with the help of the early attachment.

At this point, it is important to take the typological differences between languages into consideration as well. Hawkins (1990, 1994, 2004, 2014) emphasized the fact that, as a result of the canonical sentence structure variety among languages, the directionality of the constituents in order to ease processing is different in different languages. For instance, English, as a head-initial language, has a tendency to follow the short-before-long constituent order. Ordering them according to their length as the shorter constituent, which is the dependent of the verb, becomes closer to its head. In contrast to the head-initial languages, head-final languages such as Japanese have the

opposite tendency. They place the long constituent before the shorter one and this prevents a long distance between the verb head and its dependent constituent.

This results in the occurrence and preference of word order in specific sentences in order to ease the processing, one word order preference is heavy-NP shift. This phenomenon in a language occurs by minimizing the distance between the head and its constituent in order to prevent working memory load. This was highlighted by Frazier and Fodor (1978) and Gibson (1998, 2000). It is done by moving the longer constituent, which results in working memory load, to a place where the distance between the head and its constituent is kept at a minimum. The longer constituent, therefore, is moved to the end of the sentence as "saving the hardest for the last" (Bever, 1970) approach may be a solution to processing difficulty. In light of the previous studies emphasizing that the working memory capacity is limited to five to six words, Hawkins (1994) claimed that heavy-NP shift occurs when the word length difference between the two constituents is at least four words regardless of the consideration of the length and complexity of the constituents separately. This results in the occurrence of non-canonical word order alternatives according to the grammatical weight (heaviness) of the sentence and it is called extraposition (Arnold et al., 2000).

One of the phenomena where heavy-NP shift and extraposition can be observed is sentences with sentential subjects (Dryer, 1980). In accordance with the approach, "save the hardest for the last" by Bever (1970), Dryer (1980) states that sentences with sentential subjects (e.g. "That John is tall is obvious." (Dryer, 1980, p. 124)) have the tendency to move the subject to the end of the sentence in order to ease processing and the subject is replaced by the pronoun "it" in order for the processor to see the verb as earlier as possible (e.g. "It is obvious that John is tall." (Dryer, 1980, p. 124)). This provides the processor to start attaching the upcoming words to the verb head, the higher node, as soon as seeing the words and makes the processing faster.

Dryer (1980) claims that this phenomenon is a universal grammar issue because it can be observed in various unrelated languages. However, the differences in the grammatical structures of languages according to "head-ordering" (Corbett et al., 1993; Dryer, 1992; Greenberg, 1963; Hawkins, 1983; Newmeyer, 2005), namely "head-initial" and "head-final" languages, affect the"directionability of movement in different language types" (Hawkins, 1990, p. 247). According to the"Minimize Domains (MiD)" principle of Performance Theory, "the human processor prefers to minimize the

connected sequences of linguistic forms and their conventionally associated syntactic and semantic properties in which relations of combination and/or dependency are processed." (Hawkins, 2004, p. 31) and this has an effect on the directionability of heavy-NP shift. For instance, Japanese, as a head-final language, was found to have the long-before-short tendency in the study of Yamashita and Chang (2001. Early Immediate Constituents (EIC) predicts that the same long-before-short tendency occurs in other head-final languages (e.g. German, Persian, Korean, and Turkish) and short-before-long preference is observed in head-initial languages (e.g. English) (Hawkins, 2014). This occurs as a result of the preference of minimized domain between the head and its dependent in order to reach the head and ease processing. However, Turkish has a specific case because it has a flexible word order due to its case markers, even though its canonical word order is SOV. Because of this flexibility, the predictions of EIC are weaker for Turkish (Hawkins, 1994). German is another head-final language, and it also lets the longer constituent be extraposed when the verb is moved to an earlier position despite being classified as a head-final language. The morphological richness of German (Bahlmann, et al., 2007) and its case markers allow the language to have a flexible word order (Kamide, Scheepers & Altmann, 2003). One of the factors affecting word order in German is the finiteness of the verb. Finite verbs occur in the verb-second position in German (Weyerts et al., 2002) and non-finite ones are placed at the end of the sentence (Schulz & Schwarze, 2017). The type of the clause also plays a role in the location of the finite verbs. While finite verbs are placed at the initial position in yes/no questions and imperatives, they occur in the verb-second position in declarative main clauses (Weyerts et al., 2002). The position of these verbs is the end of the constituent in embedded clauses (Weyerts et al., 2002).

Although there have been a number of studies focusing on sentence processing and the processing ease when heavy-NP shift and extraposition occurs, the phenomenon in the second language (L2) still needs to be investigated more. As mentioned in Section 3.1, the aim of this current thesis was to find out if sentential subject length and/or position has an impact on sentence processing in L2. Another point observed was whether the difference between native language (L1) and second language (L2) in terms of canonical word order played a role in sentence processing in L2. In order to observe if there are such effects, three different native language groups whose native languages differ in terms of canonical word order, Turkish and German as SOV and English as

SVO. As mentioned in Chapter 3, the items used in order to design and conduct the experiment were in English so Turkish and German native speakers needed to have a good knowledge of English. Due to the fact that the processing of sentences with sentential subjects (e.g. “That the candidate could not arrive on time was sad.”) or extraposed subjects (e.g. “It is inevitable that she will find out his secret soon.”) was the focus of the study, the non-native speakers of English needed to have B2 level or above, according to the level of these sentence structures in CEFR and the participants of the study showed their level of English with their TOEFL or IELTS scores. As well as the experimental items mentioned above, there were also filler items in order not to make the aim of the study noticeable and these filler items were composed of simple, complex and compound sentences, which did not have sentential subjects. The self-paced reading experiment designed by the researcher took about twenty minutes for each participant and the participants saw the words in a sentence word-by-word and in the order of their position in the sentence. In order to see the following word, the participants had to press a specific key assigned by the researcher while designing the experiment, as explained in Section 3.3 of Chapter 3.

