THE EFFECTS OF WORD LENGTH AND SUFFIXATION ON EYE MOVEMENT
CONTROL IN TURKISH READING

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ABSTRACT

THE EFFECTS OF WORD LENGTH AND SUFFIXATION ON EYE MOVEMENT CONTROL IN TURKISH READING

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Findings in reading research literature reveal that eyes do not move randomly during reading; instead, they follow patterns that enable studying cognitive processes underlying reading. Recent studies report the first fixation on a word as the major measure of lexical influences in reading. Subsequent fixations on a word are usually assumed to have different roles than the first fixation. In the present study, the relationship between the first fixation and subsequent fixations is investigated by taking into account the role of suffixation. The fixation strategies of readers are examined in two experiments by controlling the factors that affect eye movement patterns. The results reveal lexical effects on morphological processing for short and frequent words through the analysis of individual fixations. The study suggests that early lexical effects on words are best observed through the single fixation duration on the words whereas the subsequent fixations have potential to provide an indication of effects related to suffixation.

Keywords: Turkish reading, eye movements, word length, suffixation, first fixation duration
ÖZ

TÜRKÇE OKUMADA SÖZCÜK UZUNLUĞU VE SONEKLEMEÑİN GÖZ HAREKETLERİ KONTROLÜ ÜZERİNDE ETKİLERİ

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Anahtar Sözcükler: Türkçe okuma, göz hareketleri, sözcük uzunluğu, sonekleme, ilk sabitleme süresi
This humble effort is dedicated to my first teachers; mom and dad, my sweet sweet brother Îlte, and my precious Serkan.
This work has been completed with the enormous contribution of some valuable people, and now it is time for me to thank them which is the least I can do.

I would like to start by expressing my sincere gratitude to my supervisor, Asst. Prof. Dr. Cengiz Acartürk, for incl

Besides my supervisor, I am also grateful to all my committee members, Prof. Dr. Cem Bozşahin, Prof. Dr. Deniz Zeyrek Bozşahin, Asst. Prof. Dr. Burcu Can Buğlalılar, and Assoc. Prof. Dr. Bilal Kırkıcı, for their constructive feedback, insightful suggestions, and questions which led me to have a deeper look at some parts of my thesis. I also would like to acknowledge the support and encouragement that Asst. Prof. Dr. Özkan Kılıç provided, especially on the defense day.

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<th>Description</th>
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<tbody>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>BOUN</td>
<td>Boğaziçi University</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence Interval</td>
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<tr>
<td>EM</td>
<td>Expectation Maximization</td>
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<tr>
<td>FFD</td>
<td>First Fixation Duration</td>
</tr>
<tr>
<td>FRFC</td>
<td>First Run Fixation Count</td>
</tr>
<tr>
<td>GLMM</td>
<td>Generalized Linear Mixed Model</td>
</tr>
<tr>
<td>LMM</td>
<td>Linear Mixed Model</td>
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<tr>
<td>METU</td>
<td>Middle East Technical University</td>
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<tr>
<td>OVP</td>
<td>Optimal Viewing Position</td>
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<td>SFD</td>
<td>Second Fixation Duration</td>
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<td>Third Fixation Duration</td>
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<td>TNC</td>
<td>Turkish National Corpus</td>
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CHAPTER 1

INTRODUCTION

1.1. The Study of Reading

In the last four decades, researchers from cognitive psychology, cognitive science and relevant fields including linguistics contributed to the study of reading and particularly to the investigation of the processes underlying reading. The major focus of reading studies is on how readers go about extracting information from the printed page during the course of comprehending the text (Rayner, et al., 2012).

The history of eye movement studies roots back to a history of more than a hundred years. Huey (1908) mentions the first observations made by Louis Émile Javal in 1879 regarding the role of the eye movements in reading; however, the methods that the reading researchers use have changed a lot since then. Currently, state of the art is mainly based on the detection of eye movements, and the assumptions about the inner processes during reading are made depending on the results of the eye movement experiments. This method of studying has more than forty years of history beginning with the original work of McConkie and Rayner (1975), and since then, many eye-movement researchers conducted their research to investigate this behavior (consult Rayner, 1998 for a substantial review). Eye movement recording is the favored method in the study of reading since eye movements have the potential to provide a moment-to-moment indication of cognitive processes during reading through the analysis of the patterns of information intake (Rayner, 2009).

One of the basic research topics in reading research has been the relation between reading patterns and relevant inner processes. Two distinct group of researchers are mentioned in the study of reading (Liversedge & Findlay, 2000). The first group bears the aim of understanding the mechanics of the eye movements behavior (viz. oculomotor processes), and their major focus is on the impact of lower-level visual (i.e., visuomotor) and linguistics factors on control of the eye movement. On the other hand, the second group is interested in higher-level psycholinguistics processes, that provides information about the comprehension of the written language. The main interests of the second group include the factors that affect the identification of the words, structural relationships between the words that compose a sentence and the meaning of a sentence; in other words, syntactic and semantic processing respectively. They are mainly concerned with the question of how different linguistic manipulations between sentences create differences in reading rather than the mechanics of how eyes move.
The question of interest in the present study is to determine which factor(s) are behind the refixation strategies of the readers. In other words, the focus is on to what degree the lexical factors such as word length, frequency, and suffixation are involved in the decision to make a single fixation or multiple fixations on a word. In the section below, the motivation of the current study will be presented.

1.2. Motivation of the Present Study

It is known from the literature that the first and subsequent fixations on a word have different roles. In the present study, the relationship of these roles with suffixation is investigated. For this, the fixation strategies of readers are examined by controlling the factors that affect eye movement patterns such as word length and frequency.

The two most frequently used eye movement measures in reading are the first fixation duration which is the duration of the first fixation on a word regardless of whether it is the only fixation or the first of multiple fixations on a word and the gaze duration on a word which is the sum of all fixations made on a word prior to a saccade to another word (Rayner, 1998). After finding that both the first fixation and gaze duration are affected by word frequency, but only the gaze duration is affected by the predictability of the word, Inhoff (1984) proposed that these two measures measure different processes.

The distinction proposed by Inhoff (1984) also involves the suggestion that while lexical access can be measured with the help of first fixation duration, gaze duration reflects text integration processes as well. Accordingly, Rayner and Pollatsek (1987) arrived at the conclusion that cognitive operation is the key factor; if the operation is very fast, the effects of it can be observed in first fixation duration. If the operation turns out to be relatively slower, the gaze duration might be affected.

First fixation duration (FFD) is assumed to be representing early word recognition processes. This measure includes two cases: First, where a word receives only one fixation and secondly, where a word is fixated more than once in the first pass reading. The first case is usually named as single fixation duration in which a word is most likely recognized whereas the second one is called FFD of multiple fixations duration in which the word has most likely not been completely recognized on the first fixation, so there occurs a need for refixation (Juhasz & Rayner, 2003). Juhasz and Rayner (2003) suggest single fixation duration as a reliable measure of word recognition time, including semantic activation by considering that most likely readers would not move off their eyes of a word before recognizing it.

There have been varying claims regarding the different roles that single fixation and first of multiple fixations play in terms of lexical access. O’Regan (1992) claims that if a word receives only one fixation, lexical and perceptual processing is completed on this
single fixation. Therefore, in case of a word only receives a single fixation, then this fixation duration is longer than another word's first or second fixation durations, given that the other word received multiple fixations. He also claims that no lexical processing occurs on the first duration of a refixated word, rather it is postponed to the second fixation in the words that received more than one fixation, thus resulting in an extended duration of this fixation.

Sereno (1992) suggested that lexical processing should be absent during the first fixation of a refixated word if the view supported by O’Regan (1992) would be confirmed. Her results revealed evidence against this interpretation: she observed the effect of frequency is significant on both single fixation duration and first fixation duration of multiple fixations whereas she did not report any significant effect on the second fixation duration of the words that are fixated more than once.

After her findings, Sereno (1992) raised the question that why readers sometimes decide to refixate a word if the lexical access is achieved in the both cases of the first fixation. One suggestion of her is that lexical access may represent an incomplete stage of word recognition: A possible cause is that readers might require more than the lexical access prior to moving onto the next word. Hence, they execute an intraword saccade to meet a certain word recognition criterion. Her second suggestion is that if the upcoming word is farther away, readers may have a tendency to make immediate intraword saccade.

While mentioning lexical access, it is also needed to mention morphological processing. In the late eighties, reading studies focusing on the morphological processing have started to be conducted (Inhoff, 1989; Lima, 1987), and one of the preliminary questions of these studies is how complex words are processed while eyes are fixated.

In the present study, the first motivation is to observe how the first and subsequent fixations differ in their roles while accessing words, especially long and morphologically complex ones. By discussing these different roles, it is aimed to gain a deeper understanding of the determining factors behind the decision of single fixation and refixation strategies of readers. To be able to realize this, in addition to First Fixation Duration and Gaze Duration, several other local eye movement measures are analyzed in the present study. In the section below, these measures and their definitions are presented.

1.3. Definitions of Relevant Eye Movement Measures

Below, the definitions of the eye movement measures which are analyzed in the present study are presented. It should be noted that only the measurements in first pass reading are used for the purposes of the present study.

- **First Fixation Duration (FFD):** The duration of the first fixation on a word regardless of whether it is the only fixation on a word or the first of multiple fixations on a word.
- **Single Fixation Duration**: The duration of the one and the only fixation on a word.

- **First Fixation Duration of Multiple Fixations**: The duration of the first of multiple fixations on a word.

- **Second Fixation Duration (SFD)**: The duration of the second fixation on a word.

- **Third Fixation Duration (TFD)**: The duration of the third fixation on a word.

- **Gaze Duration**: The sum of all fixations made on a word prior to a saccade to another word.

- **First Run Fixation Count (FRFC)**: The number of all fixations in a trial falling in the first run of the word.

1.4. **The Purpose of the Study and Hypotheses**

i. The present study aims to investigate the relation between refixation strategy and first fixation duration by an experimental investigation (Experiment 1, Chapter 3).

   It is expected to observe that long words will get more than one fixation.

ii. The present study aims to examine how the measures of the subsequent fixations differ between short and long words in terms of their roles in lexical access (Experiment 1, Chapter 3).

   It is expected to observe that in long words the second and third fixations will have complementary roles.

iii. The present study aims to come with an account related to lexical access and morphological processing by comparing the findings of the two experimental investigations (Experiment 1 and Experiment 2, Chapter 3).

In the second experiment, it is expected to detect some effects which are only related to morphological complexity since different from the first experiment, in this experiment, word length and word frequency are controlled.

The present study consists of five chapters; in the next chapter (Chapter 2), the background of the study will be presented. Chapter 3 covers the methodology part, and the findings of the experiments are presented in Chapter 4. Finally, in Chapter 5 the discussion and conclusion regarding the findings is included.
CHAPTER 2

BACKGROUND

2.1. A Brief Timeline of Eye Movement Research

The history of the eye movement research goes back more than one hundred years from now; to the initial observations made by Louis Émile Javal in 1879. In his 1908 landmark volume, The Psychology and Pedagogy of Reading, Huey mentioned that Professor Javal was the first to note the actual role of the eye movements in reading (Huey, 1908). Javal reported that the movement of the eyes while reading was discontinuous. Huey (1908) described the same observation as follows: “…eyes do not move continuously from left to right along the line, but proceed by a succession of quick, short movements to the end, then return in one quick, usually unbroken movement to the left” (p. 15-16).

The period between 1879 and 1920 was described as the first era in the history of eye-movement research in the extensive review of Keith Rayner (1998). The concerns during that era included the issues such as saccadic suppression which can be summarized as the fact that information is not perceived during an eye movement, saccadic latency which refers to the time that it takes to initiate an eye movement, and the size of the perceptual span which is the region of the effective vision (Rayner, 1998).

The period following the first era up until the mid-1970s was mentioned as the second era of the eye movement research (Rayner, 1998). According to Rayner (1998), the behaviorist movement in experimental psychology led the researches of the second era to focus more on the applied research, thus to conduct less research with eye movements with the aim of investigating cognitive processes. The eye movement studies carried out in that era focused more on the eye movement itself, and less research was done between the late 1950s and the mid-1970s.

The third era in the history of eye-movement research has begun around the mid-1970s, and today’s research is also included in this era. Measurements of eye movements have been more accurate and easy to be obtained with the help of the technological improvements in eye movement recording systems. The technological advancements also allowed to interface laboratory computers with eye-tracking systems which made it possible to collect and analyze larger amounts of data than before (Rayner, 1998). Rayner (1998) puts forward that with the development of general theories regarding language processing, it has become possible to examine the cognitive processes underlying reading by using eye movement records.

In sum, the first era of the eye movement research was based on the observations made by Javal regarding the discontinuity of the eye movements during reading. That
observation then, extended to the research on saccadic suppression, saccadic latency, and the size of the perceptual span. In the following era, the focus of the studies was more on the surface aspects of the reading task rather than the cognitive processes underlying reading. Finally, the third era which has been mostly influenced by the technological advances in recording systems for eye-movement and the theoretical developments regarding language processing has begun, and it still continues.

In the last twenty years, more and more researchers utilize eye movements to investigate tasks related to cognitive processing, since eye tracking techniques have become more user-friendly and readily available (Rayner, 2009). Rayner (2009) declares that a new era of eye movement research focused particularly on the domain of reading has begun. In this era, the driving force for many of the researchers is the predictions that develop from the computational models related to the control of the eye movement. In the following section, some essential features of the eye movements during information processing will be presented.

2.2. Basic Characteristics of Eye Movements in Information Processing

In the previous section, the timeline of the eye movement research is presented briefly. The current section aims to provide the basic characteristics of eye movements in information processing. For ease in describing these characteristics, an eye movement record of a hypothetical adult reader is presented in Figure 2.1. The four characteristics that this section includes are saccades, fixations, saccadic latency, and the visual field and acuity respectively.

Figure 2.1: An eye movement record of an adult reader on part of a sentence. The dots represent fixations, the arrows represent saccades, and the numbers represent fixation durations. Reprinted from Bertram, R. (2011). Eye movements and morphological processing in reading. The Mental Lexicon, 6 (1), 83-109. https://doi.org/10.1075/ml.6.1.04ber

2.2.1. Saccades and Fixations

Saccades are rapid eye movements with velocities as high as 500° per second that we continually make during reading, while we are looking at a scene, or searching for an object (Rayner, 1998). After every saccade, our eyes remain relatively still for a moment on a specific location for about 200-300 ms to extract information from the text (Bertram, 2011; Rayner, 1998). The length of the saccade determines the duration of the saccade; however, in reading, the typical completion of a saccade is between 20 and 30 ms (Bertram, 2011).
During a saccade, we extract almost no information, a phenomenon that is called saccadic suppression (Matin, 1974). There have been many debates regarding saccadic suppression; however, Rayner (2009) puts forward that new information is not acquired during a saccade under most normal circumstances since the eyes are moving so quickly that only a blur would be perceived. Although we tend to suppress our vision during a saccade (Matin, 1974) and only during the fixations one can acquire novel information, some studies demonstrate that cognitive processing such as lexical processing continues during a saccade in most situations (Irwin, 1998; Irwin & Carlson-Radvansky, 1996).

*Fixation* is the period of time when the eyes remain fairly still and when the reader acquire new information from the visual array (Rayner, 2009). Fixations will be mentioned in detail in the next section (see Section 2.3) which focuses on the eye movements in reading.

2.2.2. Saccadic Latency

Planning eye movements and executing them takes time and this time changes depending on the nature of the task. Saccadic latency is described by Rayner (2009) as “the time needed to encode the location of a target in the visual field and initiate an eye movement” (p.1458-1459), and it is of the order of 175–200 ms (Rayner, Slowiaczek, Clifton, & Bertera, 1983). The action of moving the eyes requires some time as a function of the movement distance, and this duration is called saccadic duration (Rayner, 2009). For instance, in a typical reading situation, 30 ms is needed for a 2-deg saccade, and 40-50 ms is needed for a typical scene perception task (Abrams, Richard A. Meyer, David E. Sylvan, 1989; Rayner, 1978).

2.2.3. The Visual Field and Acuity

When we look straight forward, we do not see everything in front of us equally; or similarly, when we look at a page, we do not see all the words on that page equally well (Rayner et al., 2012). We frequently need to make saccades due to the anatomy of the retina and the constraints that emerge from acuity outside the fovea (Rayner, 1998).

In terms of acuity, the visual field can be considered as if it consists of three separate regions when we look straight ahead: foveal, parafoveal, and peripheral (see Figure 2.2). In the fovea, which is the center of the vision, acuity is greatest (about 2 degrees of visual angle), in parafovea, acuity is not as good as fovea (extending 5 degrees of visual angle on either side of the fixation, i.e., about 10 degrees of visual angle), and peripheral area includes the region beyond the parafovea, hence, acuity drops off markedly here (Rayner, 1998; Rayner, et al., 2012).
In this section, the basic characteristics of the eye movements in information processing are introduced. The aim of the following section is to provide readers basic knowledge about eye movements in reading.

2.3. Eye Movements in Reading

In this section, the general findings obtained from the eye movement studies which have been carried out so far is presented briefly. These general findings include average fixation durations, saccade lengths, regressions during reading, and how the stimuli influence these three main components of eye movements in reading.

For the readers of English and the readers of the other alphabetic languages, the average fixation duration is between 225-250 ms., and this duration can be as short as 50-75 ms, and as long as 500-600 ms (or more) (Rayner, 2009). Accordingly, the average saccade length is 7-9 letter spaces, and it can be as short as 1 letter space and as long as 15-20 letter spaces (or more) (Rayner, 2009). The variables such as text difficulty, reading skills of the readers, font difficulty, and the characteristics of the writing system influence the duration of fixations and the length of saccades.
It would be helpful to mention *regressions* at this point. After saccades and fixations, regressions which are the saccades that move backward in the text comes as the third important component of eye movements in reading (Rayner, 2009), and in Figure 3, these eye movements are presented. The eyes typically move from left to right which is the direction of the text in languages like English and Turkish, and right to left in languages like Arabic and Hebrew. However, approximately 10 to 15% of the saccades move the eyes in the direction opposite to word order; these saccades are called regressions (Rayner, Pollatsek, & Schotter, 2012).

![Figure 2.3: Types of saccadic eye movements. The circles 1 - 5 represent fixations in a sequential order; fixations 1, 2, and 3 are first-pass fixations, fixations 4 and 5 are second-pass fixations; the sum of fixations 1 and 2 is the first-pass gaze duration on word n (as well as its total reading time); the sum of fixations 3 and 5 is the total reading time on word n+2; fixation 3 is a regression origin fixation, fixation 4 is a single fixation regression goal; word n+1 has been skipped in first-pass reading. Reprinted from Wotschack, C. (2009). *Eye movements in reading strategies how reading strategies modulate effects of distributed processing and oculomotor control*. Potsdam: Universitätsverlag.](image)

Regressions often occur as a response to the difficulty in comprehension, or they occur if the reader needs to do a small backward correction in order to process a particular word of interest (Rayner, Pollatsek, & Schotter, 2012). Regressions are often short, and eyes only move a few letters; however, if there is a difficulty comprehending the text such as while reading structurally ambiguous sentences (Frazier & Rayner, 1982), or syntactically complex ones (Clifton & Staub, 2011), longer regressions become necessary. Most of the time, after these long fixations, a long saccade follows because the readers are generally accurate in moving their eyes forward to the point from which they originally launched regression (Rayner, 2009; Rayner, Pollatsek, & Schotter, 2012).

Fixations, saccades and regressions respond differently according to the characteristics of the stimulus. For instance, as the text gets more difficult, fixations get longer while saccades get shorter, and readers make more regressions (Rayner, 1998). Further, Rayner, Reichle, Stroud, Williams, & Pollatsek (2006) also demonstrated that the use of different fonts influences eye movements. When the font was difficult to read, the
fixations were longer, saccades were shorter, and more regressions were made compared to the condition in which an easier to read font was used.

The eye movements are also influenced by the reading skill of the reader. Compared to skilled readers, beginning and dyslexic readers have longer fixations, shorter saccades, and they make more regressions (Rayner, 1998).

2.3.1. Refixation and Skipping

Eye movement data enables inferring moment-to-moment cognitive processes during reading (Rayner et al., 2012). Using eye movement data allows obtaining valuable information about the mental processes in understanding a word or a set of words whence the readers look, and how long they look there (Rayner, 1998, 2009). Regarding the question which eye movement measure provides informative estimates of this moment-to-moment process, skipping and refixation should be mentioned.

Although it seems highly intuitive to calculate the average fixation duration on a word to determine the time needed to process that particular word, two components of reading: skipping and refixation provides support against this method. Since the readers do not fixate each word and only once on each word, despite being a valuable global measure, the average fixation duration becomes inadequate in providing estimates of moment-to-moment processing time.

One of the major findings of the reading studies is that not all the words are fixated, and even when they are fixated, the duration is not the same for all words. Readers make distinction between function and content words during reading; while they fixate on the content words such as nouns, adjectives, verbs about 85% of the time, they only fixate on function words such as prepositions, conjunctions, articles about 35% of the time (Carpenter & Just, 1983; Rayner & Duffy, 1988).

When the readers fixate on the function words, they do fewer and shorter fixations than the content words (Carpenter & Just, 1983; Rayner & Duffy, 1988). Since the function words tend to be short, there is a clear relationship between the length of the word and the probability of fixating a word (Rayner & McConkie, 1976). The longer the word is, the higher the probability of fixating on it (Rayner & McConkie, 1976); and as the word length decreases, the probability of skipping it increases (Brysbaert et al., 2005). Also, the lower frequency words are fixated for longer than higher frequency words. (Rayner & McConkie, 1976).

The words with 2-3 characters are only fixated around 25% of the time while the words with 8 characters or more are almost always fixated (Rayner, 2009). Longer words are not just almost always fixated; they are often fixated more than once before leaving the word; in other words, they are refixated (McConkie, Kerr, Reddix, Zola, & Jacobs, 1989; Vergilino & Beauvillain, 2000; Vergilino, Collins, & Doré-Mazars, 2004).
These findings led the researchers to develop a number of other local measures of fixation time. Three of these alternative measures of fixation time are: first fixation duration which is the duration of the first fixation on a word, single fixation duration which addresses the cases where only a single fixation made on a word, and gaze duration which is the sum of all durations on a word before moving to another word (Rayner, 2009).

2.3.2. **Optimal Viewing Position**

In the section above, it is mentioned that most of the words are fixated once while longer words are often fixated twice (or more). In Figure 2.1, the word *movements* is dealt with two fixations which increases the overall reading time for this word (the sum of 212 ms and 186 ms). It is also possible to observe from Figure 2.1 that the short and frequent words such as the preposition *on* and the auxiliary verb *has* been skipped (then, a regression occurs from the word *revealed* to the word *has*).

Another observation from the eye movement record of a typical adult reader presented in Figure 2.1 is that fixations are often located in the middle of the word, a term called *optimal viewing position* (OVP), (O'Regan, 1992). This position is the position in which the word processing is the fastest, and this location can be in slightly left of the center in languages which have left to right direction, and right of the center in language with the right to left direction.

During reading, the eyes work in such a way that, the length of the next word can be estimated during the previous fixation. Hence, an oculomotor program is targeted to the optimal viewing position of that word (O’Regan, 1992). O’Regan (1992) proposes when leaving a word, readers attempt to saccade to just left of the middle of the next word, and when the eyes are too far from the intended position, the reader immediately makes a refixation to the other side of the word which he labels as within-word correction tactics.

In sum, there are some general findings in the eye movement in reading research obtained especially in the third era of the reading study, and a considerable amount of literature supports that these characteristics are valid cross-linguistically. There are some other questions that gathered attention in the last 30 years of reading study such as morphological processing in reading. In the section below, this topic will be presented with the studies which have been conducted recently. With that, it is hoped that the relevance of the current study which has been carried out in a morphologically rich language, Turkish, will be better understood.

2.4. **Morphological Processing in Reading**

In the sections above, the tradition of the usage of eye movements during reading is presented briefly. Although the tradition of eye movement research has a fairly long history, the studies about the role of eye movements in morphological processing have
begun in the late 1980s and gained momentum at the beginning of the 21st century (Bertram, 2011).

2.4.1. The Eye-Contingent Boundary Paradigm

The first studies concerning morphological processing during reading conducted by Inhoff (1989) and Lima (1987), and the aim of those studies was to investigate whether morphological information was parafoveally encoded or not. At this point, mentioning the eye-contingent boundary paradigm (Rayner, 1975) is needed since it was the paradigm used in those studies. The aim of developing this paradigm was to assess the type and amount of information that readers may extract from the parafovea (Rayner, 1975). In a typical design which utilizes this paradigm, there is a control condition in which nothing changes when the readers perform the reading task. In addition to the control condition, to manipulate the information in parafovea, one or more change conditions are inserted in the design (Bertram, 2011).

The boundary paradigm was used in numerous studies, and one of them was the 1986 study conducted by Rayner, Balota, and Pollatsek in which they used four conditions (three change conditions, one correct condition) in addition to a typical control condition. In the control condition, there was no change, and in the correct condition, the target word remained as it is. In the semantically related condition, instead of the target word, a word which has the same length and related meaning to the target word was inserted. In the visually-orthographically related condition, a word with the same length and with orthographically similar letters was used, and in the unrelated condition, only the length of the word was the same (Rayner et al., 1986).

There was an invisible boundary placed to the left of the parafoveal letter string in the change conditions. When the readers make saccade while they are crossing that invisible boundary, the letter string was changed into the correct form during that saccade (Rayner et al., 1986). As the result of that study, Rayner et al. found that a) even relatively short words in the parafovea were not processed up to semantic level b) when the final two letters changed into letters that are visually but not orthographically similar, the change did not influence the word processing negatively. The conclusion of that study was that target word processing was facilitated by orthographically related previews to some extent while semantically related previews did not influence target word processing (Rayner et al., 1986).

The findings of several other studies confirmed that the final letters of a word in parafovea are analyzed up to the visual level, but not to the orthographic level, or conversely the first two or three letters of a parafoveal word are encoded up to the orthographic level.
2.4.2. Parafoveal Morphological Information

Before mentioning the eye-contingent boundary paradigm, it was noted that the concern of the first studies on morphological processing was the question whether morphological information is parafoveally encoded or not (Inhoff, 1989; Lima, 1987). Although the results of those studies did not provide evidence for parafoveal information extraction, the studies conducted in Hebrew demonstrated that having a parafoveal preview of the morphological root of the word yielded significant benefits (Deutsch et al., 2000, 2003).

Kambe (2004) proposed that the reason behind obtaining different results in English and Hebrew regarding the morphological influences on parafoveal preprocessing may emerge from the difference between two languages in terms of their morphological richness (Kambe, 2004). She suggested that in the languages which have relatively limited use of morphology such as English, it may be possible that the readers’ reliance on the morphological constituents during word processing may not be maximally efficient. However, she further suggested that in highly inflected languages such as Hebrew, Finnish, and Turkish where the morphological information is more informative, it may be possible to observe the morphological influences in word processing (Kambe, 2004).

The study conducted in Finnish which is a morphologically productive language demonstrated that it was not the morphological productivity of the language which determines the extraction of the morphemes parafoveally (Bertram and Hyönä, 2007). They suggested that the characteristics of a script may be more decisive. The results of the languages such as Chinese (Yen, Tsai, Tzeng, & Hung, 2008) and Hebrew (Deutsch et al., 2000, 2003) which have visually separate individual morphemes offer that in parafoveal morphological information extraction, visual segmentability of morphemes is the key factor (Bertram, 2011).

2.4.3. Recent Studies on Morphological Processing

Although most eye movement studies focusing on morphological processing has dealt with the processing of compound words, especially there is an extensive literature in Finnish, there are also some studies that have focused on other topics such as affixed words. Since it goes beyond the scope of the present study to review the studies which have dealt with compound nouns, several studies which manipulated the affixes on target words will be presented.

In their study, Niswander-Klement and Pollatsek (2006) manipulated the root morpheme frequency and whole word frequency, as well as the word length of the English, prefixed words. Their results demonstrated a significant effect of root morpheme frequency for longer prefixed words, but the same effect was not observed for the shorter prefixed words. They have also found that there was an effect of the whole-word frequency for shorter prefixed words, but not for longer ones (Niswander-Klement & Pollatsek, 2006). Their study is not the only one which obtained root frequency effects; the same effects
were obtained both for existing and novel English prefixed words. Root frequency effects (as well as a 100 ms novelty effect) were also obtained in Pollatsek, Slattery, and Juhasz (2008) for both existing and novel English prefixed words (Pollatsek, Slattery, and Juhasz, 2008).

In the light of their 2003 and 2008 studies in which they covered the role of agreement in Finnish inflected nouns, Vainio, Hyöna, and Pajunen concluded that the effect of agreement emerges at the level of syntactic integration but not at all levels of lexical access since they obtained a delayed effect of agreement on words (Vainio, Hyöna, & Pajunen, 2003, 2008). Since the modifiers and head nouns they utilized were relatively short ones with seven or eight characters, they reinvestigated the same issue with considerably long head nouns (Vainio, Bertram, Pajunen, & Hyölä, 2011).

The results they obtained demonstrated a facilitative agreement effect similar to the results obtained in the previous studies; however, the effect did not appear late, and it was also observed in earlier processing measures. Hence, they concluded that the benefits related to the modifier-head agreement in the processing of long words extend to the lexical identification of the head noun, rather than being constricted to post-lexical syntactic integration processes (Vainio, Bertram, Pajunen, & Hyölä, 2011).

In sum, the presented eye movement studies and many others support that root and affix properties influence the morphological processing during reading by modulating the morphological constituents.

The studies in eye movement control in Turkish reading are not at a mature stage yet, so in the present study, the experimental paradigm was kept simple (i.e., normal reading). Further, from the two approaches which are used in reading studies (Yan et al., 2014), namely the corpus-analytic and experimental control (i.e., target-based approach), the later one was adopted to conduct two controlled experiments on normal reading. In the section below (Chapter 3), the methodology of this approach will be presented.
CHAPTER 3

METHODOLOGY

In this chapter, the information regarding the participants who involved in the experiments will be presented together with the information of the materials and the apparatus used. Further, in this chapter, the design of the experiments, the data collection procedure, how the data selection was made, and the way the eye movement data analysis was conducted are explained. Since two separate experiments were conducted, the information regarding the experiments will be presented in different parts respectively.

3.1. Experiment I

3.1.1. Participants

Forty-eight participants who were studying at the Middle East Technical University (METU) at that time participated in Experiment 1. All the participants were native speakers of Turkish, all of them were monolingual speakers, and their ages were between 19 and 28 ($M = 22.6$, $SD = 2.3$, 24 females).

The participants were recruited through a combination of public advertisements (e.g., flyers placed around the campus and online groups). In the adverts, it was stated that the participants should not be using glasses or contact lenses in daily life since they would not be allowed to do so in the experiment. In the appointment process, the participants were reminded that they were going to participate in an eye-tracking experiment, so they arrived without any eye make-up.

The ethical approval was taken from Middle East Technical University Human Subjects Ethics Committee, and before the experiment, each participant read and signed an informed consent form. After the consent form, a demographic information form (see Appendix A) was given to the participants. In that form, the participants were asked some personal questions such as their age, gender, educational status, and contact information. In the second part of this form, there were questions related to the linguistic background of the participants. In that part, none of the participants reported that they had a language-related disorder, such as dyslexia, stuttering, rhoticism, etc. None of the 48 participants were wearing glasses or contact lenses during the experiment.

The total time for the experiment including welcoming a participant and form filling durations was 90 minutes. At the end of the experiment, each participant was paid 20 TL (approximately $7).
3.1.2. Materials

Target Word Selection and Properties

The target words were selected according to their frequency information and word length by using Turkish National Corpus (TNC, Aksan et al., 2012), METU Turkish Corpus (Say, Zeyrek, Oflazer, & Özge, 2002), The Dictionary of Word Frequency in Written Turkish (Göz, 2003), and Boğaziçi University (BOUN) Corpus (Bilgin, 2016).

Word length was 4 letters for short words and 10 letters for long words. The short and long words were divided into two groups according to their frequency range. So, in the full target word set, there were 16 short words with high frequency (Short-Frequent), 16 short words with low frequency (Short-Infrequent), 16 long words with high frequency (Long-Frequent), and 16 long words with low frequency (Long-Infrequent). Therefore, words were grouped under four different conditions and each word under each condition were added the suffixes "-de / -da / -te / -ta" and "-deki / -daki / -teki / -taki". A total list of 192 target words was created with the base and suffixed forms. The log10 transformation was applied to the frequency values of the words. Log10 frequency values according to the conditions are presented in the table below.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Infrequent</th>
<th>Frequent</th>
<th>Infrequent</th>
<th>Frequent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short</td>
<td>Long</td>
<td>Short</td>
<td>Long</td>
</tr>
<tr>
<td>Mean</td>
<td>1.54</td>
<td>1.71</td>
<td>4.42</td>
<td>4.43</td>
</tr>
<tr>
<td>SD</td>
<td>0.44</td>
<td>0.53</td>
<td>0.40</td>
<td>0.41</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.60</td>
<td>0.60</td>
<td>3.60</td>
<td>3.61</td>
</tr>
<tr>
<td>Maximum</td>
<td>2.19</td>
<td>2.64</td>
<td>5.15</td>
<td>5.24</td>
</tr>
</tbody>
</table>

- There was no statistically significant difference between the frequency values of the base forms of the short frequent words and the frequency values of the base forms of the long frequent words.
- There was no statistically significant difference between the frequency values of the base forms of the short infrequent words and the frequency values of base forms of the long infrequent words.

Stimulus Sentences Selection and Properties

The texts were taken from METU Turkish Corpus (Say et al., 2002), BOUN Web Corpus (Sak et al., 2008), and TNC (Aksan et al., 2012), including each target word and its suffixed versions. Some of the infrequent words, especially their suffixed versions
were not found from the sources mentioned, so they were quoted from various sources using the Google search engine. Some of the words were not possible to be found in a text even in that way, so their synonyms were searched in for in any context. Finally, the texts were recreated by replacing the words that are closest to the target word with the target word (see Appendix C).

A total of 192 texts were chosen based on the criteria below:

- There was no statistically significant difference between the word counts and the character counts of the texts among four conditions (see Table 3.2).
- There was no statistically significant difference in the number of characters between the lines that include the target words.
- Each text was presented at least in two lines and at most in three lines.
- The target words appeared approximately in the middle of a line to eliminate the start-of-line and end-of-line effects in reading.
- There were no punctuation marks or numbers in the immediate environment of the target words.
- The words before the target word and the words after the target word consisted of at least five characters.
- Each target word appeared once in a text and only in one text. Therefore, each target word and its suffixed versions appeared once in the entire text set.
- To prevent ambiguity, the same meaning of polysemous target words was used across all conditions.
- Some texts were composed of more than one sentence (155 single sentences, 34 with two sentences, and 3 with three sentences). In the sentences which included the target word, there were at least two words between the target word and the beginning and the end of the sentence. Similarly, in the sentences which included conjunctions, there were at least two words between the target word and the conjunctions.
Table 3.2: Word counts and number of characters in texts according to conditions.

<table>
<thead>
<tr>
<th></th>
<th>WORD COUNT</th>
<th>NUMBER OF CHARACTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequent</td>
<td>Infrequent</td>
</tr>
<tr>
<td>Short</td>
<td>15.73</td>
<td>15.35</td>
</tr>
<tr>
<td>Long</td>
<td>14.87</td>
<td>15.51</td>
</tr>
<tr>
<td>TOTAL</td>
<td>15.33</td>
<td>14.81</td>
</tr>
<tr>
<td>Short</td>
<td>124.65</td>
<td>131.33</td>
</tr>
<tr>
<td>Long</td>
<td>123.54</td>
<td>125.13</td>
</tr>
<tr>
<td>TOTAL</td>
<td>125.13</td>
<td>125.13</td>
</tr>
</tbody>
</table>

3.1.3. Apparatus

Experiment 1 was conducted by using an SR Research EyeLink 1000 (1000 Hz) eye tracking device, and a computer at 3.0 GHz to which a 17 inch, 1024 x 768 resolution CRT monitor (VGA) was connected and the operating system of the computer was Windows XP. Participants placed their heads on a forehead rest; a part of a tower mount. The usage of tower mount reduced the head movements during the experiments. They read the texts displayed from a distance of 62 cm from the screen. In Figure 3.1, the complete setup is demonstrated.