6.2. Summary of the Results

The results presented in Chapter 4 and discussed in Chapter 5 provided answers to the research questions of the study. These answers will be summarized under each research question in the following part of this chapter and all of the research questions were discussed under two aspects: subject reading time and verb reading time.

- *The processing of sentences with sentential subjects at different lengths*

When subject reading times were observed, all of the native language groups performed similarly although their processing speed differed. The Turkish group performed the fastest and the other two groups showed some differences in speed when the sentential subjects became longer. However, the trends of the performances of all of the groups showed similarities. It can be concluded from these results that the subject processing performances of non-native speakers of a language showed similarities with the performances of the native speakers in different subject length conditions. In all the groups, 2-word-longer subjects were one of the (or the) most-slowly processed subjects, which does not seem to support Performance Theory. However, it should be taken into

consideration that the participants could have expected to see more words in order to obtain enough information. Since they did not have enough input, they could not use their computational skills for predicting the upcoming words, as suggested by Levy (2008) in Expectation-based Syntactic Theory. The reason why 5-word-longer subjects were the most-rapidly processed ones was because they included enough information about the sentential subject and the processors were able to make predictions about the following words, regardless of their native language. Additionally, the 2-word-longer subjects ended with the verb of the sentential subject and the verb of the main clause appeared later. Seeing two verbs one after another might have been unexpected. This might have resulted in processing difficulty. However, a significant difference between the processing by the Turkish-native-speaker and the other two groups was observed in this subject length condition. It may be explained by the flexibility of word order in Turkish, which enables the native speakers of Turkish to be familiar with alternative word orders. While some differences were observed in the processing speed of 7-word-longer and 10-word-longer sentential subjects, an increase in the processing time of 7-word-longer and a decrease in the processing time of 10-word-longer subjects were observed in all groups. The processing difficulty of 7-word-longer subjects can be explained by the number of words exceeding the working memory load and 10-word-longer sentential subjects may have been processed more rapidly than the former because the predictability of the upcoming word increases as a result of a decrease in the number of possibilities for the following words. It can be concluded that length of constituents affects sentence processing performances of native and non-native speakers of a language in the same way despite several differences.

When it comes to the verb processing time according to the subject length, it was observed that the processing speed was stable, with slight fluctuations, in all of the groups, in 7-word-longer and 10-word-longer subject length condition. The Turkish and German-native-speaker groups performed similarly, with an increase in the processing time of the verb as the subject became longer, unlike the English-native speaker-group whose processing times were faster as the sentential subjects became longer. This can be explained with the proposal of Hawkins (1990, 1994, 2004) and several other parallel theories and models (e.g. Dependency Locality Theory by Gibson (2000) stating that processors attach the previously seen words to a higher node when they see the head of

a constituent in order to process the entire constituent and end the process for that part of the sentence, as mentioned in Section 2.2.3.1.1. of Chapter 2.

In summary, while the subject processing performances of native and non-native groups showed similar trends, the verb processing times differed between these two groups. Subject processing times became longer as subject length increased in all the groups, which supports the predictions of Performance Theory. Non-native speakers also showed the same tendency as native speakers, which shows that they used their L2 knowledge while processing. However, non-native speakers processed the verb of the sentences with sentential subjects more slowly as subject length increased, unlike the native speaker group. It shows that the non-native speakers used their L2 knowledge and adopted the short-before-long preference of L2 while processing the verb and attaching the dependents to the verb head. On the contrary, the native speakers could attach the sentential subject to the verb head as subject length increased because they could predict the upcoming word while reading the subject, which supports Expectation-based Syntactic Theory by Levy (2008).

- *The processing of sentences with sentential subjects in situ and their extraposed counterparts*