To start and continue the experiment or to answer the questions or pass the on-screen instructions, participants used the Host PC Response Box (see Figure 3.2) by pressing any key. Using the Host PC Response Box allowed participants to be able to keep their eyes on the screen and thus prevented the calibration to be distorted while giving a response to the tasks in the experiment. While answering the questions, the participants used the left back key for the “wrong” answer and the right back key for the “right”
answer. There was a reminder regarding which key was for which answer below each question.

![Host PC Response Box](http://www.sr-research.com/accessories_ELII_resbox.html)


### 3.1.4. Design and Procedure

The experiment has been developed using EyeLink Experiment Builder 1.10.1630 and implemented with Tower Mount in EyeLink 1000 device. Courier New font type which allows all characters to have equal widths (monospace) and 18 font size were used. Each character had a visual angle of 0.46 degrees and 14.03 pixels. Margins are set to top 250, bottom 0, left 42, right 28 pixels, and a 1.5 line spacing is used. Each word was split using the Word Segment property provided by the experiment design software.

Experiments were initiated with a screen which presented the instructions and followed by a standard nine-point grid calibration and validation of calibration. Calibration and validation of calibration for each participant were repeated after each break during the experiment. Before the display of each text, a bullseye appeared on the left corner of the screen, and when the participant fixated on the middle of it for one second, the text appeared in a way that the first letter of the text was at the same position with the bullseye. After the participant had finished reading the text, she had to fixate on the middle of the other bullseye which was located on the lower right side of the screen for one second to be able to see the next screen. With the help of an automatic calibrating procedure inserted in the experiment, automatic re-calibration was started when the device failed to capture the one-second eye fixation on the middle of the bullseye for 10 seconds.

The original experiment was composed of two parts with the same structure, and there were two blocks in each part for oral and silent reading. Although each participant attended in both parts of the experiment, the present study focuses only on silent reading; oral reading part is beyond the scope of the present study.

There were four exercise texts and one paragraph at the beginning of each block, thus summing up 16 practice texts and four paragraphs besides the stimulus sentences. Only one text appeared on the screen at each time and texts were displayed on at least two lines (107 texts) and at most three lines (85 texts). Participants were asked to read the
texts at their normal speeds. To be able to ensure that the participants read the sentences by understanding them; after some of the texts true/false questions were asked. The questions appeared randomly so that the participants were not able to predict when the next one would come. The total number of questions was 48. There was a break after each 16 texts and another break between the blocks thus summing up 10 breaks throughout the experiment. In Figure 3.3, the distribution between the parts and the blocks is presented. Participants read half of the texts silently, and the other half was read orally. The order of the silent and oral readings was balanced between the participants, and each text was read in both ways by different participants.

After the experiment, the participants were given two tests (Corsi Block Tapping Test and Digit Span Test) to measure the visual and verbal working memory spans of the participants. Additionally, a test (Familiarity test) was completed to measure how familiar were the target words to the participants before the experiment. The application of those three tests lasted approximately 15 minutes.

![Figure 3.3: Design of Experiment I.](image)

3.2. Experiment II

3.2.1. Participants

Forty people, who did not participate in Experiment 1, participated in Experiment 2. All the participants were native and monolingual Turkish speakers. The participants’ ages
were between 19 and 32 (M = 23.17, SD = 3.24, 20 females). All the participants had a normal or corrected to normal vision.

The recruitment and appointment processes were the same as Experiment 1. Accordingly, the participants of the second experiment also read and signed an informed consent form similar to the one used in Experiment 1; they also filled the same demographic information form with Experiment 1 (see Appendix A). The total time for the experiment including welcoming the participant and form filling durations was 30 minutes. At the end of the experiment, each participant was paid 20 TL (approximately $7).

3.2.2. Materials

Target Word Selection and Properties

All the target words were chosen among the frequent words, and they all consisted of seven characters. Three conditions were created according to the number of the suffixes attached to the target words. In the first condition, the target words had seven characters in the base form, and they had no suffix attached (no suffix condition). In the second condition, the suffix -DA was attached to the target words which had five characters in their base form (one suffix condition). Finally, the third condition included the words with three characters in their base form with the suffixes -DA and -ki attached (two suffixes condition). There were 12 words in each condition; the total number of target words was 36.

- Word initial bigrams of target words were controlled; they were selected among the frequent ones.
- There were no derived words in target word set.
- The mean base (i.e., root form) and surface (i.e., suffixed form) frequency values of the words were not significantly different among the conditions for each bigram.
- Sentence frames before and after target word were the same among word initial bigrams.

Stimulus Sentences Selection and Properties

Sentences (see Appendix C) that include the target words were formed based on the following criteria:

- For each bigram, the sentence frame before the target words was the same. Similarly, for each bigram, the sentence frame after the target words was the same.
Each sentence was presented in one line.

Sentence lengths were 59-61 characters, sentence frame lengths before target words were 24-27 characters, and sentence frame lengths after target words were 25-27 characters.

There were no punctuation marks or numbers in the immediate environment of the target words.

The words before the target words and the words after the target words were consisted of at least four characters.

Each target word appeared once in a sentence and only in one sentence.

To prevent ambiguity, the same meaning of polysemous target words was used across all conditions.

3.2.3. Apparatus

Experiment 2 was conducted by using an SR Research EyeLink 1000 Plus (1000 Hz) with desktop mount eye tracking device and a computer at 3.60 GHz to which a 24 inch, 1024 x 768 resolution and 4:3 screen scale ratio monitor was connected (VGA), and the operating system of the computer was Windows 7. Participants placed their heads on a forehead rest which reduced the head movements during the experiments. They read the texts displayed from a distance of 73 cm from the screen and 66 cm from the desktop mount. (see Figure 3.4)

In Experiment 2, participants used the Logitech Gamepad F310 (see Figure 3.5) to start and continue the experiment or pass the on-screen instructions. Similar to the usage of the Host PC Response Box in Experiment 1 (see Figure 3.2), the left back key was used for “wrong” while the right back key was used for the “right” answers.
3.2.4. Design and Procedure

The development, calibration and the validation of calibration processes were the same with Experiment 1. Similarly, the original Experiment 2 was composed of two blocks for oral and silent reading. However, it is worth to remind that the present study only focuses on silent reading; oral reading part is beyond the scope of the present study.

The counterbalance in Experiment 2 was ensured in a different way. To prevent participants to read same sentence frames more than once, each participant read one sentence from each bigram group. Sentences that include target words from different suffixation conditions in each bigram group were selected for a participant in a way that each participant read at least one sentence from each suffixation condition. Accordingly, each participant read 12 sentences that include one target word from each bigram group and at least one target word from each suffixation condition. Reading modality and the suffixation conditions balanced among participants and the full sentence set was read in both modalities by different participants.

There were four practice sentences and one paragraph at the beginning of each block, and there were 6 sentences in each block. There was one break during the experiment. Only one text appeared on the screen at each time and participants were asked to read the texts at their normal speeds. There were comprehension questions after every sentence, and eight practice sentences to familiarize the participant and two paragraphs as fillers in the experiment. In Figure 3.6, the distribution between the parts and the blocks is presented.

After the experiment, the participants were given two tests (Corsi Block Tapping Test and Digit Span Test) to measure the visual and verbal working memory spans of the participants. The application of those tests took approximately 10 minutes.
3.3. Eye Movement Data Selection

The software tool EyeLink Data Viewer (Data Viewer 2.3.22) was used to analyze the data. This software allows the users to view, process and filter the eye data which was taken on EyeLink, and it is possible to determine different variables according to the purposes of the studies and get reports accordingly. In the present study, Interest Area Report outputs taken from Data Viewer were used.

Despite all the precautions taken, there were some cases where the calibration deteriorated during the experiments. Those cases were determined by analyzing the reading recordings from the participants individually by using the software provided with the eye tracking device, and the drift correction process was performed.

The calibration deteriorations in eye data appeared as two different types. In the first type, the eye fixations appeared below or above the line that the participant was reading. Such defects were corrected by sliding all eye fixations up or down. In the second type, the eye fixations appeared to be sloping up or down at the end or beginning of the line. Such defects were corrected by bringing the fixations, that were determined to be done on the same line, together by using the Drift Correct function. In the cases where both types of problems were experienced together, corrections were made using the combination of the two methods.

All the corrections were conducted by shifting the eye fixations only vertically, and no fixations were moved horizontally in any correction method (x values in the coordinate plane were preserved). Data that were not possible to be corrected by any method were removed from the analyses. Further, the trials in which the target words were skipped
were also removed from the analyses. In Table 3.3 below, the information regarding the data cleansing performed in silent reading data of the two experiments is presented.

Table 3.3: Data cleansing information for both experiments.

<table>
<thead>
<tr>
<th>TRIAL NUMBER</th>
<th>Total</th>
<th>Skipped Target Word</th>
<th>Drift Correction Problem</th>
<th>Both</th>
<th>After Cleansing</th>
<th>Data Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment 1</td>
<td>4606</td>
<td>155</td>
<td>5</td>
<td>5</td>
<td>4451</td>
<td>3.36%</td>
</tr>
<tr>
<td>Experiment 2</td>
<td>240</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>239</td>
<td>0.41%</td>
</tr>
</tbody>
</table>

3.4. Data Analysis

All the analyses were conducted by using the software package IBM SPSS Statistics 23.0. In order to manage missing data, the technique, EM (expectation-maximization) was used. This technique fills in missing values with estimated values using EM methods, and it is crucial in solving problems which are likely to be caused by missing data. By using that technique, it was ensured that the number of the cases analyzed for each measure was equal (\(N = 48\) for Experiment 1, \(N = 40\) for Experiment 2) throughout the analyses. Below the independent and dependent variables used in the present study will be presented.

3.4.1. Independent Variables

Experiment I:

- **Word Length**

  There were six different groups of words according to the word length: words with 4, 6, 8, 10, 12 and 14 characters respectively.

- **Word Frequency**

  There were two groups of words according to their frequency values: frequent and infrequent words respectively.

Experiment II:

- **Suffixation Condition**

  There were three groups of target words according to their suffixation conditions: no suffix condition (only the root form of the word), one suffix condition (the suffix -DA is attached to the word), and two suffixes condition (the suffixes - DA and -ki are attached to the word together).
Experiment I and II:

- **Refixation**

  This variable is only related to the First Fixation Duration measure since it is about whether there is a single fixation on a word or there is one or more subsequent fixation after the first one, and this variable was analyzed for both experiments.

3.4.2. **Dependent Variables**

The dependent variables were the same for both of the experiments. The measures which were analyzed are: First Run Fixation Count, First Fixation Duration, Second Fixation Duration, Third Fixation Duration, Gaze Duration, The Sum of First and Second Fixation Duration, and The Sum of First, Second, and Third Fixation Duration. The definitions of these measures were presented in Chapter 1 (see Section 1.3.).

In the following chapter, the results obtained from the analyses of the two experiments described in this section will be presented.
CHAPTER 4

RESULTS

This chapter consists of two main sections: In the first section, the findings of Experiment 1, and in the second section, the findings of Experiment 2 will be presented. In both of the experiments, the same eye movement measures were analyzed. Hence, it would be helpful to remember these measures. In Figure 4.1, four of the measures are presented visually, the definitions of each measure are provided in the related sections.

Figure 4.1: Four of the eye movement measures used in the present study. The filled dots represent the fixations.

4.1. Experiment I

This section includes the findings obtained from the analyses of Experiment 1. The order of presentation is as follows: First Run Fixation Count, First, Second, and Third Fixation Durations, Gaze Duration, Sum of First and Second Fixation Duration, and finally Sum of First, Second, and Third Fixation Duration.

4.1.1. First Run Fixation Count (FRFC) Results

Before reporting the findings related to fixation durations, it would be helpful to have a look at how many fixations were done on the target words. In order to examine the effects of word length and frequency on the fixation count in first pass reading, First Run Fixation Count was analyzed. In this section, findings of this measure will be presented, below the definition of this measure is provided.

- **First Run Fixation Count**: The number of all fixations in a trial falling in the first run of the word.

From Figure 4.1 above, it is possible to observe that the fixation count that the word *taşeronluktaki* received was three. Below, Table 4.1 presents the mean First Run Fixation Counts according to the related variables.
Table 4.1: Mean First Run Fixation Counts according to frequency and word length.

<table>
<thead>
<tr>
<th>Word Length</th>
<th>Frequent</th>
<th></th>
<th>Infrequent</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (root)</td>
<td>1.04</td>
<td>0.08</td>
<td>1.14</td>
<td>0.20</td>
</tr>
<tr>
<td>6 (one suffix)</td>
<td>1.25</td>
<td>0.21</td>
<td>1.50</td>
<td>0.50</td>
</tr>
<tr>
<td>8 (two suffixes)</td>
<td>1.45</td>
<td>0.38</td>
<td>1.75</td>
<td>0.71</td>
</tr>
<tr>
<td>10 (root)</td>
<td>1.57</td>
<td>0.41</td>
<td>2.27</td>
<td>0.78</td>
</tr>
<tr>
<td>12 (one suffix)</td>
<td>1.75</td>
<td>0.47</td>
<td>2.60</td>
<td>0.78</td>
</tr>
<tr>
<td>14 (two suffixes)</td>
<td>2.08</td>
<td>0.59</td>
<td>3.07</td>
<td>1.02</td>
</tr>
</tbody>
</table>

A Factorial ANOVA was conducted to compare the main effects of frequency and word length and the interaction effect between frequency and word length on First Run Fixation Count. A two-way analysis of variance was conducted to investigate the influence of two independent variables (frequency, word length) on First Run Fixation Count. Frequency included two levels (frequent, infrequent) and word length consisted of six levels (words with 4, 6, 8, 10, 12, 14 characters respectively).

When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of word length, $\chi^2(14) = 69.83$, $p < .001$ and the interaction effect between frequency and word length, $\chi^2(14) = 69.99$, $p < .001$. In this case, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\epsilon = .64$ for the main effect of word length and .62 for the interaction between frequency and word length).

The main effects and the interaction are reported as significant at $p < .001$. The main effect of frequency yielded $F(1, 47) = 125.96$, $p < .001$, indicating that the mean fixation count in the first run was significantly higher for infrequent words ($M = 2.05$, $SE = 0.07$) than for frequent words ($M = 1.52$, $SE = 0.04$).

The main effect of word length yielded a significant effect, $F(3.18, 149.68) = 125.86$, $p < .001$. Pairwise comparisons (see Figure 4.2) demonstrated that the mean First Run Fixation Count was significantly the highest for the words with 14 characters, ($M = 2.57$, $SE = 0.10$) and significantly the lowest for the words with 4 characters, ($M = 1.09$, $SE = 0.01$). Accordingly, the mean First Run Fixation Count was significantly higher for the words with 12 characters, ($M = 2.18$, $SE = 0.08$) compared to the words with 10 characters, ($M = 1.92$, $SE = 0.08$). It was also higher for the words with 10 characters than for the ones with 8 characters, ($M = 1.60$, $SE = 0.07$), and for the words with 8 characters than the ones with 6 characters, ($M = 1.38$, $SE = 0.04$).
There was a significant interaction effect between frequency and word length, $F(3.08, 144.82) = 24.14$, $p < .001$. Figure 4.3 presents the interaction between frequency and word length on First Run Fixation Count; it increases for both frequent and infrequent words as the words get longer.

4.1.1.1. First Run Fixation Count: Frequent vs. Infrequent Words

A one-way analysis of variance was conducted to investigate the influence of the word length of the frequent words on First Run Fixation Count. The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the
main effect of word length, $\chi^2(14) = 68.42, p < .001$. So, corrected degrees of freedom were used from Greenhouse–Geisser estimates of sphericity ($\varepsilon = .63$).

The main effect of word length yielded a significant effect, $F(3.16, 148.95) = 71.83, p < .001$. Pairwise comparisons (see Figure 4.4) demonstrated that the mean First Run Fixation Count of the frequent words was significantly different ($p < .05$) among different word lengths except for the difference between the words with 6 characters, ($M = 1.45, SE = 0.05$) and 8 characters, ($M = 1.57, SE = 0.05$), and it was significantly the lowest for the words with 4 characters, ($M = 1.04, SE = 0.01$) and the highest for the words with 14 characters, ($M = 2.08, SE = 0.08$).

Figure 4.4: Word length effect of frequent words on First Run Fixation Count. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.

Another one-way analysis of variance was conducted to investigate the influence of the word length of the infrequent words on First Run Fixation Count. When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of word length, $\chi^2(14) = 55.61, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\varepsilon = .69$).

The main effect of word length yielded a significant effect, $F(3.44, 161.97) = 94.35, p < .001$. Pairwise comparisons (see Figure 4.5) demonstrated that the mean First Run Fixation Count of the infrequent words was significantly the lowest for the words with 4 characters, ($M = 1.14, SE = 0.02$) and the highest for the words with 14 characters ($M = 3.07, SE = 0.14$). The difference among all word lengths was statistically significant ($p < .05$).
4.1.1.2. Summary of First Run Fixation Count Results

The mean fixation count in the first run was significantly higher for infrequent words than for frequent words. For the frequent words, it was significantly different among all word lengths except for the difference between the words with 6 and 8 characters while for the infrequent words, the difference among all word lengths was significant.

It was the lowest both for frequent and infrequent words with 4 characters and the highest both for frequent and infrequent words with 14 characters. The significant interaction between frequency and word length demonstrated that for both the frequent and infrequent words, the fixation count in the first run increased as the word length increased.

4.1.2. First Fixation Duration (FFD) Results

In this section, the findings regarding the First Fixation Durations on the target words will be presented. Before presenting these results, it would be helpful to provide the definitions of the measures which will be referred to in this section.

- **First Fixation Duration (FFD):** Duration of the first fixation on a word during the first pass through the text (i.e., excluding fixations that occur after regressions)

Since FFD is the duration of the first fixation on a word regardless of whether it is the only fixation on a word or the first of multiple fixations on a word, the differentiation between these two cases will be addressed by two other local measures (see Figure 4.6):
1. Single Fixation Duration: First pass fixation duration on a word that is only fixated once.

2. FFD of Multiple Fixations: Duration of the first of multiple fixations on a word.

Figure 4.6: Single Fixation Duration and FFD of multiple fixations.

In other words, Single Fixation Duration is obtained when the readers pass a word by making only a single fixation, and FFD of multiple fixation cases represent the cases where the readers make second or more fixations after they fixate once on a word. It should again be noted that all the measures that will be presented in the present study are the measures of the first pass reading, (i.e., the fixations occur after regressions are excluded).

Table 4.2: Mean First Fixation Durations according to refixation, frequency, and word length.

<table>
<thead>
<tr>
<th>Word Length</th>
<th>SINGLE FIXATION DURATION</th>
<th>FFD OF MULTIPLE FIXATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequent</td>
<td>Infrequent</td>
</tr>
<tr>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>4 (root)</td>
<td>207.69</td>
<td>34.40</td>
</tr>
<tr>
<td>6 (one suffix)</td>
<td>232.52</td>
<td>38.09</td>
</tr>
<tr>
<td>8 (two suffixes)</td>
<td>251.93</td>
<td>73.50</td>
</tr>
<tr>
<td>10 (root)</td>
<td>224.92</td>
<td>35.67</td>
</tr>
<tr>
<td>12 (one suffix)</td>
<td>224.30</td>
<td>52.38</td>
</tr>
<tr>
<td>14 (two suffixes)</td>
<td>213.69</td>
<td>56.46</td>
</tr>
</tbody>
</table>

Investigating the different possible findings that will be obtained when Single Fixation Duration and FFD of Multiple Fixations are handled separately was crucial in the present study. However, before that, a Factorial ANOVA was conducted to compare the
main effects of refixation, frequency and word length and the interaction effects among them on First Fixation Duration itself.

A three-way analysis of variance was conducted to investigate the influence of three independent variables (refixation, frequency, and word length) on First Fixation Duration. Refixation included two levels (single fixation and more than one fixation), frequency included two levels (frequent, infrequent) and word length consisted of six levels (words with 4, 6, 8, 10, 12, 14 characters respectively).

The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, \( \chi^2(14) = 24.15, p < .05 \) and for the three interaction effects; refixation and word length, \( \chi^2(14) = 34.77, p < .05 \); frequency and word length, \( \chi^2(14) = 24.41, p < .05 \), and refixation, frequency and word length, \( \chi^2(14) = 15.92, p < .05 \). Therefore, corrected degrees of freedom from Huynh-Feldt estimates of sphericity were used (\( \varepsilon = .89 \) for the main effect of word length, .86 for the interaction effect between refixation and word length, .92 for the interaction effect between frequency and word length, and .97 for the interaction effect among refixation, frequency and word length).

The main effects and interaction effects are reported as significant at \( p < .05 \) except the interaction between frequency and word length and the interaction effect among refixation, frequency, and word length.

The main effect of refixation yielded \( F(1, 47) = 13.21, p < .05 \), indicating that the mean FFD was significantly higher for the words which were passed with a single fixation (\( M = 239.83, SE = 4.30 \)) than for the ones which received more than one fixation (\( M = 223.76, SE = 4.64 \)).

The main effect of frequency yielded \( F(1, 47) = 68.60, p < .001 \), indicating that the mean FFD was significantly higher for infrequent words (\( M = 248.70, SE = 4.57 \)) than for frequent words (\( M = 214.89, SE = 4.21 \)).

The main effect of word length yielded a significant effect, \( F(4.46, 209.96) = 20.55, p < .001 \). Pairwise comparisons (see Figure 4.7) demonstrated that the mean FFD was significantly the lowest for the words with 4 characters (\( M = 199.56, SE = 4.82 \)). The differences among the words with 6 characters, (\( M = 236.82, SE = 5.00 \)), 8 characters, (\( M = 249.18, SE = 6.31 \)), 10 characters, (\( M = 236.36, SE = 4.71 \)), 12 characters, (\( M = 233.96, SE = 4.92 \)), and 14 characters, (\( M = 234.87, SE = 4.96 \)) were not significantly different.
There was a significant interaction effect between refixation and word length, $F(4.32, 203.36) = 6.78, p < .001$. Figure 4.8 presents the interaction between refixation and word length; in longer words, especially after the words 10 characters, FFD decreases in the cases when there is a single fixation while it increases in the cases when there is more than one fixation.

The interaction effect between frequency and word length was not significant, $F(4.63, 217.97) = 0.79, p = .55$. Additionally, the interaction effect among refixation, frequency and word length was not statistically significant, $F(4.87, 229.25) = 0.75, p = .58$.

This section has provided the general picture of First Fixation Duration. However, in order to examine the nature of the interaction between refixation and word length
accurately, Single Fixation Duration and FFD of Multiple Fixations were needed to be analyzed separately. The section below presents those analyses.

4.1.2.1 Single Fixation Duration vs. FFD of Multiple Fixations

In the section above, the general findings regarding the First Fixation Duration are reported. In the current section, the findings regarding the Single Fixation Duration and FFD of Multiple Fixations will be presented respectively.

A two-way analysis of variance was conducted to investigate the influence of two independent variables (frequency, word length) on Single Fixation Duration. Frequency included two levels (frequent, infrequent) and word length consisted of six levels (words with 4, 6, 8, 10, 12, 14 characters respectively).

The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, $\chi^2(14) = 26.68, p < .05$ and the interaction effect between frequency and word length, $\chi^2(14) = 58.15, p < .001$. Therefore, degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon = .90$ for the main effect of word length) and Greenhouse–Geisser estimates of sphericity ($\varepsilon = .66$ for the interaction term).

The main effect of frequency yielded $F(1, 47) = 23.63, p < .001$, indicating that the mean Single Fixation Duration was significantly higher for the infrequent words ($M = 253.81, SE = 5.90$) than for the frequent words ($M = 225.84, SE = 4.33$).

The main effect of word length yielded a significant effect, $F(4.50, 211.81) = 10.98, p < .001$. Pairwise comparisons (see Figure 4.9.) demonstrated that the mean Single Fixation Duration was significantly higher for the words with 8 characters ($M = 268.01, SE = 7.81$) than the words with 4 characters ($M = 218.21, SE = 5.36$), 10 characters ($M = 245.95, SE = 5.62$), 12 characters ($M = 230.60, SE = 7.06$), and 14 characters ($M = 232.83, SE = 6.18$). Additionally, the mean Single Fixation Duration was significantly higher for words with 6 characters ($M = 243.7, SE = 5.75$) and words with 10 characters than for the words with 4 characters. The interaction effect among frequency and word length was not statistically significant, $F(3.27, 153.83) = 1.23, p = .30$. 
Another two-way analysis of variance was conducted to investigate the influence of two independent variables (frequency, word length) on FFD of Multiple Fixations. Frequency included two levels (frequent, infrequent) and word length consisted of six levels (words with 4, 6, 8, 10, 12, 14 characters respectively).

The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, $\chi^2(14) = 55.15, p < .001$ and the interaction effect between frequency and word length, $\chi^2(14) = 39.70, p < .001$. Therefore, degrees of freedom were corrected using Greenhouse–Geisser estimates of sphericity ($\varepsilon = .74$ for the main effect of word length) and Huynh-Feldt estimates of sphericity ($\varepsilon = .83$ for the interaction term).

The main effect of frequency yielded $F(1, 47) = 94.31, p < .001$, indicating that the mean FFD of Multiple Fixations was significantly higher for the infrequent words ($M = 243.58, SE = 4.86$) than for the frequent words ($M = 203.94, SE = 5.27$).

The main effect of word length yielded a significant effect, $F(3.71, 174.38) = 16.12, p < .001$. Pairwise comparisons (see Figure 4.10.) demonstrated that the mean FFD of Multiple Fixations was significantly the lowest for the words with 4 characters, ($M = 180.90, SE = 6.89$) while the difference among the words with 6, ($M = 230.27, SE = 7.72$), 8, ($M = 230.36, SE = 7.56$), 10, ($M = 226.78, SE = 5.62$), 12, ($M = 237.33, SE = 6.12$), and 14 characters, ($M = 236.91, SE = 6.16$) was not statistically significant. Additionally, the interaction effect among frequency and word length was not statistically significant, $F(4.19, 197.08) = 0.38, p = .83$. 

Figure 4.9: Word length effect on Single Fixation Duration. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.
Since the main effect of frequency was always significant in the analyses above, to be able to observe only the effect of word length on Single Fixation Duration and FFD of Multiple Fixations separately, further analyses were needed. In sections 4.1.2.2. and 4.1.2.3., those analyses are presented.

### 4.1.2.2 Single Fixation Duration: Frequent vs. Infrequent Words

A one-way analysis of variance was conducted to investigate the influence of the word length of the frequent words on Single Fixation Duration. The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, $\chi^2(14) = 79.56, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\varepsilon = .65$).

The main effect of word length yielded a significant effect, $F(3.23, 152.20) = 5.88, p < .05$. Pairwise comparisons (see Figure 4.11) indicated that the mean Single Fixation Duration of the frequent words was significantly higher for the words with 8 characters, ($M = 251.93, SE = 10.60$) than the words with 4 characters ($M = 207.69, SE = 4.96$), and 14 characters ($M = 213.69, SE = 8.15$). Additionally, the words with 6 characters ($M = 232.52, SE = 5.49$) had a significantly higher mean Single Fixation Duration than the words with 4 characters.
Another one-way analysis of variance was conducted to investigate the influence of the word length of the infrequent words on Single Fixation Duration. The chi-square statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, $\chi^2(14) = 38.01, p < .05$. Therefore, corrected degrees of freedom from Huynh-Feldt estimates of sphericity were used ($\varepsilon = .84$).

The main effect of word length yielded a significant effect, $F(4.22, 198.48) = 6.26, p < .001$. Pairwise comparisons (see Figure 4.12) indicated that the mean Single Fixation Duration of the infrequent words was significantly higher for the words with 8 characters than the words with 4 characters ($M = 228.73, SE = 7.20$), and 12 characters ($M = 236.90, SE = 11.23$). Additionally, the words with 10 characters ($M = 266.97, SE = 9.66$) had a significantly higher mean Single Fixation Duration than the words with 4 characters.

There was a pattern that is likely to be realized in the results of Single Fixation Duration about the relationship among the words with 4, 6, and 8. It is worth to remember that the
words with 4 and 10 characters are the root forms while the ones with 6 and 12 characters are the ones representing the roots with one suffix (-DA) attached, and 8 and 14 characters are the ones to which two suffixes (-DAki) attached. Single Fixation Duration revealed a regular increase until to the words with 8 characters, then decreased on the words the words with 10 characters, and provided mixed results regarding the words with longer than 10 characters.

### 4.1.2.3. FFD of Multiple Fixations: Frequent vs. Infrequent Words

A one-way analysis of variance was conducted to investigate the influence of the word length of the frequent words on FFD of Multiple Fixations. When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of word length, $\chi^2(14) = 54.01, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\epsilon = .74$).

The main effect of word length yielded a significant effect, $F(3.69, 173.69) = 9.96, p < .001$. Pairwise comparisons (see Figure 4.13) indicated that the mean FFD of Multiple Fixations of the frequent words was significantly the lowest for the words with 4 characters ($M = 155.54, SE = 11.67$).

![Figure 4.13: Word length effect of the frequent words on FFD of Multiple Fixations. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.](image)

Another one-way analysis of variance was conducted to investigate the influence of the word length of the infrequent words on FFD of Multiple Fixations. The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, $\chi^2(14) = 26.11, p < .05$. Therefore, corrected degrees of freedom from Huynh-Feldt estimates of sphericity were used ($\epsilon = .93$).

The main effect of word length yielded a significant effect, $F(4.62, 217.30) = 5.97, p < .001$. Pairwise comparisons (see Figure 4.14) indicated that the mean FFD of Multiple
Fixations of the infrequent words was significantly the lowest for the words with 4 characters \((M = 206.26, SE = 7.67)\).

![Graph showing FFD of Multiple Fixations](image)

Figure 4.14: Word length effect of infrequent words on FFD of Multiple Fixations. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.

The analysis regarding the FFD of Multiple Fixations revealed that when there was more than one fixation on a word, the lowest first fixation duration was on the words with 4 characters which was the shortest group in Experiment 1, and those words were in their root form. There was not a significant result regarding the other word length groups observed by looking at the FFD of Multiple Fixation Duration Results.

### 4.1.2.4. Summary of FFD Results

FFD is an important parameter since it is associated with lexical access. The analyses conducted so far demonstrated that FFD was higher for the words which were passed with a single fixation than for the ones which received more than one fixation and it was higher for infrequent words than for frequent words. There was an interaction between refixation and word length.

When the further analysis conducted on the two sub-local measures of First Fixation Duration, the findings that Single Fixation Duration could reveal more about relatively shorter words (up until 8 characters) while FFD of Multiple Fixations could only reveal that root forms of the short words (4 characters) received the lowest first fixation duration. Since the analyses of FFD of Multiple Fixations provided less about longer words, in the following sections, the findings regarding the subsequent fixations will be presented.

### 4.1.3. Second Fixation Duration (SFD) Results:

In this section, the findings regarding the Second Fixation Duration will be presented. The definition of Second Fixation Duration and the image representing it (see Figure 4.15) are presented below.
Second Fixation Duration (SFD)

Figure 4.15: Second Fixation Duration.

- **Second Fixation Duration**: The duration of the second fixation on a word.

A Factorial ANOVA was conducted to compare the main effects of frequency and word length and the interaction effect between frequency and word length on Second Fixation Duration. A two-way analysis of variance was conducted to investigate the influence of two independent variables (frequency, word length) on Second Fixation Duration in first pass reading. Frequency included two levels (frequent, infrequent) and word length consisted of six levels (words with 4, 6, 8, 10, 12, 14 characters respectively).

When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of word length, $\chi^2(14) = 100.75, p < .001$ and the interaction effect between frequency and word length, $\chi^2(14) = 70.35, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\epsilon = .59$ for the main effect of word length and .61 for the interaction effect between frequency and word length).

The main effects and the interaction are reported as significant at $p < .05$. The main effect of frequency yielded $F(1, 47) = 29.40, p < .001$, indicating that the mean SFD was

<table>
<thead>
<tr>
<th>Word Length</th>
<th>Frequent M</th>
<th>Frequent SD</th>
<th>Infrequent M</th>
<th>Infrequent SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (root)</td>
<td>207.13</td>
<td>94.58</td>
<td>174.10</td>
<td>61.35</td>
</tr>
<tr>
<td>6 (one suffix)</td>
<td>174.55</td>
<td>47.66</td>
<td>231.80</td>
<td>59.80</td>
</tr>
<tr>
<td>8 (two suffixes)</td>
<td>183.65</td>
<td>55.91</td>
<td>221.66</td>
<td>56.32</td>
</tr>
<tr>
<td>10 (root)</td>
<td>171.66</td>
<td>43.02</td>
<td>199.42</td>
<td>41.57</td>
</tr>
<tr>
<td>12 (one suffix)</td>
<td>195.73</td>
<td>41.86</td>
<td>211.75</td>
<td>40.57</td>
</tr>
<tr>
<td>14 (two suffixes)</td>
<td>202.76</td>
<td>37.09</td>
<td>213.36</td>
<td>40.34</td>
</tr>
</tbody>
</table>
significantly higher for infrequent words ($M = 208.68$, $SE = 5.00$) than for frequent words ($M = 189.25$, $SE = 4.82$).

The main effect of word length yielded a significant effect, $F(2.94, 138.25) = 4.03$, $p < .05$. Pairwise comparisons (see Figure 4.16) demonstrated that the mean SFD was significantly higher for words with 6 characters, ($M = 203.18$, $SE = 6.37$), 12 characters, ($M = 203.74$, $SE = 4.97$) and 14 characters, ($M = 208.06$, $SE = 4.33$) than words with 10 characters, ($M = 185.54$, $SE = 5.08$).

![Figure 4.16: Word length effect on SFD. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.](image)

There was a significant interaction effect between frequency and word length, $F(3.02, 142.29) = 9.576$, $p < .001$. Figure 4.17 presents the interaction between frequency and word length; starting from the words with 8 characters, frequent and infrequent words follow a similar pattern on their SFDs.

![Figure 4.17: Interaction effect between frequency and word length on SFD.](image)
4.1.3.1. Second Fixation Duration: Frequent vs. Infrequent Words

A one-way analysis of variance was conducted to investigate the influence of the word length of the frequent words on Second Fixation Duration. The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, \( \chi^2(14) = 104.92, p < .001 \). Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used (\( \varepsilon = .48 \)).

The main effect of word length yielded a significant effect, \( F(2.37, 111.735) = 4.18, p < .05 \). Pairwise comparisons (see Figure 4.18) demonstrated that the mean SFD of the frequent words was significantly higher for the words with 12 characters, \( (M = 195.73, SE = 6.04) \) and 14 characters, \( (M = 202.76, SE = 5.35) \) than the words with 6 characters, \( (M = 174.55, SE = 6.88) \) and 10 characters, \( (M = 171.66, SE = 6.21) \).

![Figure 4.18: Word length effect of the frequent words on SFD. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.](image)

Another one-way analysis of variance was conducted to investigate the influence of the word length of the infrequent words on Second Fixation Duration. When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of word length, \( \chi^2(14) = 45.08, p < .001 \). Therefore, corrected degrees of freedom from Huynh-Feldt estimates of sphericity were used (\( \varepsilon = .85 \)).

The main effect of word length yielded a significant effect, \( F(4.25, 199.92) = 11.65, p < .001 \). Pairwise comparisons (see Figure 4.19) demonstrated that the mean SFD of the infrequent words was significantly higher for the words with 6 characters, \( (M = 231.81, SE = 8.63) \) than the words with 10 characters, \( (M = 199.42, SE = 6.00) \), and it was the lowest for the words with 4 characters \( (M = 174.10, SE = 8.85) \).
4.1.3.2. Summary of SFD Results

The analyses on SFD demonstrated that similar to FFD, SFD was also higher for infrequent words than for frequent words. There was a significant interaction between frequency and word length. SFD of the frequent words was higher for the words with 12 and 14 characters than the words with 6 and 10 characters while SFD of the infrequent words was significantly higher for the words with 6 characters than the words with 10 characters, and it was the lowest for the words with 4 characters.

Different from the results of FFD (see section 4.1.2.), the results of SFD suggest differences between frequent and infrequent words with different lengths. Findings of Third Fixation Duration will be presented in the following section in order to examine whether there are clearer effects on this measure.

4.1.4. Third Fixation Duration (TFD) Results

This section includes the findings regarding the Third Fixation Duration. The definition of Third Fixation Duration and the image representing it (see Figure 4.20) are presented below.