The results of the subject processing performances of these three native language groups in different sentential subject position conditions show some similarities. The Turkish native speaker group processed the sentential subject the fastest while the German native speaker group was the slowest, especially when the sentential subject was in canonical position. While the subject processing of the German native speaker group was the slowest, this group processed extraposed sentential subjects more rapidly than the English native speaker group and there is almost no difference in the subject processing of the Turkish native speaker group in different subject position conditions. The performances by the German-native-speaker group can be explained by Performance Theory because longer subjects were processed more slowly, which delays seeing the verb head in English. The flexibility of Turkish language in terms of alternative word orders may be the explanation of the subject processing performance of Turkish native-speakers, like in the answer of the first research question explained above. As previously mentioned, Early Immediate Constituents (EIC) has weaker predictions for Turkish because of its flexibility and these results also show weaker

predictions for Turkish. German also has flexible word order due to its case markers. However, the place of the verb in a sentence depends on the type of the clause and verb. This might also have resulted in processing difficulty in German speakers of English. The reason why German native speakers processed the extraposed sentential subjects more rapidly may be explained by the attachment of the sentential subject to the higher node, verb head, just after seeing the words of the sentential subject as they had already seen the head. However, they had to wait until they saw the verb in order to attach the sentential subject to the higher node, which made them focus on the words in the subject in order not to miss the verb. In the English native-speaker group, a slower subject processing of extraposed sentential subjects was observed. It can be explained by the head-initial structure of English. Since seeing the verb as soon as possible is important in English in order to attach the constituents to a higher node, the English native-speaker group may have wanted to reach the verb as early as possible and, therefore, they may have read the words of the sentential subjects in the canonical position faster. The slight increase in the subject processing times of extraposed sentential subjects may have been caused by the increasing working memory load after seeing the verb early and directly attaching the words of the sentential subjects to a higher node as soon as seeing them. However, this may have resulted in working memory load as the sentential subject moved on and the distance between the verb head and the end of the sentential subject, as the dependent. As a result, it might have been more challenging for the processors to remember and process the entire sentence.

When it comes to the verb processing times, the German native-speaker group performed the same in both subject position conditions and the verb processing times of this group were the slowest among the three native language groups. This might be because this group processed sentences in L2, which has a different canonical sentence structure from their native language and it might have been challenging to attach the sentential subject to a higher node, verb because of the differences in two languages and the memory load. The verb processing of the Turkish and English native-speaker groups were slower when the sentential subjects were in canonical position, which supports Performance Theory as seeing the verb before the extraposed subject made it easier for the processors, regardless of their native languages, to attach the following words to the verb head. However, when the processors saw the verb head after the sentential subject, in canonical position condition, they had to store the words in working memory until

attaching to a higher node, the verb. When they saw the verb, they had to retrieve the preceding words and attach the sentential subject to the verb. This resulted in a longer verb reading time because this time includes not only the processing of the verb itself but also the attachment of the preceding words and ending the processing of the entire phrase.

To conclude this part, German native-speaker performed differently from the other two groups and the performances of the Turkish and English native-speaker groups were parallel in terms of both subject and verb reading times. In other words, the processing performances of the Turkish native-speaker group in L2 were in the same way as the ones of L1 speakers. Besides supporting the predictions of the theory, the flexibility in Turkish might have also resulted in the similar performances of the Turkish-native-speaker group when compared to the English-native-speaker group. However, the processing performances of the German native-speaker group were slower than the other group and this group showed differences from the other two groups. Despite being a head-final language, German shows a variety in terms of the position of the verb in a sentence and it might have affected sentence processing in L2. That is why this group might have performed differently than the other group.

- *The effect of the subject position and subject length of sentential subjects on the processing of sentences*

The processing performances of the three native-speaker groups were also observed by taking both subject length and subject position factors into consideration in order to find out if the interaction of these two conditions plays a role in the processing of sentences with sentential subjects. As it can be seen in the results presented in Section 4.3.1 in Chapter 4, the English and Turkish native-speaker groups performed similarly, like in the previous findings despite several differences as seen in the graphs in the section. While there was not a dramatic change in the subject processing performances in the Turkish native-speaker group when the subjects were in extraposed position, a more noticeable difference in the subject processing performances were observed in the native-speaker group of English. The biggest processing speed in different subject position conditions was observed in 5-word-longer subject length condition in these two groups. In the German native-speaker group, however, the subject processing in extraposed conditions was faster with several fluctuations and the

differences in the subject processing times of same-length sentential subjects in different subject position conditions were bigger compared to the other two groups. This shows that the German native-speaker group preferred the extraposed sentences to the canonical ones and long-before-short preference in L1 due to being a head-final language did not affect their processing in L2. While the fluctuations of subject processing times when the interaction of the two factors were taken into consideration together were parallel in all groups, Turkish and English native speakers performed similarly, which may have been caused by the flexibility of Turkish in terms of word order and the adaptability of Turkish native speakers to canonical and alternative sentence structures. German also shows flexibility in word order but the position of the verb depends on the finiteness of the very and type of the clause. This feature of German might have affected the subject processing performances of the German-native-speaker group.

As mentioned before, the importance of verb processing times is that it does not only show the processing of the verb independently but it also includes the attachment of the dependents to the verb head. It can be seen in the graphs displayed in Section 4.3.2 of Chapter 4 that the verb processing performances of non-native speakers of English showed similarities, with a decreasing processing time as the sentential subjects in canonical position became longer and an opposite trend in the other subject position condition. This indicates that both non-native speaker groups of English, whose native languages were head-final and had long-before-short tendency, were affected by their L1 preference while processing the sentences in L2 and attaching the words to a higher node, the verb. The differences in the verb processing of the sentences with canonical and extraposed sentential subjects were more noticeable in the German native-speaker group than the Turkish-native speaker group. The flexibility of Turkish in terms of alternative word order may have also resulted in this difference between the performances of the Turkish and German native-speaker groups.

It can be concluded from the findings that while processing the sentential subject without attaching the dependents to the head, the difference between L1 and L2 in terms of canonical sentence structure does not have a noticeable effect on the processing in L2. Instead, the prediction of the following word may have played a role in the processing of sentential subjects and as the constituent became longer, it may have been easier for the processors to predict the upcoming word because of the decrease in the

number of possibilities, as suggested by Expectation-based Structure Theory (Levy, 2008). However, when it comes to attaching the constituent to a higher node and ending the phrase, it was observed that the canonical sentence structure and constituent order preference in L1 has an impact in sentence processing in L2 at that stage. These findings support the assumptions of Performance Theory by Hawkins (1990, 1994, 2004, 2014), especially in terms of cross-linguistic variation.

6.3. Implications of the Study for English Language Teaching

This experimental study holds implications for English language teaching and the findings provide insights which may contribute to the area from several perspectives. To begin with, the outcomes of the study might be considered useful in teaching writing skills. The findings indicated that it is more difficult to process longer subjects. In light of this, language teachers may encourage language learners to avoid using longer subjects in their written work. This may help language learners to produce clearer and easier texts. In addition to this, while preparing reading and writing materials, slower processing of longer subjects may also be taken into consideration. The number of longer subjects in materials may be reduced and this might contribute to an effective learning process. In this way, language learners may find reading and writing in the target language less challenging. This may contribute to improve their reading and writing skills. The findings of the study should also be considered during testing and evaluation of reading and writing skills. According to the results, the position and length of subjects play a role in sentence processing because of the changes in working memory load. Including test items which require more working memory may affect the test performances of language learners negatively. The test results may be a problem for teachers and learners in terms of observing the learning process. That is why, the effect of subject position and length on sentence processing should be considered while preparing test items. Last but not least, reducing the use of longer subjects in language learning process might also contribute to a decrease in language learning anxiety. Avoiding longer subjects in language production and testing might be useful for eliminating the challenge in processing caused by the length of subjects. A less challenging processing in the target language may reduce language learning anxiety and language learners will be able to see their improvement more clearly. This might also contribute to an effective language learning process.

6.4. Limitations and Further Suggestions

This study has focused on the effect of subject length and position on sentence processing in L2. Based on this, there are some suggestions to be considered for further research. Firstly, this study may be conducted by including participants whose native languages are in the same head-ordering group as their second language and the processing performances may be observed. As another suggestion for further research, the experimental aspect of the study may be extended by including different tests (e.g. eye-movement tests, reproduction tests or acceptability judgment tests) into the experimental procedure in addition to a self-paced reading experiment. The reading and reproduction times of participants on different tasks may be measured and compared.

REFERENCES

Abney, S. P., & Johnson, M. (1991). Memory requirements and local ambiguities of parsing strategies. *Journal of Psycholinguistic Research*, *20*(3), 233-250.

Arnold, J. E., Losongco, A., Wasow, T., & Ginstrom, R. (2000). Heaviness vs. newness: The effects of structural complexity and discourse status on constituent ordering. *Language*, *76*(1), 28-55.

Arnold, J. E., Kaiser, E., Kahn, J. M., & Kim, L. K. (2013). Information structure: linguistic, cognitive, and processing approaches. *Wiley Interdisciplinary Reviews: Cognitive Science*, *4*(4), 403-413.

Bahlmann, J., Rodriguez-Fornells, A., Rotte, M., &Münte, T. F. (2007). An fMRI study of canonical and noncanonical word order in German. *Human brain mapping*, *28*(10), 940-949.

Beck, M. L. (1998). L2 acquisition and obligatory head movement: English-speaking learners of German and the local impairment hypothesis. *Studies in Second Language Acquisition*, *20*(3), 311-348.

Behaghel, O. (1932). Deutsche Syntax: *Eine geschichtliche Darstellung.* Bd. 4: Wortstellung – Periodenbau. Heidelberg: Winter.

Bever, T. G. (1970). The cognitive basis for linguistic structures. *Cognition and the development of language*.

Bock, J. K. (1982). Toward a cognitive psychology of syntax: Information processing contributions to sentence formulation. *Psychological review*, *89*(1), 1.

Bresnan, J. (1982). Control and complementation. *Linguistic inquiry*, *13*(3), 343-434.

Burmester, J., Spalek, K., &Wartenburger, I. (2014). Context updating during sentence comprehension: The effect of aboutness topic. *Brain and language*, *137*, 62-76.

Chafe, W. (1976). Givenness, contrastiveness, definiteness, subjects, topics, and point of view. *Subject and topic*.

Chomsky, N. (1957). *Syntactic structures*. The Hague: Mouton.

Chomsky, N. (1965). *Aspects of the Theory of Syntax*. Cambridge, Mass.: MIT Press.

Corbett, G. G., Fraser, N. M. and McGlashan, S. (eds) (1993). *Heads in Grammatical Theory*. Cambridge: Cambridge University Press.

Council of Europe. (2001). *Common European framework of reference for languages: Learning, teaching, assessment*. Cambridge, U.K: Press Syndicate of the University of Cambridge.