- Third Fixation Duration: The duration of the third fixation on a word.
A Factorial ANOVA was conducted to compare the main effects of frequency and word length and the interaction effect between frequency and word length on Third Fixation Duration. A two-way analysis of variance was conducted to investigate the influence of two independent variables (frequency, word length) on Third Fixation Duration in first pass reading. Frequency included two levels (frequent, infrequent) and word length consisted of six levels (words with 4, 6, 8, 10, 12, 14 characters respectively).

The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, $\chi^2(14) = 387.72, p < .001$ and the interaction effect between frequency and word length, $\chi^2(14) = 249.65, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\epsilon = .25$ for the main effect of word length and .30 for the interaction term).

The main effects and the interaction are reported as significant at $p < .05$. The main effect of frequency yielded $F(1, 47) = 21.67, p < .001$, indicating that the mean TFD was significantly higher for infrequent words ($M = 217.93, SE = 7.77$) than for frequent words ($M = 169.72, SE = 12.11$).

The main effect of word length yielded a significant effect, $F(1.25, 59.13) = 6.23, p < .05$. Pairwise comparisons (see Figure 4.21) demonstrated that the mean TFD was significantly higher for the words with 8 characters, ($M = 204.92, SE = 6.09$), 10 characters, ($M = 196.69, SE = 4.89$), 12 characters, ($M = 212.60, SE = 7.28$), and 14 characters, ($M = 207.95, SE = 5.30$) than the words with 4 characters, ($M = 115.45, SE = 10.37$).
There was a significant interaction effect between frequency and word length, $F(1.46, 69.93) = 11.77, p < .001$. Figure 4.22 presents the interaction between frequency and word length; between the words with 6 and 12 characters, the mean TFD of infrequent words increases while the mean TFD of the frequent words decreases between the words with 6 and 10 characters.

**4.1.4.1. Third Fixation Duration: Frequent vs. Infrequent Words**

A one-way analysis of variance was conducted to investigate the influence of the word length of the frequent words on Third Fixation Duration. When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of word length, $\chi^2(14) = 557.51, p <$
Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\epsilon = .21$).

The main effect of word length yielded a significant effect, $F(1.06, 50) = 12.27, p < .05$. Pairwise comparisons (see Figure 4.23) demonstrated that the mean TFD of the frequent words was significantly higher for the words with 8 characters, ($M = 205.39, SE = 4.77$) than the words with 10 characters ($M = 167.95, SE = 7.15$). There was no third fixation on the frequent words with 4 characters.

![Figure 4.23: Word length effect of the frequent words on TFD. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.](image)

Another one-way analysis of variance was conducted to investigate the influence of the word length of the infrequent words on Third Fixation Duration. The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, $\chi^2(14) = 132.20, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\epsilon = .52$).

The main effect of word length yielded $F(2.58, 121.67) = 1.43, p = .23$ indicating that the difference among the mean TFD on infrequent words was not significantly affected by the word length.

**4.1.4.2. Summary of TFD Results**

The TFD analyses revealed that TFD was higher for infrequent words than for frequent words which was the case for FFD and SFD as well. There was a significant interaction effect between frequency and word length. There was no Third Fixation Duration on frequent words with 4 characters. Additionally, while frequent words with 8 characters had a higher mean TFD than the frequent words with 10 characters, there was no significant effect of the word length on TFD for infrequent words.
4.1.5. Gaze Duration Results

In this section, the findings regarding the Gaze Duration will be presented. The definition of Gaze Duration and the image representing it (see Figure 4.24) are presented below.

\[
\text{Gaze Duration} = F_1 + F_2 + F_3
\]

Figure 4.24: Gaze Duration.

- **Gaze Duration**: The sum of all fixations made on a word prior to a saccade to another word.

Table 4.5: Mean Gaze Durations according to frequency and word length.

<table>
<thead>
<tr>
<th>Word Length</th>
<th>GAZE DURATION (ms)</th>
<th>Frequent</th>
<th>Infrequent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>4 (root)</td>
<td>600.15</td>
<td>146.23</td>
<td>628.52</td>
</tr>
<tr>
<td>6 (one suffix)</td>
<td>656.35</td>
<td>178.54</td>
<td>807.47</td>
</tr>
<tr>
<td>8 (two suffixes)</td>
<td>695.80</td>
<td>162.27</td>
<td>878.79</td>
</tr>
<tr>
<td>10 (root)</td>
<td>637.62</td>
<td>115.44</td>
<td>921.99</td>
</tr>
<tr>
<td>12 (one suffix)</td>
<td>690.94</td>
<td>119.45</td>
<td>965.58</td>
</tr>
<tr>
<td>14 (two suffixes)</td>
<td>727.11</td>
<td>146.70</td>
<td>1075.91</td>
</tr>
</tbody>
</table>

A Factorial ANOVA was conducted to compare the main effects of frequency and word length and the interaction effect between frequency and word length on Gaze Duration. A two-way analysis of variance was conducted to investigate the influence of two independent variables (frequency, word length) on Gaze Duration in first pass reading. Frequency included two levels (frequent, infrequent) and word length consisted of six levels (words with 4, 6, 8, 10, 12, 14 characters respectively).

When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of word length, \(\chi^2(14) = 53.47, p < .001\) and the interaction effect between frequency and word length, \(\chi^2(14) = 31.86, p < .05\). Therefore, degrees of freedom were corrected using Greenhouse–Geisser estimates of sphericity (\(\varepsilon = .71\) for the main effect of word length).
and Huynh-Feldt estimates of sphericity .91 for the interaction effect between frequency and word length).

The main effects and the interaction are reported as significant at $p < .001$. The main effect of frequency yielded $F(1, 47) = 168.36, p < .001$, indicating that the mean Gaze Duration was significantly higher for infrequent words ($M = 879.70, SE = 25.22$) than for frequent words ($M = 667.99, SE = 15.60$).

The main effect of word length yielded a significant effect, $F(3.56, 167.56) = 38.93, p < .001$. Pairwise comparisons (see Figure 4.25) demonstrated that the mean Gaze Duration was significantly the lowest for the words with 4 characters, ($M = 614.33, SE = 18.57$). Pairwise comparisons also demonstrated that the mean Gaze Duration was significantly higher for the words with 14 characters, ($M = 901.51, SE = 29.56$) than the words with 10 characters, ($M = 779.80, SE = 22.98$), 8 characters, ($M = 787.29, SE = 22.19$), and 6 characters, ($M = 731.91, SE = 28.15$). Additionally, the words with 12 characters ($M = 828.259, SE = 20.136$) had a mean Gaze Duration significantly higher than the words with 6 characters.

![Figure 4.25: Word length effect on Gaze Duration. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.](image)

There was a significant interaction effect between frequency and word length, $F(4.58, 215.48) = 17.93, p < .001$. Figure 4.26 illustrates the interaction effect between frequency and word length on Gaze Duration; for the infrequent words, Gaze Duration increases as the words get longer. On the other hand, for the frequent words, it increases up to words with 8 characters, then decreases on the words with 10 characters, then it again increases as the words get longer.
4.1.5.1. Gaze Duration: Frequent vs. Infrequent Words

A one-way analysis of variance was conducted to investigate the influence of the word length of the frequent words on Gaze Duration. The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, $\chi^2(14) = 73.41, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\varepsilon = .63$).

The main effect of word length yielded a significant effect, $F(3.19, 149.93) = 8.56, p < .001$. Pairwise comparisons (see Figure 4.27) demonstrated that the mean Gaze Duration of the frequent words was significantly higher for the words with 14 characters, ($M = 727.11, SE = 21.17$), 12 characters, ($M = 690.93, SE = 17.24$), and 8 characters, ($M = 695.80, SE = 23.42$) than the words with 4 characters, ($M = 600.15, SE = 21.10$). Pairwise comparisons also demonstrated that the mean Gaze Duration of the frequent words was significantly higher for the words with 12 characters than the words with 10 characters, ($M = 637.62, SE = 16.66$).
Another one-way analysis of variance was conducted to investigate the influence of the word length of the infrequent words on Dwell Time. When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of word length, $\chi^2(14) = 43.13, p < .05$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\varepsilon = .74$).

The main effect of word length yielded a significant effect, $F(3.70, 174.33) = 38.39, p < .001$. Pairwise comparisons (see Figure 4.28) demonstrated that the mean Gaze Duration of the infrequent words was significantly the lowest for the words with 4 characters, $(M = 628.52, SE = 24.86)$ and it was higher for the words with 14 characters, $(M = 1075.90, SE = 45.17)$ than the words with 10 characters, $(M = 921.98, SE = 34.27)$, 8 characters, $(M = 878.78, SE = 31.11)$, and 6 characters, $(M = 807.46, SE = 33.79)$. Additionally, the words with 12 characters, $(M = 965.58, SE = 29.88)$ and 10 characters had a significantly higher mean Gaze Duration than the words with 6 characters.
4.1.5.2. Summary of Gaze Duration Results

The analyses of Gaze Duration demonstrated that it was higher for the infrequent words than for the frequent words which was consistent with the results of the findings of the other measures that were reported in the above sections. There was a significant interaction effect between frequency and word length.

For the frequent words, Gaze Duration was significantly higher for the words with 14, 12, and 8 characters than the words with 4 characters; it was also higher for the words with 12 characters than the words with 10 characters. For the infrequent words Gaze Duration was the lowest for the words with 4 characters and it was higher for the words with 14 characters than the words with 10, 8, and 6 characters. The words with 12 and 10 characters had a significantly higher mean Gaze Duration than the words with 6 characters.

So far, the findings of the analyses conducted on First, Second, and Third Fixation Duration and Gaze Duration are reported. In the following section, the results of the Sum of First and Second Fixation Duration will be presented. The rationale behind this analysis is the fact that lexical access is assumed to be started in First Fixation Duration, and it is likely that for longer words, this access may take longer than the duration of the first fixation. Although this method of analyzing may not suggest much for the cases when lexical access is completed with a single fixation, there is a possibility for longer words such that this process is completed together with first and one or more subsequent fixations. In order to examine this possibility, this further analysis was conducted.

4.1.6. Sum of First and Second Fixation Duration Results

The Sum of First and Second Fixation Duration measure was obtained by adding the duration of the first of multiple fixations on a word to the duration of the second fixation on a word.
Table 4.6: Mean Sum of First and Second Fixation Durations according to frequency and word length.

<table>
<thead>
<tr>
<th></th>
<th><strong>FFD + SFD (ms)</strong></th>
<th>Frequent</th>
<th>Infrequent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Word Length</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 (root)</td>
<td>373.48</td>
<td>127.32</td>
<td>380.58</td>
</tr>
<tr>
<td>6 (one suffix)</td>
<td>392.93</td>
<td>83.43</td>
<td>482.02</td>
</tr>
<tr>
<td>8 (two suffixes)</td>
<td>397.28</td>
<td>92.07</td>
<td>472.01</td>
</tr>
<tr>
<td>10 (root)</td>
<td>380.43</td>
<td>70.18</td>
<td>444.47</td>
</tr>
<tr>
<td>12 (one suffix)</td>
<td>414.50</td>
<td>71.34</td>
<td>467.96</td>
</tr>
<tr>
<td>14 (two suffixes)</td>
<td>421.19</td>
<td>63.26</td>
<td>468.76</td>
</tr>
</tbody>
</table>

A Factorial ANOVA was conducted to compare the main effects of frequency and word length and the interaction effect between frequency and word length on the sum of First and Second Fixation Duration. A two-way analysis of variance was conducted to investigate the influence of two independent variables (frequency, word length) on the sum of First and Second Fixation Duration. Frequency included two levels (frequent, infrequent) and word length consisted of six levels (words with 4, 6, 8, 10, 12, 14 characters respectively).

The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, \( \chi^2(14) = 58.74, p < .001 \) and the interaction effect between frequency and word length, \( \chi^2(14) = 31.13, p < .05 \). Therefore, degrees of freedom were corrected using Greenhouse–Geisser estimates of sphericity (\( \epsilon = .71 \) for the main effect of word length) and Huynh-Feldt estimates of sphericity (\( \epsilon = .86 \) for the interaction effect between frequency and word length).

The main effects and the interaction are reported as significant at \( p < .05 \). The main effect of frequency yielded \( F(1, 47) = 160.02, p < .001 \), indicating that the mean Sum of First and Second Fixation Duration was significantly higher for infrequent words (\( M = 452.63, SE = 8.62 \)) than for frequent words (\( M = 396.63, SE = 8.83 \)).

The main effect of word length yielded a significant effect, \( F(3.52, 165.65) = 14.01, p < .001 \). Pairwise comparisons (see Figure 4.29) demonstrated that the mean Sum of First and Second Fixation Duration was significantly the lowest for the words with 4 characters, (\( M = 377.03, SE = 13.69 \)) and it was significantly higher both for the words with 14, (\( M = 444.97, SE = 9.27 \)) and 12 characters, (\( M = 441.23, SE = 9.12 \)), than for the words with 10 characters, (\( M = 412.45, SE = 8.33 \)).
There was a significant interaction effect between frequency and word length, $F(4.31, 202.83) = 4.25, p < .05$. In Figure 4.30, the interaction between frequency and word length is presented. The frequent and infrequent words follow a similar pattern except for the duration on words with 6 characters.

**Figure 4.30:** Interaction effect between frequency and word length on Sum of First and Second Fixation Duration. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.

### 4.1.6.1. Sum of First and Second Fixation Duration: Frequent vs. Infrequent Words

A one-way analysis of variance was conducted to investigate the influence of the word length of the frequent words on the sum of First and Second Fixation Duration. When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of word
length, $\chi^2(14) = 82.82, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\varepsilon = .57$).

The main effect of word length yielded a significant effect, $F(2.82, 132.76) = 3.58, p < .05$. Pairwise comparisons (see Figure 4.31) demonstrated that the mean Sum of First and Second Fixation Duration of the frequent words was significantly higher for the words with 14 characters, ($M = 421.19, SE = 9.13$) than the words with 4 characters ($M = 373.48, SE = 18.37$). Additionally, the mean Sum of First and Second Fixation Duration of the frequent words was significantly higher for the words with 14 and 12 characters, ($M = 414.50, SE = 10.29$) than the words with 10 characters, ($M = 380.43, SE = 10.13$).

![Figure 4.31: Word length effect of the frequent words on Sum of First and Second Fixation Duration. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.](image)

Another one-way analysis of variance was conducted to investigate the influence of the word length of the infrequent words on the sum of First and Second Fixation Duration. The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, $\chi^2(14) = 47.27, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\varepsilon = .69$).

The main effect of word length yielded a significant effect, $F(3.42, 161.18) = 15.02, p < .001$. Pairwise comparisons (see Figure 4.32) demonstrated that the mean Sum of First and Second Fixation Duration of the infrequent words was significantly the lowest for the words with 4 characters, ($M = 380.59, SE = 13.37$).
4.1.6.2. Summary of Sum of First and Second Fixation Results

The results of the analysis on Sum of First and Second Fixation Duration revealed that it was higher for infrequent words than for frequent words. Further, for frequent words, it was higher for the words with 14 characters than the words with 4 characters while it was higher for the words with 14 and 12 characters than the words with 10 characters. For the infrequent words, it was the lowest for the words with 4 characters.

In the following section, the findings regarding the Sum of First, Second and Third Fixation Duration will be presented in order to examine whether the lexical access can be completed in three subsequent fixations. It is especially important for longer words; although the analyses of the Sum of First and Second Fixations provided results related to long and frequent words, less is known for the long and infrequent words from the analyses reported so far.

4.1.7. Sum of First, Second, and Third Fixation Duration Results

The Sum of First, Second and Third Fixation Duration measure was obtained by summing up the duration of the first of multiple fixations on a word with the duration of the second and the third fixation on a word.
Table 4.7: Mean Sum of First, Second, and Third Fixation Durations according to frequency and word length.

<table>
<thead>
<tr>
<th>Word Length</th>
<th>Frequency</th>
<th>Infrequent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>M</strong></td>
<td><strong>SD</strong></td>
</tr>
<tr>
<td><strong>FFD + SFD + TFD (ms)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 (root)</td>
<td>375.31</td>
<td>121.47</td>
</tr>
<tr>
<td>6 (one suffix)</td>
<td>462.03</td>
<td>338.95</td>
</tr>
<tr>
<td>8 (two suffixes)</td>
<td>473.18</td>
<td>145.69</td>
</tr>
<tr>
<td>10 (root)</td>
<td>450.22</td>
<td>132.35</td>
</tr>
<tr>
<td>12 (one suffix)</td>
<td>525.68</td>
<td>151.72</td>
</tr>
<tr>
<td>14 (two suffixes)</td>
<td>571.06</td>
<td>115.46</td>
</tr>
</tbody>
</table>

A Factorial ANOVA was conducted to compare the main effects of frequency and word length and the interaction effect between frequency and word length on the sum of First, Second and Third Fixation Duration. A two-way analysis of variance was conducted to investigate the influence of two independent variables (frequency, word length) on the sum of First, Second and Third Fixation Duration. Frequency included two levels (frequent, infrequent) and word length consisted of six levels (words with 4, 6, 8, 10, 12, 14 characters respectively).

When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of word length, $\chi^2(14) = 87.20, p < .001$ and the interaction effect between frequency word length, $\chi^2(14) = 41.39, p < .001$. Therefore, degrees of freedom were corrected using Greenhouse–Geisser estimates of sphericity ($\varepsilon = .51$ for the main effect of word length) and Huynh-Feldt estimates of sphericity (.85 for the interaction effect between frequency and word length).

The main effects and the interaction are reported as significant at $p < .05$. The main effect of frequency yielded $F(1, 47) = 117.75, p < .001$, indicating that the mean Sum of First, Second and Third Fixation Duration was significantly higher for infrequent words ($M = 592.57, SE = 16.13$) than for frequent words ($M = 476.25, SE = 16.69$).

The main effect of word length yielded a significant effect, $F(2.42, 114.16) = 31.65, p < .001$. Pairwise comparisons (see Figure 4.33) demonstrated that the mean Sum of First, Second and Third Fixation Duration was significantly the lowest for the words with 4 characters, ($M = 387.14, SE = 16.59$) and it was significantly higher for the words with 14 characters, ($M = 626.51, SE = 13.68$) than for the words with 10, ($M = 548.72, SE = 15.99$), 8, ($M = 535.01, SE = 18.41$), and 6 characters, ($M = 514.20, SE = 35.08$). Accordingly, the mean Sum of First, Second and Third Fixation Duration was significantly higher for the words with 12 characters, ($M = 594.86, SE = 15.64$) than for the words with 10 and 8 characters.
Figure 4.33: Word length effect on Sum of First, Second, and Third Fixation Duration. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.