Dryer, M. S. (1992). The Greenbergian word order correlations. *Language*, *68*(1), 81-138.

Erdmann, P. (1988). On the principle of 'weight' in English. *On language: rhetorica, phonological, syntactica: A festschrift for Robert P. Stockwell*, 325-339.

Fodor, J. D. (1978). Parsing strategies and constraints on transformations. *Linguistic Inquiry*, *9*(3), 427-473.

Fodor, J. D. (1983). Phrase structure parsing and the island constraints. *Linguistics and Philosophy*, 163-223.

Fodor, J. D. (1984). Constraints on gaps: Is the parser a significant influence? In B. Butterworth, B. Comrie, & O. Dahl (Eds.), Explanations for language universals (pp. 85-107). Mouton.

Fodor, J., Bever, A., & Garrett, T. G. (1974). The psychology of language: An introduction to psycholinguistics and generative grammar.

Francis, E. J. (2010). Grammatical weight and relative clause extraposition in English.

Frazier, L., & Fodor, J. D. (1978). The sausage machine: A new two-stage parsing model. *Cognition*, *6*(4), 291-325.

Frazier, L. (1988). Parametrizing the language processing system: Left-vs. right-branching within and across languages. *Explaining language universals*, 247-279.

Frick, R. W., & Miller, G. A. (1951). A rate-of-reading study of the effects of type size upon reading speed. *Journal of Applied Psychology*, 35(4), 233-238.

Gattei, C. A., París, L. A., & Shalom, D. E. (2021). Information Structure and Word Order Canonicity in the Comprehension of Spanish Texts: An Eye-Tracking Study. *Frontiers in Psychology*, *12*.

Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. *Cognition*, *68*(1), 1-76.

Gibson, E. (2000). The dependency locality theory A distance-based theory of linguistic complexity. *Image, language, brain*, 2000, 95-126.

Gil, D. (1986). A prosodic typology of language. *Folia Linguistica*, 20, 165-231.

Greenberg, J. H. (1963). Some universals of grammar with particular reference to the order of meaningful elements. *Universals of language*, *2*, 73-113.

Hale, J. (2001). A probabilistic Earley parser as a psycholinguistic model. In *Second meeting of the North American chapter of the Association for Computational Linguistics*.

Halliday, M. A. K. (1967). Notes on transitivity and theme in English: Part 2. *Journal of Linguistics*, 3(2), 199-244.http://dx.doi.org/10.1017/S0022226700016613

Hawkins, J. A. (1983). *Word Order Universals*. New York: Academic Press.

Hawkins, J. A. (1990). *'A Parsing Theory of Word Order Universals,'* Linguistic Inquiry, 21: 223–61.

Hawkins, J. A. (1994). *A Performance Theory of Order and Constituency*. Cambridge: Cambridge University Press.

Hawkins, J. A. (2004). *Efficiency and Complexity in Grammars*. Oxford: Oxford University Press.

Hawkins, J. A. (2014). *Cross-linguistic variation and efficiency*. OUP Oxford.

Hawkins, J. A., & Cutler, A. (1988). Psycholinguistic factors in morphological asymmetry.

Hawkins, J. A., & Gilligan, G. (1988). Prefixing and suffixing universals in relation to basic word order. *Lingua*, *74*(2-3), 219-259.

IBM Corp. (2019). *IBM SPSS Statistics for Windows*. Armonk, NY: IBM Corp. Retrieved from https://hadoop.apache.org.

Jegerski, J. (2014). Self-paced reading. *Research methods in second language psycholinguistics*, 20-49.

Joshi, A. K. (1990). Processing crossed and nested dependencies: An automation perspective on the psycholinguistic results. *Language and cognitive processes*, *5*(1), 1-27.

Just, M. A., & Carpenter, P. A. (1992). A capacity theory of comprehension individual differences in working memory. Psychological review, 99(1), 122.

Kaiser, E., &Trueswell, J. C. (2004). The role of discourse context in the processing of a flexible word-order language. *Cognition*, 94, 113 147.https://doi.org/10.1016/j.cognition.2004.01.002

Kamide, Y., Scheepers, C., & Altmann, G. T. (2003). Integration of syntactic and semantic information in predictive processing: Cross-linguistic evidence from German and English. *Journal of psycholinguistic research*, *32*, 37-55.

Keating, G. D., & Jegerski, J. (2015). Experimental designs in sentence processing research: A methodological review and user's guide. *Studies in Second Language Acquisition*, *37*(1), 1-32.

Keenan, E. L., & Comrie, B. (1977). Noun phrase accessibility and universal grammar. *Linguistic inquiry*, *8*(1), 63-99.

Kimball, J. (1973). Seven principles of surface structure parsing in natural language. *Cognition*, *2*(1), 15-47.

Kintsch, W., & Van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological review*, *85*(5), 363.

Konieczny, L. (2000). Locality and parsing complexity. *Journal of psycholinguistic research*, *29*(6), 627-645.

Konieczny, L., &Döring, P. (2003, July). Anticipation of clause-final heads: Evidence from eye-tracking and SRNs. In *Proceedings of iccs/ascs* (pp. 13-17).

Kuno, S. (1974). The position of relative clauses and conjunctions. *Linguistic Inquiry*, *5*(1), 117-136.

Lamers, M., & De Swart, P. (Eds.). (2011). *Case, word order and prominence: Interacting cues in language production and comprehension* (Vol. 40). Springer Science & Business Media.

Levy, R. (2008). Expectation-based syntactic comprehension. *Cognition*, 106(3), 1126-1177.

Lewis, R. L., & Vasishth, S. (2013). An activation-based model of sentence processing as skilled memory retrieval. In *Cognitive science* (pp. 375-419). Routledge.

Marcus, M. P. (1980). A theory of syntactic recognition for natural language Cambridge. *MA: MIT Press Google Scholar Google Scholar Digital Library Digital Library*.

MacDonald, M. C. (1993). The interaction of lexical and syntactic ambiguity. *Journal of memory and language*, *32*(5), 692-715.

Mehler, J. (1963). Some effects of grammatical transformations on the recall of English sentences. *Journal of verbal Learning and verbal Behavior*, *2*(4), 346-351.

MehIer, J., and Bever, T. G. (1968). Quantifiation, conservation and nativism (reply). *Science* 162, 979 - 981.

Miller, G. A., & Chomsky, N. (1963). Finitary models of language users.

Miller, G. A., & Frick, F. C. (1949). Statistical behavioristics and sequences of responses. *Psychological Review*, *56*(6), 311.

Miller, G. A., & Isard, S. (1964). Free recall of self-embedded English sentences. *Information and control*, *7*(3), 292-303.

Newmeyer, F. J. (2005). *Possible and probable languages: A generative perspective on linguistic typology*. Oxford University Press on Demand.

Peirce, J. W. (2007). PsychoPy—psychophysics software in Python. *Journal of neuroscience methods*, *162*(1-2), 8-13.

Peirce, J., Gray, J., Halchenko, Y., Britton, D., Rokem, A., &Strangman, G. (2011). PsychoPy–A Psychology Software in Python.

Pollard, C., & Sag, I. A. (1994). *Head-driven phrase structure grammar*. University of Chicago Press.

Quirk, R., Greenbaum, S., Leech, G. N., &Svartvik, J. (1972). A grammar of contemporary English.

Rambow, O., & Joshi, A. K. (1994). A Processing Model for Free Word-Order Languages. *Perspectives on sentence processing*. Hillsdale, N.J.: Erlbaum, 267-301.

Rayner, K., Sereno, S. C., Morris, R. K., Schmauder, A. R., & Clifton Jr, C. (1989). Eye movements and on-line language comprehension processes. *Language and Cognitive processes*, *4*(3-4), SI21-SI49.

Richards, J. C., & Schmidt, R. W. (2013). *Longman dictionary of language teaching and applied linguistics*. Routledge.

(c.f.) Ross, J. R. (1967). Constraints on variables in syntax. Unpublished PhD Dissertation, MIT

Schulz, P., & Schwarze, R. (2017). How strong is the ban on non-finite verbs in V2? Evidence from early second language learners of German with and without SLI. *ZeitschriftfürSprachwissenschaft*, *36*(1), 51-78.

Siewierska, A. (1993). Syntactic weight vs information structure and word order variation in Polish. *Journal of Linguistics*, *29*(2), 233-265.

Stallings, L. M., MacDonald, M. C., & O'Seaghdha, P. G. (1998). Phrasal ordering constraints in sentence production: Phrase length and verb disposition in heavy-NP shift. *Journal of Memory and Language*, *39*(3), 392-417.

Stallings, L. M., & MacDonald, M. C. (2011). It's not just the "heavy NP": relative phrase length modulates the production of heavy-NP shift. *Journal of psycholinguistic research*, *40*(3), 177-187.

Staub, A., Clifton, C., & Frazier, L. (2006). Heavy NP shift is the parser's last resort: Evidence from eye movements. *Journal of Memory and Language*, 54, 389–406.

Svartvik, J. (1966). *On Voice in the English Verb. The Hague: Mouton. 1967." A New Generation of Passives."* (pp. 1137-44). Göteborg University, mimeo. Published in 1970 in Actes du Xe Congrès International des Linguistes.

Schumacher, P. B., & Hung, Y. C. (2012). Positional influences on information packaging: Insights from topological fields in German. *Journal of Memory and Language*, *67*(2), 295-310.

Ueda, M. (1984). Notes on parsing in Japanese. *Unpublished. Department of Linguistics, University of Massachusetts, Amherst*.

Uszkoreit, H., Brants, T., Duchier, D., Krenn, B., Konieczny, L., Oepen, S., &Skut, W. (1998). Studien zur performanzorientierten Linguistik. *Kognitionswissenschaft*, *7*(3), 129-133.

Vallduví, E. (1993). Information packaging: A survey, report prepared for Word Order, Prosody, and Information Structure. *Centre for Cognitive Science and Human Communication Research Centre, University of Edinburgh*.

VAN DIJK, T., & Kintsch, W. (1983). Strategies of Discourse Comprehension. San Diego: Academic Press.