There was a significant interaction effect between frequency and word length, $F(4.22, 198.55) = 4.78, p < .05$. Figure 4.34 illustrates the interaction effect between frequency and word length; the Sum of First, Second and Third Fixation Duration increases for the infrequent words as the words get longer while for the frequent words it increases up to words with 8 characters, then decreases on the words with 10 characters, then it again increases as the words get longer which is similar to the interaction effect between frequency and word length on Gaze Duration (see Figure 4.26).

Figure 4.34: Interaction effect between frequency and word length on Sum of First, Second, and Third Fixation Duration. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.
4.1.7.1. Sum of First, Second and Third Fixation Duration: Frequent vs. Infrequent Words

A one-way analysis of variance was conducted to investigate the influence of the word length of the frequent words on the sum of First, Second and Third Fixation Duration. The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of word length, $\chi^2(14) = 89.97, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\epsilon = .49$).

The main effect of word length yielded a significant effect, $F(2.44, 115.01) = 8.68, p < .001$. Pairwise comparisons (see Figure 4.35) demonstrated that the mean Sum of First, Second and Third Fixation Duration of the frequent words was significantly lower for the words with 4 characters ($M = 375.31$, $SE = 17.53$) than the words with 14 characters, ($M = 571.06$, $SE = 16.66$), 12 characters, ($M = 525.68$, $SE = 21.90$), 10 characters, ($M = 450.22$, $SE = 19.10$), and 8 characters, ($M = 473.18$, $SE = 21.03$). Additionally, it was significantly higher for the words with 14 characters than the words with 8 and 10 characters. The words with 12 characters had a significantly higher mean Sum of First, Second and Third Fixation compared to words with 10 characters.

![Figure 4.35: Word length effect of the frequent words on Sum of First, Second, and Third Fixation Duration. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.](image)

Another one-way analysis of variance was conducted to investigate the influence of the word length of the infrequent words on the sum of First, Second and Third Fixation Duration. When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of word length, $\chi^2(14) = 51.73, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\epsilon = .73$).
The main effect of word length yielded a significant effect, $F(3.62, 170.33) = 43.97, p < .001$. Pairwise comparisons (see Figure 4.36) demonstrated that the mean Sum of First, Second and Third Fixation Duration of the infrequent words was significantly the lowest for the words with 4 characters, ($M = 398.97, SE = 24.84$) and it was significantly higher for the words with 14 characters, ($M = 681.96, SE = 16.15$), 12 characters, ($M = 664.04, SE = 16.97$), and 10 characters, ($M = 647.22, SE = 19.15$) than for the words with 6 characters, ($M = 566.38, SE = 26.13$). Additionally, the words with 14 characters had a significantly higher mean Sum of First, Second and Third Fixation Duration than the words with 8 characters, ($M = 596.83, SE = 24.08$).

![Infrequent Words](image)

Figure 4.36: Word length effect of the infrequent words on Sum of First, Second, and Third Fixation Duration. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.

### 4.1.7.2. Summary of Sum of First, Second and Third Fixation Duration

The mean Sum of First, Second and Third Fixation Duration was significantly higher for infrequent words than for frequent words. For the frequent words, it was lower for the words with 4 characters than the words with 14, 12, 10, and 8 characters. Additionally, it was significantly higher for the words with 14 characters than the words with 8 and 10 characters. The frequent words with 12 characters had a higher mean Sum of First, Second and Third Fixation compared to words with 10 characters.

For the infrequent words Sum of First, Second and Third Fixation Duration was the lowest for the words with 4 characters and it was higher for the words with 14, 12, and 10 characters than for the words with 6 characters. Additionally, it was higher for the words with 14 characters than the words with 8 characters. The results of the Sum of First, Second, and Third Fixation Duration provided findings regarding the long and infrequent words compared to the results of the Sum of First and Second Fixation.
4.2. Experiment 2

In Experiment 1, the words were grouped according to their length and frequency values. There were two groups of words according to their frequencies: frequent and infrequent, and there were six groups of words according to their lengths: words with 4, 6, 8, 10, 12, and 14 characters respectively. Observing and understanding only the possible effects of morphological complexity was not possible solely with the results of Experiment 1 since in that experiment, word length and frequency were confounding factors. Moreover, sentence frames (i.e. the parts before and after the target words in the sentences) were not controlled in Experiment 1, and some of the target words with no suffix were derived words which were also confounding factors.

So, Experiment 2 was designed with the aim of eliminating the mentioned confounding factors by using only the frequent words with the same length, and among the target words, there were no derived ones. Further, word-initial bigrams of target words were controlled, and sentence frames before target word and after target word were the same among word-initial bigrams. The present section presents the findings of Experiment 2.

4.2.1. First Run Fixation Count (FRFC) Results

In order to examine the effects of suffixation condition on the fixation count in first pass reading, First Run Fixation Count which is the number of all fixations in a trial falling in the first run of the word was analyzed.

A Factorial ANOVA was conducted to compare the main effect of suffixes on First Run Fixation Count. A one-way analysis of variance was conducted to investigate the influence of one independent variable (condition) on First Run Fixation Count. The condition included three levels (1, 2, 3; representing words with no suffix, words with one suffix and words with two suffixes respectively).

The results show that there was no statistically significant effect of condition on First Run Fixation Count, $F(2, 78) = 1.38$, $p = .25$.

4.2.2. First Fixation Duration (FFD) Results

In this section, the findings regarding the First Fixation Durations on the target words will be presented. First Fixation Duration is the duration of the first fixation on a word during the first pass through the text. Since FFD is the duration of the first fixation on a word regardless of whether it is the only fixation on a word or the first of multiple fixations on a word, the differentiation between these two cases is needed. So, two local measures: Single Fixation Duration which is the first pass fixation duration on a word that is only fixated once and FFD of Multiple Fixations which is the duration of the first of multiple fixations on a word were used (see Figure 4.6).
Table 4.8: Mean First Fixation Durations according to the suffixation conditions.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Single Fixation Duration</th>
<th>FFD of Multiple Fixations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>1-NoSuffix</td>
<td>218.81</td>
<td>49.56</td>
</tr>
<tr>
<td>2-OneSuffix</td>
<td>242.14</td>
<td>77.89</td>
</tr>
<tr>
<td>3-TwoSuffixes</td>
<td>248.21</td>
<td>71.42</td>
</tr>
</tbody>
</table>

A Factorial ANOVA was conducted to compare the main effects of refixation and condition (suffixes) and the interaction effect between refixation and condition on First Fixation Duration. A two-way analysis of variance was conducted to investigate the influence of two independent variables (refixation, condition) on First Fixation Duration. Refixation included two levels (single fixation and more than one fixation), and condition included three levels (1, 2, 3; representing words with no suffix, words with one suffix and words with two suffixes respectively).

The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the interaction effect between refixation and condition, $\chi^2(2) = 12.04, p < .05$. Therefore, corrected degrees of freedom from Huynh-Feldt estimates of sphericity were used ($\varepsilon = .81$).

The main effect of refixation and the interaction effect are reported as significant at $p < .05$. The main effect of refixation yielded an F ratio of $F(1, 39) = 9.79, p < .05$, indicating that the mean FFD was significantly higher for the words which were passed with a single fixation ($M = 236.39, SE = 6.99$) than for the ones which received more than one fixation ($M = 209.26, SE = 5.66$).

The main effect of the suffixation condition was not statistically significant on the mean FFD $F(2, 78) = 2.44, p = .09$. The interaction effect between refixation and the suffixation condition was statistically significant though, $F(1.62, 63.46) = 4.90, p < .05$. Figure 4.37 presents the interaction between refixation and the suffixation condition; while the Single Fixation Duration increases on the words with one suffix, FFD of Multiple Fixations decreases. Additionally, they both increase on the words with two suffixes; however, the increase in FFD of Multiple Fixations is larger.
4.2.2.1 Single Fixation Duration vs. FFD of Multiple Fixations

A one-way analysis of variance was conducted to investigate the influence of the condition on Single Fixation Duration. The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of condition, $\chi^2(2) = 8.33, p < .05$. Therefore, corrected degrees of freedom from Huynh-Feldt estimates of sphericity were used ($\varepsilon = .87$).

The main effect of the suffixation condition yielded an F ratio of $F(1.73, 67.74) = 2.48$, $p = .10$, indicating that the mean Single Fixation Duration was not statistically different among the suffixation conditions.

Another one-way analysis of variance was conducted to investigate the influence of the condition on FFD of Multiple Fixations. When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of condition, $\chi^2(2) = 9.18, p < .05$. Therefore, degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon = .86$).

The results show that the mean FFD of Multiple Fixations was significantly affected by the suffixation condition $F(1.71, 66.67) = 6.07, p < .05$. Pairwise comparisons (see Figure 4.38) demonstrated that the mean FFD was significantly higher for the words with two suffixes, ($M = 219.35, SE = 6.95$) and for the ones with no suffix, ($M = 217.79, SE = 8.26$) than the words with one suffix, ($M = 190.63, SE = 8.08$).
4.2.3. Second Fixation Duration (SFD) Results:

In the section above, the findings of FFD analyses are reported. Since Single Fixation Duration was not statistically different among the suffixation conditions, but FFD of Multiple Fixations was significantly affected by the suffixation condition, Second Fixation Duration analyses will be reported in this section. Second Fixation Duration is the duration of the second fixation on a word (see Figure 4.15).

Table 4.9: Mean Second Fixation Durations according to the suffixation conditions.

<table>
<thead>
<tr>
<th>Condition</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-NoSuffix</td>
<td>173.10</td>
<td>34.15</td>
</tr>
<tr>
<td>2-OneSuffix</td>
<td>215.33</td>
<td>44.36</td>
</tr>
<tr>
<td>3-TwoSuffixes</td>
<td>157.44</td>
<td>53.43</td>
</tr>
</tbody>
</table>

A Factorial ANOVA was conducted to compare the main effect of condition (suffixes) on Second Fixation Duration. A one-way analysis of variance was conducted to investigate the influence of one independent variable (condition) on Second Fixation Duration in first pass reading. The condition included three levels (1, 2, 3; representing words with no suffix, words with one suffix and words with two suffixes respectively).

The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of condition, $\chi^2(2) = 47.23, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\varepsilon = .58$).

The results show that Second Fixation Duration was significantly affected by the suffixation condition, $F(1.16, 45.57) = 31.51, p < .001$. Pairwise comparisons (see Figure 4.39) demonstrated that the mean SFD was significantly the highest for the words
with one suffix, \((M = 215.33, SE = 7.01)\), and the lowest for the words with two suffixes, 
\((M = 157.44, SE = 8.44)\). Additionally, the mean SFD was significantly higher for the 
words with no suffix, \((M = 173.10, SE = 5.40)\) than for the words with two suffixes.

![Figure 4.39: Suffixation Condition effect on Second Fixation Duration. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.](image)

### 4.2.4. Third Fixation Duration (TFD) Results

The results of Second Fixation Duration revealed that the mean SFD was the lowest for 
the words with two suffixes. In order to examine the access of the word with two 
suffixes, Third Fixation Duration results may be needed. Hence, the findings of this 
measure will be presented in this section. Third Fixation Duration is the duration of the 
third fixation on a word (see Figure 4.20).

<table>
<thead>
<tr>
<th>Condition</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-NoSuffix</td>
<td>132.52</td>
<td>7.81</td>
</tr>
<tr>
<td>2-OneSuffix</td>
<td>148.00</td>
<td>27.29</td>
</tr>
<tr>
<td>3-TwoSuffixes</td>
<td>206.64</td>
<td>16.98</td>
</tr>
</tbody>
</table>

A Factorial ANOVA was conducted to compare the main effect of suffixes on Third 
Fixation Duration. A one-way analysis of variance was conducted to investigate the 
influence of one independent variable (condition) on Third Fixation Duration in first 
pass reading. The condition included three levels (1, 2, 3; representing words with no 
suffix, words with one suffix and words with two suffixes respectively).

When Mauchly’s test is applied to investigate whether the assumption of sphericity had 
been violated, the chi-square test statistic yielded that it is violated for the main effect of 
condition, \(\chi^2(2) = 25.71, p < .001\). Therefore, corrected degrees of freedom from 
Greenhouse–Geisser estimates of sphericity were used \((\varepsilon = .67)\).
The results show that Third Fixation Duration was significantly affected by the suffixation condition, $F(1.34, 52.29) = 177.84, p < .001$. Pairwise comparisons (see Figure 4.40) demonstrated that the mean TFD was significantly the highest for the words with two suffixes, $(M = 206.64, SE = 2.68)$, and the lowest for the words with no suffix, $(M = 132.52, SE = 1.23)$. Accordingly, the mean TFD was significantly higher for the words with two suffixes than for the words with one suffix, $(M = 148.00, SE = 4.31)$ for which the mean TFD was significantly higher than the words with no suffix.

![Figure 4.40: Suffixation Condition effect on Third Fixation Duration. Error bars indicate CI for the mean at 95% significance level and asterisk (*) shows significance.](image)

4.2.5. Gaze Duration Results

A Factorial ANOVA was conducted to compare the main effect of suffixes on Gaze Duration which is the sum of all fixations on a word prior to a saccade to another word (see Figure 4.24). A one-way analysis of variance was conducted to investigate the influence of one independent variable (condition) on Gaze Duration in first pass reading. Condition included three levels (1, 2, 3; representing words with no suffix, words with one suffix and words with two suffixes respectively).

The chi-square test statistic from Mauchly’s test revealed that the assumption of sphericity had been violated for the main effect of condition, $\chi^2(2) = 9.72, p < .05$. Therefore, corrected degrees of freedom from Huynh-Feldt estimates of sphericity were used ($\varepsilon = .85$).

The results show that there was no statistically significant effect of the suffixation condition on Gaze Duration, $F(1.69, 66.02) = 2.93, p = .06$.

4.2.6. Sum of First and Second Fixation Duration and Sum of First, Second, and Third Fixation Duration Results

The results of the Gaze Duration analysis revealed that Gaze Duration was not affected by the suffixation condition. However, FFD of Multiple Fixations and Second and Third Fixations were affected by the suffixation condition, so the Sum of First and Second
Fixation Duration and the Sum of First, Second, and Third Fixation Durations were also analyzed.

First, a one-way analysis of variance was conducted to investigate the influence of one independent variable (condition) on the sum of First and Second Fixation Duration. Condition included three levels (1, 2, 3; representing words with no suffix, words with one suffix and words with two suffixes respectively).

When Mauchly’s test is applied to investigate whether the assumption of sphericity had been violated, the chi-square test statistic yielded that it is violated for the main effect of condition, $\chi^2(2) = 19.69, p < .001$. Therefore, corrected degrees of freedom from Greenhouse–Geisser estimates of sphericity were used ($\epsilon = .71$). The results show that there was no statistically significant effect of the suffixation condition on Sum of First and Second Fixation Duration, $F(1.42, 55.53) = 3.29, p = .06$.

Then, another one-way analysis of variance was conducted to investigate the influence of one independent variable (condition) on the sum of First, Second and Third Fixation Duration. The results show that there was no statistically significant effect of the suffixation condition on the sum of First, Second, and Third Fixation Duration, $F(2, 78) = 1.30, p = .28$.

**4.3. Overall Summary of Results**

In this section, findings that are presented in the previous sections of the present chapter (Chapter 4) will be summarized. Since the eye movement measures under investigation were the same for both experiments, the results of eye movement measures will be included together. Thus, it would be possible to compare the findings for Experiment 1 and 2.

**4.3.1. First Run Fixation Count (FRFC)**

**Experiment I**

There was a significant main effect of word length both for frequent and infrequent words which was qualified by the interaction between frequency and word length. The mean fixation count was significantly higher for infrequent words than for frequent words. Nevertheless, for both frequent and infrequent words, there was a regular increase in the fixation count in the first run which was parallel to the increase in the word length.

**Experiment II**

The results of Experiment 2 demonstrated that there was no statistically significant effect of the suffixation condition on First Run Fixation Count.
4.3.2. First Fixation Duration (FFD)

Experiment I

Single Fixation Duration analyses revealed that there was a regular increase in the durations of the words according to their word length up until the words with 8 characters. However, the decrease on the words with 10 characters which are the roots forms could suggest that the given increase in the durations might be due to the suffixation in the case of the words with 6 and 8 characters. Nevertheless, it still might be the case that word length effect on Single Fixation Duration was more observable in shorter words since the distinction of the word length and suffixation effect is difficult to make for Experiment 1. On the other hand, when the FFD of Multiple Fixations were analyzed, the only findings that could be reached that it was the lowest for the words with 4 characters.

Experiment II

This experiment revealed different results than the first one regarding FFD. The suffixation condition did not have a significant main effect either on First Fixation Duration or on Single Fixation Duration. However, FFD of Multiple Fixations was significantly affected by the suffixation condition which revealed that it was significantly higher for the words with two suffixes and for the ones with no suffix than the words with one suffix.

4.3.3. Second Fixation Duration (SFD)

Experiment I

Second Fixation Duration analyses demonstrated that it was significantly higher for the words with 6, 12, and 14 characters than words with 10 characters. This finding is interesting because normally we would expect the words with 10 characters to receive longer second fixation than the words with 6 characters. However, when it is considered that the words with 10 letters were actually in their base forms, it could imply that the words with 6 characters received longer fixations because of the suffix attached to them. Moreover, despite not yielding a significant difference, the words with 8 characters (two suffixes attached) also received longer SFDs than the ones with 10 characters.

There was also a significant interaction effect between frequency and word length. The mean SFD of the frequent words was significantly higher for the words with 12 (one suffix) and 14 (two suffixes) characters than the words with 6 (one suffix) and 10 (root) characters. Besides, the mean SFD of the infrequent words was significantly higher for the words with 6 (one suffix) characters than the words with 10 (root) characters, and it was the lowest for the words with 4 (root) characters.
Experiment II

In Experiment 2, the mean SFD was significantly the highest for the words with one suffix, and the lowest for the words with two suffixes. Additionally, the mean SFD was significantly higher for the words with no suffix than for the words with two suffixes. These results of Experiment 2 may suggest that readers could complete the processing of the words with one suffix, and the words with no suffix with the Second Fixations they made on the word.