Wanner, E., Maratsos, M. (1978) An ATH approach in comprehension. In *Lingustic theory and psychological reality*. Cambridge, Mass.: MIT Press 119-161.

Warren, T., & Gibson, E. (1999). The effects of discourse status on intuitive complexity: Implications for quantifying distance in a locality-based theory of linguistic complexity. In *Poster presented at the Twelfth CUNY Sentence Processing Conference, New York*.

Wasow, T. (1997). Remarks on grammatical weight. *Language variation and change*, *9*(1), 81-105.

Wasow, T. (2002). *Postverbal behavior*. Stanford, CA: CSLI.

Weyerts, H., Penke, M., Münte, T. F., Heinze, H. J., & Clahsen, H. (2002). Word order in sentence processing: An experimental study of verb placement in German. *Journal of Psycholinguistic Research*, *31*, 211-268.

Yamashita, H., & Chang, F. (2001). "Long before short" preference in the production of a head-final language. *Cognition*, *81*(2), B45-B55.

Yngve, V. H. (1960). A model and an hypothesis for language structure. *Proceedings of the American philosophical society*, *104*(5), 444-466.

Yngve, V. H. (1961). The depth hypothesis. In R. Jakobson (Ed.), Structure of language and its mathematical aspect. *Proc. 12th Symp. in App. Math. Providence, R. I. :AmericanMathematical Society* 130-138.

Yun, J., Whitman, J., & Hale, J. (2010). Subject-object asymmetries in Korean sentence comprehension. In *Proceedings of the Annual Meeting of the Cognitive Science Society* (Vol. 32, No. 32).

APPENDICES

APPENDIX-1 The experimental and Filler Items Used for the Self-Paced Reading Task

Experiment items

1. Long NP – V – Short AP

11 – V – 1 (10-word difference)

1. That he has always supported my sister whenever she feels useless is undeniable.
2. That the famous actor was nominated for the Golden Globe awards was amazing.
3. That we are getting late just because of this weird show is irritating.
4. That they spend at least one month of the holiday altogether is adorable.
5. That she saved the day storing the files in another computer was brilliant.

8 – V – 1 (7-word difference)

1. That you have been misled by the consultant is obvious.
2. That the candidate could not arrive on time was sad.
3. That he passed all of his final exams is impressive.
4. That he had not talked to his wife was noticeable.
5. That he fell down on my shopping bags is unforgettable.

6 – V – 1 (5-word difference)

1. That income tax will be reduced is unlikely.
2. That the captain was injured badly was unlucky.
3. That John had so much energy was surprising.
4. That they have accepted our offer is wonderful.
5. That we met Elton John yesterday is true.

3 – V – 1 (2-word difference)

1. That they disappeared is unfortunate.
2. That she left is unforgivable.
3. That he died is terrible.
4. That she came was fortunate.
5. That she slept was good.

2. Short AP – V – Long NP

1 – V – 11 (10-word difference)

1. It was unlikely that my cousin would pass the final exam without constant practice.
2. It is sad that they won't be able to see her for another year.
3. It is horrible that he had been lying about his job since the beginning.
4. It is awful that students in this deserted village are in need of transportation.
5. It was surprising that her elder sister understood what was happening at first glance.

1 – V – 8 (7-word difference)

1. It was obvious that you really wanted that black summer dress.
2. It is funny that he always gets lost in this neighborhood.
3. It is wonderful that they are planning to start a business.
4. It is inevitable that she will find out his secret soon.
5. It was horrible that I had to spend three hours there.

1 – V – 6 (5-word difference)

1. It was unfortunate that his favorite mug was broken.
2. It is weird that he did not recognize you
3. It was terrible that this took for so long.
4. It is surprising that shops are closed on Sundays.
5. It was adorable that she called me 'Dear Auntie.'

1 – V – 3 / 2 – V – 4 (2-word difference)

1. It is amazing that you came.
2. It is terrible that she died.
3. It is unlucky that she fell.
4. It is sad that Jack left.
5. It is great that we succeeded.

Filler items

Relative clause sentences-1 (long subject)

1. The new car that I want to buy looks so comfortable.
2. The people who live in that village are so friendly.
3. The summer when I graduated from university was long and hot.
4. The washing machine which I want to buy is cheaper now.
5. The cat which is lying on the floor was adopted from a sanctuary.
6. The man who stole and sold my computer has been arrested.
7. The students who came late missed the test.
8. The country which I visited was incredible.
9. The woman I talked to this morning is our new colleague.
10. The restaurant which is located in the corner of the street is so expensive.
11. The decoration that he bought for our new house is my favorite object in the living room.
12. The village that is visited by thousands of people every year is so expensive nowadays.
13. The boy who I liked at high school texted me last night.
14. The meal that I was planning to cook for the guests belongs to Italian cuisine.
15. The assignment given by the professor requires a lot of research.