It should be noted that the mean FFD of Multiple Fixations was significantly higher for the words with two suffixes and the ones with no suffix than the words with one suffix. As a complement, in the Second Fixation Duration, the words with one suffix had a longer Second Fixation Duration than the ones with two suffixes which may allow arguing that Second Fixation had a complementary role for the words with one suffix.

4.3.4. Third Fixation Duration (TFD)

Experiment I

There was a significant interaction effect between frequency and word length. Furthermore, the mean TFD of the frequent words was significantly higher for the words with 8 characters than the words with 10 characters. There was not any third fixation on the frequent words with 4 characters. Hence, the difference between this group and words with other lengths was significant.

The evidence that there was not any third fixation on the words with 4 characters may suggest that the processing of these words was completed either with one fixation or with two fixations (a shorter FFD of multiple fixations and a longer SFD). The mean TFD on infrequent words was not informative since it was not significantly affected by the word length.

Experiment II

The mean TFD was significantly the highest for the words with two suffixes and the lowest for the words with no suffix. Accordingly, the mean TFD was significantly higher for the words with two suffixes than for the words with one suffix for which the mean TFD was significantly higher than the words with no suffix. The findings of the TFD in Experiment 2 support the argument regarding the role of SFD in the processing of the words with one suffix. This may suggest that the processing of the words with no suffix was less related to the Third Fixation on the word than the processing of the words with one suffix. Moreover, the words with two suffixes benefited from the Third Fixation on the word the most.
4.3.5. Gaze Duration

Experiment I

The mean Gaze Duration of the frequent words was significantly higher for the words with 14, 12, and 8 characters than the words with 4 characters. The mean Gaze Duration of the frequent words was significantly higher for the words with 12 characters than the words with 10 characters.

The mean Gaze Duration of the infrequent words was significantly the lowest for the words with 4 characters, and higher for the words with 14 characters than the words with 10, 8, and 6 characters. Additionally, the words with 12 and 10 characters had a significantly higher mean Gaze Duration than the words with 6 characters.

Experiment II

In the second experiment, the results demonstrated that there was no statistically significant effect of the suffixation condition on Gaze Duration. This finding might lead one to consider the possibility by looking at the results of Experiment 1 and 2 together that Gaze Duration seems to be affected by the length of the word rather than the suffixation.

4.3.6. Sum of First and Second Fixation Duration

Experiment I

The mean Sum of First and Second Fixation Duration of the frequent words was significantly higher for the words with 14 characters than the words with 4 characters. For the frequent words, it was significantly higher for the words with 14 and 12 characters than the words with 10 characters. These findings may suggest that the processing that was not observable in the First and the Second Fixation Durations separately for the long words could be observable in the sum of these two fixations on the word.

The mean Sum of First and Second Fixation Duration of the infrequent words was significantly the lowest for the words with 4 characters which was also not informative enough to speculate on the processing of the long and infrequent words.

Experiment II

The results demonstrated that there was no statistically significant effect of the suffixation condition on Sum of First and Second Fixation Duration.
4.3.7. Sum of First, Second, and Third Fixation Duration

Experiment I

The mean Sum of First, Second, and Third Fixation Duration of the frequent words was significantly lower for the words with 4 characters than the words with 14, 12, 10, 8 characters. Additionally, it was significantly higher for the words with 14 characters than the words with 8 and 10 characters. The words with 12 characters had a significantly higher mean Sum of First, Second, and Third Fixation compared to words with 10 characters.

The mean Sum of First, Second, and Third Fixation Duration of the infrequent words was significantly the lowest for the words with 4 characters, and it was significantly higher for the words with 14, 12, and 10 characters than for the words with 6 characters. Additionally, the words with 14 characters had a significantly higher mean Sum of First, Second, and Third Fixation Duration than the words with 8 characters.

The Sum of First, Second, and Third Fixation Duration may suggest an explanation both for frequent and infrequent words regarding particularly the online processing of the long words. The process in question can be described more reliably with the sum duration of these three fixations rather than the individual fixation durations.

Experiment II

The results of the second experiment revealed that there was no statistically significant effect of the suffixation condition on the Sum of First, Second, and Third Fixation Duration which is compatible with the argument above that the sum of the first three fixations might be more informative for the processing of long words.
CHAPTER 5

DISCUSSION AND CONCLUSION

The present study was conducted bearing the aim of investigating the word length and suffixation on eye movement control in Turkish reading. The motivation behind the present study was to contribute to the existing literature on lexical access and morphological processing in reading by studying in a morphologically rich language. However, the broader motivation was getting closer to the underlying mechanisms of reading as a cognitive process. Although studies on reading have a longer history than the cognitive science, origins of which can be traced to the mid-1950s, cognitive science offers theories and methodologies that promise progress in the reading research in the years to come.

Cognitive science, which can be defined as the scientific study of mind from an interdisciplinary perspective, makes use of various methods such as thinking and discussing the mind, collecting, reporting human behavior data and engineering. However, none of these methods is enough in isolation to come with an account regarding how the mind works according to the cognitive scientists. At this point, as a field which studies how people extract information from the written text, reading is one of the relevant fields of cognitive science. The present study was conducted as a part of a more comprehensive project which initiated the investigation of eye movement control modeling in Turkish reading. The evaluation of the results obtained, the limitations of the present study, possible future work, and the conclusion will be introduced in this chapter.

5.1. Evaluation of Results

Before starting evaluating the results, it would be helpful to remember the motivation behind the present study. It was to observe how the first and subsequent fixations differ in their roles while accessing words, especially long and complex ones. By discussing these different roles, it was aimed to gain a deeper understanding of the determining factors behind the decision of single fixation and refixation strategies of the readers.

The first run fixation count results provided evidence regarding one of the determining factors of the refixation strategy of the readers. In Experiment 1, both frequency and word length had a significant effect on First Run Fixation Count. However, the interaction effect between frequency and word length demonstrated that for both frequent and infrequent target words, there was a regular increase in the fixation count in the first run which was parallel to the increase in the word length. On the other hand, the results of Experiment 2 revealed that there was no significant effect of the suffixation condition on First Run Fixation Count.
At this point, it is needed to remember that in Experiment 2, the target words had the same length (seven characters), and they were all frequent words. The only difference among the words was regarding the suffixation conditions they belong to. The findings of the two experiments regarding the First Run Fixation Count suggest that this measure is related to word length rather than suffixation. So, it is legitimate to argue that as a strategy, refixation is determined not by the suffixation but by the word length.

The evaluation regarding the first fixation duration includes two cases: fixation of a singly fixated word and first fixation of a refixated word. The results of Experiment 1 demonstrated that lexical effects such as frequency, word length, and suffixation could be best observed through the Single Fixation Duration analyses while the results of the FFD of Multiple Fixation analyses did not reveal much about the lexical access of the words. Here, it should be noted whether the suffixation or word length effects were observed in Single Fixation Duration analyses in Experiment 1 is not certain due to the design of the experiment. However, the result of Experiment 2, in which only the suffixation conditions were manipulated revealed no significant effect of conditions on the Single Fixation Duration. Therefore, it is reasonable to argue that lexical effects such as frequency and word length are best represented by the measure of Single Fixation Duration in the present study at least for the short words, which are up to 8 characters.

The findings of the subsequent fixations obtained from both experiments provided mixed results to discuss. Since the finding that the fixation count in the first run is related to word length rather than suffixation or frequency is obvious as a result of the present study, what Sereno (1992) suggested to explain the refixations in the words are worth to remember. Her first explanation was that a deeper level of word recognition is required for a decision to move the eyes to the next word. The other one was that if the upcoming word is farther away, readers may have a tendency to make immediate intraword saccade. Although the launch sites and landing positions were not analyzed in the present study, the findings favor the second suggestion since it seems more related to the word length effect. In other words, since for long words, the upcoming word is farther away compared to shorter ones, it is likely that readers tend to make refixations on the long ones.

O'Regan (1992) suggests that only oculomotor factors determine when to move the eyes. According to his interpretation, lexical variables should only influence the duration of single fixations on a word but only the second fixation the words which received more than one fixation. However, in the present study word frequency had a significant effect on all fixation duration measures, thus revealing its importance in all aspects of the word recognition processes.

In terms of morphological processing, the results can be evaluated within the theoretical framework of the dual-route model (Pollatsek & Hyönä, 2006). This framework assumes that there are two routes to encode words which are made of multiple morphemes (i.e. polymorphemic), namely the compositional and the holistic route. The compositional route involves accessing the morphemic components first, and putting them together
afterward while the holistic route involves accessing the word as a whole (Pollatsek & Hyönä, 2006).

Since there are some other models which assume dual routes to lexical access, it should be noted that the one referred here is the dual-route theory of the type Pollatsek & Hyönä (2006) advocated. As they made clear earlier, the framework they support does not assume a holistic route which accesses words like visual templates; rather they argue that the inputs that holistic route takes are not morphemes. They support that the holistic and compositional route work in parallel; however, success in one route may inhibit the other (Pollatsek & Hyönä, 2006).

Pollatsek & Hyönä (2006) argues that since the short words fall within the fovea on a fixation, accessing the word via holistic route is more efficient than trying to find the component boundaries and then encoding them. Hence, it is legitimate to argue that the effect of suffixation may be emerging in the durations of the fixations. The results of the second experiment demonstrated that the duration of the first three fixations changed according to the suffixation conditions; however, no significant effect of the suffixation condition found on Gaze Duration and the Sum of First and Second Fixation Duration and Sum of First, Second, and Third Fixation Duration. On the other hand, in Experiment 1, the first three fixation durations were informative for the short words (up until 8 characters), but to be able to observe the situation of the long words Sum of First, Second and Third Fixation Durations and Gaze Duration were needed.

The dual-route model argues that for short words, the holistic route is more efficient, and since the inputs in this route are not morphemes, the readers access the words as a whole. When this argument and the results of the present study are taken into account, it is likely that the short words might be accessed via the holistic route, and the suffixation conditions they were in might determine the fixation durations of the words. For the first experiment, it is challenging to talk about the effect of suffixation solely; however, in the results of the second experiment, there may be implications for the effects of suffixation conditions on the individual fixation durations namely the First, Second, and Third Fixation Durations.

For the long words in the first experiment, the first three individual fixations did not reveal much. However, especially, the Sum of First and Second Fixation and Sum of First, Second, and Third Fixation Duration analyses demonstrated similar patterns obtained for the short words from the analysis of First, Second and Third Fixation Durations. Hence, a reasonable argument to explain it may be that there occurred a componential process involving morphemes for the long words which would be compatible with the argument of the dual-route regarding the compositional route used in the access of long words.
5.2. Limitations and Future Research

A general limitation of the present study is that it is almost impossible to understand the mechanisms underlying an information processing such as reading, solely by collecting and reporting human data, computational models are needed to provide a nearly full account of this process. However, the studies in Turkish reading are not mature enough, and the present study and similar others bear the aim of collecting data and reporting preliminary results which possibly shed light on the discussions regarding the eye movement control modeling in Turkish.

Moreover, the present study has dealt with reading at the level of word recognition by making important, yet incomplete assumptions since reading is not just an orthographic process. Although the cognitive processes underlying reading are much more complex, the systematic findings obtained as a result of the present study contribute to our knowledge about reading.

Additionally, as the individual differences and despite being controlled, the items (target words in the case of the present study) are random effects in most of the studies, statistical analysis could be further extended with results from a Linear Mixed Model (LMM) or a Generalized Linear Mixed Model (GLMM). However, the kind of analysis reported in Chapter 4 still served well to the purposes of the present study.

Finally, and perhaps more fundamentally, the fact that the evaluations made in Section 5.1. are based on only 2 suffixes, more empirical justification is needed to build on these conclusions. The question that would the same or similar results be obtained if different suffixes were used instead of the ones used in the present study is a one difficult to answer. The reason for the difficulty is that there might be spillover effects which are not covered in the scope of the present study. When readers start to look at the next word (N+1) while completing the procession of the previous word (N), there assumed to be some influence, which is called “spillover effect,” of the properties of word N on the duration time on N+1 (Just et al., 1982). In the case of the present study, durations on the next word (N+1) were not investigated, hence not reported. Nevertheless, it would still be assertive to answer this question. The words with the suffix -ki attached and the words ending with another suffix like -DIK which is a multifunctional subordinating suffix in Turkish might or might not differ in their procession which would be a real investigation topic for future search.

As a future experimental investigation in Turkish reading, an experiment in which word length and frequency are controlled similar to Experiment 2, but with a target word set with longer words (i.e., more than 7 characters) can reveal more about the effect of suffixation in long words. Furthermore, it would be helpful to gain a deeper understanding regarding the role of suffixation in the morphological processing in Turkish when the present and further studies are extended by making use of the derivational morphemes in the experiments.
Further, the suffixes used in the present study were -DA, and -DAki. -DA is the marker of the locative case, and it is unproductive whereas -DAki is formed by adding the suffix -ki to the locative marked noun phrase, and this is a productive construction (Göksel & Kerslake, 2005). The words with unproductive suffixes are argued to be always stored and never parsed while the ones with productive suffixes are argued to be always parsed and never stored (Anshen & Aronoff, 1988, 1997). However, especially the results of the second experiment revealed that the unproductive suffix -DA may not be stored or may be parsed as well. Experimental investigations with different productive and unproductive affixes can contribute to the literature regarding the morphological processing in reading.

5.3. Conclusion

The results of the present study show the effects of word length, frequency, and suffixation on eye movement control in Turkish reading. The results are also evaluated within the theoretical framework of the dual-route model; however, as Pollatsek & Hyönä (2006) indicated themselves; this theory is a vague one from many perspectives. For instance, how the effect of suffixation and in what way it can be observed in the holistic or compositional route is not clear. Thus, the present study is an important one since it provided an alternative way of searching for the effects of suffixation by looking at several other within word measures in addition to First Fixation and Gaze Duration.

The finding that First Run Fixation Count is an orthographical measure which is not related to suffixation but to the word length is an important one since it suggested that refixation strategy is related to word length. However, the modulating effects of word length on lexical access; especially when it is manipulated together with other variables as done in Experiment 1 are still not trivial to be understood. The other major findings of the present study are that (i) it revealed that the Single Fixation Duration provides the best chance to observe the lexical effects on words (ii) subsequent fixations on the words reveal effects related to suffixation conditions of the words as reported in the results of Experiment 2.

In sum, this study in Turkish reading offers that to be able to gain a deeper understanding of the lexical access, the cases when Single Fixation occur need to be investigated. Languages which have morphological systems with productivity in segmental morphology like Turkish may contribute more to the debate of lexical access and research on reading. However, more experimental investigations in a wider range of languages are needed to come with a coherent cross-linguistics theory of morphological processing.
REFERENCES


Table A.1: Demographic information form used in both experiments.

<table>
<thead>
<tr>
<th>Kişisel Bilgiler</th>
<th>Kod:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soyadı</td>
<td>Adı</td>
</tr>
<tr>
<td>Doğum Yılı</td>
<td>Kadın ( )</td>
</tr>
<tr>
<td>Telefon Numarası</td>
<td>E-posta Adresi</td>
</tr>
<tr>
<td>Şu anki mesleğiniz?</td>
<td></td>
</tr>
<tr>
<td>En yüksek tahsiliniz (veya muadili) (lütfen yuvarlama alınız)</td>
<td>Ortaokul</td>
</tr>
<tr>
<td></td>
<td>Mesleki Eğitim</td>
</tr>
<tr>
<td>Fakülteniz</td>
<td></td>
</tr>
<tr>
<td>Bölümünüz</td>
<td></td>
</tr>
<tr>
<td>Sınıfiniz</td>
<td>Hazırlık ( )</td>
</tr>
<tr>
<td></td>
<td>3. Sınıf ( )</td>
</tr>
<tr>
<td>Lisede hazırlık okunuz mu?</td>
<td>Evet ( )</td>
</tr>
<tr>
<td>Üniversitede hazırlık okudunuz mu?</td>
<td>Evet ( )</td>
</tr>
</tbody>
</table>
**Genel Sağlık Durumunuz**

<table>
<thead>
<tr>
<th>Yazarken hangi elinizi kullanıyorsunuz?</th>
<th>Sağ ( )</th>
<th>Sol ( )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanısal konmuş herhangi bir dil bozukluğunuz var mı (disleksi, kekemelik gibi)?</td>
<td>Hayır ( )</td>
<td>Evet ( )</td>
</tr>
<tr>
<td>Çalışma sırasında gözlük kullanıncınız mı?</td>
<td>Hayır ( )</td>
<td>Evet ( )</td>
</tr>
<tr>
<td>Çalışma sırasında lens kullanıncınız mı?</td>
<td>Hayır ( )</td>
<td>Evet ( )</td>
</tr>
</tbody>
</table>

**Hangi dil(ler), hangi sırayla öğrendiniz? (anadiliniz dahil)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Türkiye dışında başka ülkelerde yaşadıınız mı?**

<table>
<thead>
<tr>
<th>Türkiye dışında başka ülkelerde yaşadıınız mı?</th>
<th>Nekadar süreyle?</th>
<th>Hangi sebeple? (okul, eğitim, vs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## APPENDIX B

**Stimulus Texts for Experiment I**

Table B.1: Stimulus Texts used in Experiment 1. Texts are presented according to the conditions that target words belong to.