Relative clause sentences-2 (short subject)

1. A doctor is someone who finds solutions to the health problems of people.
2. He is the neighbor who helped me while I was moving in.
3. It is the movie that I was talking about last night.
4. My sister got married just after her graduation from university.
5. This is the list of the flights that have been cancelled.
6. I don't like the table that stands in the kitchen.
7. They told me about the woman who was invited to give a speech.
8. This is the picture which caused a big sensation.
9. John belongs to a group of people who send food packages to Africa.
10. These books are the ones which my mother ordered last week.
11. That is the lab where we had an accident while doing an experiment.
12. Our school has a gym which has a lot of modern equipment.
13. This is the girl who lives in the house opposite yours.
14. We live in a town which does not have a supermarket.
15. They have just rented a house which has a fireplace in the living room.

Compound sentences

1. It was getting dark and we weren't near the cabin yet.
2. It was a difficult test but John could pass it.
3. I just went to bed and had an early night.
4. He ran out of money, so he sold his guitar
5. Everyone was busy, so I went to the movie alone.
6. The class went to the zoo, but they didn’t enjoy it.
7. We could not believe the news that we had seen on TV.
8. He prefers waking up early and taking a walk on the weekends.
9. Yesterday was the day when everything started going wrong.
10. Mary is quite intelligent but she doesn't think before she acts.
11. He has already had three beers and wants one more.
12. I want to lose weight, yet I eat chocolate daily.
13. I saw your cousin at the market but he didn’t see me.
14. We don’t want to go out tonight; besides, we have an exam tomorrow.
15. My brother fell out of the bed, so I went to check on him.

Complex sentences

1. I heated it in the microwave because my coffee was too cold.
2. When she was younger, she used to believe in fairy tales.
3. I really didn't like the movie even though the acting was good.
4. After being apart for years, he still had feelings for her.
5. Before going home, I will drop by to pick up the bag.
6. Although I am not so good at it, I really enjoy dancing salsa.
7. Everybody loves eating popcorn while watching a movie.
8. You wouldn't be so tired if you had gone to bed earlier.
9. July has decided to learn German as she needs it for further studies.
10. Nobody will notice if you leave the party now.
11. Some students carry a lot of pencils in case they need them.
12. Since he lost his money, he had to pay it with his credit card.
13. When the doorbell rang, the old man was having a nap in the living room.
14. While I was waiting for the bus, I met one of my school friends.
15. Even if Lola earned a big salary, he would not spend money on those shoes.

Simple sentences

1. I looked for Ed and Jake at the train station.
2. We made a cake for Ben's birthday.
3. She always forgets her keys.
4. The teacher gave her favorite book to that student.
5. The music is too loud for my ears.
6. The manager of the department wanted to see them.
7. Jessie and James were classmates.
8. There was heavy rain yesterday.
9. That man has been waiting for two hours.
10. This is one of the most well-known paintings of Picasso.
11. I encountered a really beneficial source for our research.
12. One of our colleagues has just quit the job.
13. You should check your mailbox regularly, especially these days.
14. We are planning to pay a visit to our friend tomorrow.
15. Eating vegetables boosts our immune system.
16. The effects of global warming are already being observed.
17. He feels guilty for having forgotten her birthday gift at home.
18. Cheesecake is just one of the most delicious desserts.
19. Playing an instrument is such a relaxing hobby.
20. He always has oatmeal and coffee for breakfast.

APPENDIX-2 The Comprehension Questions Used for the Self-Paced Reading Task

Comprehension Questions

1. Does he support the sister?
2. Was the cousin at the cinema?
3. Are the effects of global warming observed?
4. Is the object for the new office?
5. Did she used to believe in fairy tales?
6. Did the speaker talk about the movie the previous night?
7. Did July need German for her boyfriend?
8. Did the speaker live in that country?
9. Did the professor give an exam?
10. Did he recognize the person?
11. Did the brother of the speaker fall out of the bed?
12. Will they see her this year?
13. Did Jack stay?
14. Does everybody love popcorn while watching a movie?
15. Was John energetic?
16. Was he lying about his job?
17. Was the coffee hot?
18. Did the manager want to see them?
19. Does she want to gain weight?
20. Did the mug get broken?
21. Was the weather in that summer cold?
22. Did she order the books last month?
23. Do they want to go out?
24. Should they check the mailbox?
25. Was the woman going to give a speech?
26. Did he forget the gift?
27. Did the speaker go to bed late?
28. Did they have an accident in the classroom?
29. Did she stay?
30. Was the captain injured?

APPENDIX-3

Evrak Kayıt Tarihi: 18.05.2021 | Protokol No: 69265 | Tarih: 07.06.2021

ANADOLU ÜNİVERSİTESİ
SOSYAL VE BEŞERÎ BİLİMLER BİLİMSEL ARAŞTIRMA VE YAYIN ETİĞİ KURULU
KARAR BELGESİ

ÇALIŞMANIN TÜRÜ:	Bilimsel Araştırma
KONU:	Eğitim Bilimleri
BAŞLIK:	The Processing of Heavy Subjects and Extraposition by L2 Learners of English. İngilizceyi İkinci Dil Olarak Öğrenen Bireylerde Ağır Öznelerin ve Extrapozisyonun İşlenmesi
PROJE/~~TEZ~~ YÜRÜTÜCÜSÜ:	Prof. Dr. Ümit Deniz TURAN
TEZ YAZARI:	-
ALT KOMİSYON GÖRÜŞÜ:	-
KARAR:	Olumlu

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