### Short and Frequent Words

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Word</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>asit</td>
<td>Kapakçık ters çalışiyor ve midenin salgılıdığı asit yemek suyunu tahriş ediyor, siz de sürekli öksürük ve tıksırmaya dayanmıştı.</td>
</tr>
<tr>
<td>-DA</td>
<td>asitte</td>
<td>Zaman kapsülünün içindeki eşyalar asitte yanmaklarını ardından pırrit bir kutuya yerleştirilmişti.</td>
</tr>
<tr>
<td>-DAki</td>
<td>asitteki</td>
<td>Tuz, kimyada, bir tepkime neticesinde oluşan maddedir ve bazda pozitif yükli iyonla asitteki negatif yükli iyondan meydana gelir.</td>
</tr>
<tr>
<td>-</td>
<td>depo</td>
<td>Teknenin taşıyabileceğini tatlı su miktarı belirlenirken teknenin tasarımların planlarında hangi miktar depo hacimleri öngörüldüğü incelenmelidir.</td>
</tr>
<tr>
<td>-DA</td>
<td>depoda</td>
<td>Uzun yıllar boyunca depoda bekleyen geçmişim, bana dünyayla arasına duvarları ören bir ülkeyi hatırlattı.</td>
</tr>
<tr>
<td>-DAki</td>
<td>depodaki</td>
<td>Kitle içindeki her birey depodaki farklı bir bilgiyi seçip ulaşabilir ve yayıncı kurullara göndermelidir.</td>
</tr>
<tr>
<td>-</td>
<td>doku</td>
<td>Üretim ortamları hazırlanarak alınan doku parçalarının bu ortamlara konulmasıyla köklendirme işlemlerini gerçekleştirecektir.</td>
</tr>
<tr>
<td>-DA</td>
<td>dokuda</td>
<td>Hastanın hormon tedavisinden faydalanıp faydalanamayacağını görmek için alınan kanserli dokuda östrojen ve progesteron reseptörlerini tayin etmek gereklidir.</td>
</tr>
<tr>
<td>-DAki</td>
<td>dokudaki</td>
<td>Erişkin kok hücreler her yaşta insanda bulunmakta ve ihtiyac duyulduğunda bulundukları dokudaki değişik hücre türlerine dönüşebilmektedirler.</td>
</tr>
<tr>
<td>-</td>
<td>etüt</td>
<td>Haftada bir gün, cuma öğlenleri okulun etüt salonunda toplanıp, mısır - çtırt atardık birbirimize.</td>
</tr>
<tr>
<td>-DA</td>
<td>etütte</td>
<td>Heyecanlıydı çünkü bir gün önceki etütte kartlarını alamayın ve kartsız kalan çocuklara o gün öğle yemeği çekmeyecaktı.</td>
</tr>
<tr>
<td>-DAki</td>
<td>etütteki</td>
<td>Öğrencilerin okulda durumlarından etütteki başlarlara kadar çeşitli konulara öğrencileri takip etme ve öğrenme deneyimlerini sağlamak için bir sistemdir.</td>
</tr>
<tr>
<td>-</td>
<td>fuar</td>
<td>Merkez bu yıl daha çocuklara sosyal ve toplumsal değerine katkıda bulunmak amacıyla fuar boyunca elde edebileceğini geliri çocuk yuvasına bağışlayacak.</td>
</tr>
<tr>
<td>-DA</td>
<td>fuarda</td>
<td>Şehir ekonomisine katkı sağlamak ve ticari hayatı hareketlendirmek amacıyla düzenlenen fuarda ziyaretçilere aradıkları tüm materyalleri bulabilecekler.</td>
</tr>
<tr>
<td>-DAki</td>
<td>fuardaki</td>
<td>Farklı ülkelerden gelen ziyaretçilere fuardaki mevcut firmalarla markalarını buluşturmaları sağlayan yeni iş fırsatları ortaya çıkmıştır.</td>
</tr>
<tr>
<td>-</td>
<td>gişe</td>
<td>Maddenin asylıla muhtap olunup olunmadığını bilinmez. Açıktaki konu hakkında gişe rekorları karan filmler bile çekilmişken bu teoriye kulak kabartmamak olmaz.</td>
</tr>
</tbody>
</table>
88

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Word</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>-DA</td>
<td>gişede</td>
<td>Onda şeytan tüyü var: Çevirdiği filmler gişede başarılı oluyor, daha önemlisı, özel hayatın filmlerinin önüne geçmiyor.</td>
</tr>
<tr>
<td>-DAki</td>
<td>gişedeki</td>
<td>Eski klişe yugun olarak, bilet almak için sırada bekleyen müşterilere rağmen gişede başarı oluyor, daha önemlisı, özel hayatın filmlerinin önüne geçmiyor.</td>
</tr>
<tr>
<td>jüri</td>
<td></td>
<td>Rock müziğin önemli isimlerinden oluşan jüri tarafından yapılacak elemelerin ardından finale katılma hakkı kazanan gruplar, canlı performanslarıyla yarışacak.</td>
</tr>
<tr>
<td>-DA</td>
<td>jüride</td>
<td>Fotoğraf Sanatu Kurumu üyelereğin jüride bulunmaları tamamen iradeleri dışında gelişmiştir.</td>
</tr>
<tr>
<td>-DAki</td>
<td>jürideki</td>
<td>Hemen rezervasyon defterlerine bakıp jürideki isimleri artıyorlar ve 68 kişilik ekip sadece 8 kişinin geldiğini öğreniyorlar.</td>
</tr>
<tr>
<td>kta</td>
<td></td>
<td>Asya’nın en çok nüfus barındıran kta olması özelliği korunmaktadır. Üstelik toplam nüfus içine deki payı da artmıştır.</td>
</tr>
<tr>
<td>-DA</td>
<td>kttada</td>
<td>Güneş tapmak, bir zamanlar egemen olduğu kttada kutsallığı kaybetmiş olsa da etkisini yeni yöntemlerle sürdürür.</td>
</tr>
<tr>
<td>-DAki</td>
<td>kttadaki</td>
<td>Avustralya onbinlerce yıldır kttadaki yerliler tarafından yurt edinilmiş olmakla birlikte, yakın zamana kadar diğer ülkelerle bilinmiyordu.</td>
</tr>
<tr>
<td>-kyt</td>
<td></td>
<td>Kalenin denize hakim olduğu ve ticaret yollarının birleştiği noktada bulunan kyt tutuklu yaşamını sürdürmekle birlikte, yakın zamana kadar diğer ülkelerle bilinmiyordu.</td>
</tr>
<tr>
<td>-DA</td>
<td>kryda</td>
<td>Merdivenlerden inin ve masmavi denizin kryda turuça dönüşduğu bu minik sahildeki dalgaların keyfini çıkarmadan satın birakmadan ayrılmamak.</td>
</tr>
<tr>
<td>-DAki</td>
<td>krydaki</td>
<td>Özellikle baskı avlarını krydaki dalgaların hareketliliği denemizde bozabileceği için ağırlık seçimini uygun arayalım.</td>
</tr>
<tr>
<td>-DA</td>
<td>masada</td>
<td>Bu tozlu baraka senelerdir önemli bir bilgi akış noktası olmuştur. Dolayısıyla birazdan masada duran zarfın içinde çıkacaklar da önemli görüyorum.</td>
</tr>
<tr>
<td>-DAki</td>
<td>masadaki</td>
<td>Kasabayın yakın olmanın avantajından masadaki çilek reçelini tadarak yararlanıyoruz.</td>
</tr>
<tr>
<td>-ofis</td>
<td></td>
<td>Saatlerce oturarak çalışan bir kişinin ofis şartları ergonomik değişse bu kişi sağlık problemlerine geçebilir.</td>
</tr>
<tr>
<td>-DA</td>
<td>ofiste</td>
<td>İki yılın bulan ekonomi mühahlirliği gorevinden sonra vaktinin büyük bir kısımı ofiste geçmesinin nedeni olan ediyor olarak süreci başlar.</td>
</tr>
<tr>
<td>-DAki</td>
<td>ofistekki</td>
<td>Çalışanlarla birlikte kendi sosyal komünlerini kuran kediler mekana yeni bir düzen getirirken ofistekki günlük hayatın tüm süreçlerine katılır.</td>
</tr>
<tr>
<td>-ökü</td>
<td></td>
<td>Anlatının derin yapısı üstünde dururken bu bir sorulara yönelmek, tüm ilgiyi belli başlı ökü kişileri arasındaki ilişkileri üzerinde toplayor.</td>
</tr>
<tr>
<td>-DA</td>
<td>öyküde</td>
<td>Etrafinca çizilen daireden çıkamayan adamın azınlıkta kalan bireylerin simgesine dönüştüğü öyküde tarihsel bir arka plan varlığı duyuruyor.</td>
</tr>
<tr>
<td>-DAki</td>
<td>öyküdeki</td>
<td>Sonunda adet olduğu üzere mutlu sona ulaşılıyorsa da, çatışan kız kardeş öyküdeki büyük ödülü kavuşurken esmer kız kardeşine düşen ölüp gitmekte.</td>
</tr>
<tr>
<td>Suffix</td>
<td>Word</td>
<td>Sentence</td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>-</td>
<td>saha</td>
<td>Eğer kaleci topu yumruklayıp saha dışına atarsa veya topu yakalayıp durdurursa şutu çekene kaleye geçiyor.</td>
</tr>
<tr>
<td>-DA</td>
<td>sahada</td>
<td>Sayı almak için vuruş yapılan topun sahada rakiği oyuncu topa vuramadan iki kere sıçraması gerekir.</td>
</tr>
<tr>
<td>-DAki</td>
<td>sahadaki</td>
<td>Herhangi bir erteleme halinde, aksi kararlaştırılmaz ise, önceki skor ve oyuncuların sahadaki duruş yerleri muhafaza edilir.</td>
</tr>
<tr>
<td>-</td>
<td>uçak</td>
<td>İlk belirlemede göre kayıp uçak bulunmadığı halde yetkililer hıbarın yine de araştırıldığı bildirdi.</td>
</tr>
<tr>
<td>-DA</td>
<td>uçakta</td>
<td>New York seferini yapan uçakta yaşanların şişrayıda sosyal medyada büyük bir çalkantıya sebep oldu.</td>
</tr>
<tr>
<td>-DA</td>
<td>uçaktaki</td>
<td>Motor, havayı çektiği için, kullanılan motor gücünü düşürüyor. Sıcaktaki ve basınç altında uçaktaki titanyum borularla hava dışarı veriliyor.</td>
</tr>
<tr>
<td>-</td>
<td>uyku</td>
<td>Karnını doyurup kapıdan çıkınca, neredeyse tüm kasabanın gözye o gece boyunca uyku girmesiini gördü: Millet sokağa dökülmüştu.</td>
</tr>
<tr>
<td>-DA</td>
<td>uykuda</td>
<td>Her günün en fazla altı saatini uykuda geçirdiği için, geri kalan on sekiz saat, haksız bir işkence haline gelyordu.</td>
</tr>
<tr>
<td>-DA</td>
<td>uykudaki</td>
<td>Yakınlarında bulunan çocukları uykudaki küçük köylünün yanına getiriyor ve gene bir şeyler söylüyor.</td>
</tr>
<tr>
<td>-</td>
<td>üzüm</td>
<td>Ürünçetler, talep baskı sayesinde fazladan üzüm satarak daha çok para kazanmak amacıyla olabildiğince fazla verim almaya çalışılıyor.</td>
</tr>
<tr>
<td>-DA</td>
<td>üzümde</td>
<td>Dalyla birlikte ezilen üzümde bulunan bir maddenin kabukunun kabukta toplanlığını göstermektedir.</td>
</tr>
<tr>
<td>-DA</td>
<td>üzümdeki</td>
<td>Son zamanlarda yapılan çalışmalar üzümdeki aroma maddelerinin büyük kısmının kabukta toplanışını göstermektedir.</td>
</tr>
</tbody>
</table>

**Long and Frequent Words**

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Word</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>alternatif</td>
<td>Olası senaryolar, bunlar karşısında uygulanılacak eylem planları, birbirlerini destekleyecek alternatif uygulamalar ve tercih sıralamaları karar aşamasının ürünleri.</td>
</tr>
<tr>
<td>-DA</td>
<td>alternatifte</td>
<td>Bu kumsalda hafta sonu tatili geçirmek isteyenler için çeşitli alternatifte konaklama olanakları bulunmaktadır.</td>
</tr>
<tr>
<td>-DAki</td>
<td>alternatifteki</td>
<td>Geçen sezonda belli renklerde sunulan kalem etekler, bu yıl yüzlerce farklı alternatifteki renkleri ile satışı çıkartılıyor.</td>
</tr>
<tr>
<td>-</td>
<td>bilgisayar</td>
<td>Çocukla, evle ilgili bir iş yapmak şartıyla bilgisayar kullanma süresi kazanması konusunda bir sözleşme yapılabilir.</td>
</tr>
<tr>
<td>-DA</td>
<td>bilgisayarda</td>
<td>Çalışmalarımız, elektriksel işaretlerin bilgisayarda modellenmesine ve simülasyonuna dayanıyor.</td>
</tr>
</tbody>
</table>
Okuma ve yazma izni olduğunda bilgisayardaki dosyalara erişim sağlanarak değişiklik veya dosya silme yapılabılır.

Fransız ulusu, büyük bir endişeyi geride bıraktı ve bu seçim sonuçlarıyla cumhuriyet değerlerine güvenoyu verdi.

Her yurttaşı istediği cumhuriyette yaşama hakkına sahiptir. Bu hakkı hiçbir şekilde müdahale edilemez.

Bağımsızluktan önce azınlıklar cumhuriyetteki çoğunlukla karşı, çoğunluklar Sovyet sistemine karşı kültürel ve siyasal hak talep etmişlerdir.

Bazı hesaplaşmalar belki eleştirmen cephesinde daha fazladır ama doğru modern sinema seyircisi de farklı davranmasını, aşağı yukarı aynı güzergâhta ilerler.

Belirtilenlerden anlaşılacağı üzere, nesnel bir çeviri eleştirisi yapabilmek eleştirmende birtakım birikimlerin bulunmasını gerektirmektedir.

Yazar, modern kültür ve yüzyılların düşüncelerini yeniden kendilerine mal eden birçok eleştirmendeki bilindik yerel içgüdüleri, parodileştirme yoluyla ifade etmektedir.

Sağlığını kaybedenler hastanelerde enfeksiyon tehlikesiyle de karşı karşıya kalıyor.

Ama ateşi her yükselen hastanın mutlaka antibiyotik kullanması gerekmez. Her gribal enfeksiyonda hastanın ateşi zaten yükselir.

Kalp hastalığını tetikleyen enfeksiyondaki bakteriler diş etinde de kanama, ağrı ve kokuya kendini gösteriyor.

Girdi katmanı dışarıdan gelen verilerin yapay sinir ağına alınmasını sağlar. Bu veriler istatistikte bağımsız değişkenlere karşılık gelmektedir.

Bu soruyu yanıtلامadığı veya bir tercih yapmadıkça diğer planlar maalesef kendilerini istatistikteki negatif sonuçla yüzleşmekten koruyamayacaktır.

Eksik, belgesiz, delilsiz denemez çünkü hepsinin delili var. Örneğin bankanın istihbarat raporlarında kredi verilemez nitelikte bulunan firmalara kredi verilmiştir.

Üç yıldır telefonlarının dinlendiği anlaşılan bir gazetecinin bütün kayıtları istihbaratta bulunuyor olsa da belli ki kafaları karştırmamak için içlerinden özenle seçiliyör.

Acaba onun defteri istihbarattaki karanlık çalışmalar gibi siyah mı, yoksa farklı renkte mi olacak onu ise biz bilemez.
Yoğun yağmur yağışı nedeniyle özellikle asansör ve yürüyen merdivende meydana gelen arızalar karşılaşıla öncesi yapılan çalışmalarla giderildi.


Mezuniyet gecelerine özel olarak koleksiyon hazırlayan ünlü giyim markası, özel fiyatlar ve taksit olanakları da sunuyor.

Yıllar boyunca topladığı koleksiyonda yaşanan figürlerin dantel duygusu ile işlenmiş eserler olduğunu vurguluyor.

Yılların yaşanmış olduğu figürlerin dantel duygusu ile işlenmiş eserler oldu günden vurguluyor.

Şık elbiselerin yer aldığı koleksiyonda parçalar bağcıklı ve boncuklarla örülmüş kemerlerle tamamlıyor.

Yılların yaşanmış olduğu figürlerin dantel duygusu ile işlenmiş eserler oldu günden vurguluyor.

Büyük Dersler Şube Müdürlüğü’nün yaptığı görevi duyunca çok şaşırdım. Çünkü bu görev komutanlıkta önemli görevlerden biriydi bana göre.

Arabic, taksitleri ödediğimiz kooperatif evimiz ve birlikte aldığımız gayri menkulkerden payımı almak için gerekli başvuruyu yaptı.

Çevre karargâhlarda ve alaylarda komutanlık görevi yaptı. Bu yarı akademisyen subayı görev aldığı birliklerde herkes seviyordu.

Yılların yaşanmış olduğu figürlerin dantel duygusu ile işlenmiş eserler oldu günden vurguluyor.

Dragonya geçildi ama sorunun devam ettiği bölgeler var. İzmit ile Gölcük arası taşımacılık yapan kooperatifte yaşananlar buna bir örnek.

Ortakların sorumlu olacakları miktar kooperatifteki paylarının tutarı ile orantılı olarak da gösterilebilir.

Alman Dersler Şube Müdürlüğü’nün yaptığı görevi duyuncu çok şaşırdım. Çünkü bu görev kooperatifteki önemli görevlerden biriydi bana göre.

Çeşitli karargâhlarda ve alaylarda komutanlık görevi yaptı. Bu yarı akademisyen subayı görev aldığı birliklerde herkes seviyordu.

Bayram dolayısıyla sınırın sıfır noktasında bulunan komutanlıkta askeri tören düzenlendi.

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Yılların yaşanmış olduğu figürlerin dantel duygusu ile işlenmiş eserler oldu günden vurguluyor.

Ortakları için bağımızdır. İkinci ve üçüncü kooperatifteki parçaların belirli bir oranla bağlı olduğunu vurguluyor.

Bayram dolayısıyla sınırın sıfır noktasında bulunan komutanlıkta askeri tören düzenlendi.

Çeşitli karargâhlarda ve alaylarda komutanlık görevi yaptı. Bu yarı akademisyen subayı görev aldığı birliklerde herkes seviyordu.

Son soru, keşfedilen tüm theötrleri ve tarihi araçtırma sonucunu vermemiştir. Psikolojideki çöküşü tüm theötrlerin de öne çıkmasına neden olmuştur.

Diğer disiplinlerle de bağlarını kurar; müzik sanatını eğitim, estetik, tarih gibi birçok perspektifte inceleyerek sonuçlara varır.

Çevre karargâhlarda ve alaylarda komutanlık görevi yaptı. Bu yarı akademisyen subayı görev aldığı birliklerde herkes seviyordu.

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Diğer uzmanlık alanlarında daha ayrıntılı değerlendirmeler de yer verilmişken psikiyatrideki hükmünün geçerli olduğuna da dair kesin sonucu olmadığı belirtmek gerekir.

Psikolojideki çöküşü tüm theötrlerin de öne çıkmasına neden olmuştur.

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Iki ülkenin başbakanları görüşlerini, niyetlerini, temennilerini söyledi.

Bundan sonra tamamıyla referandum sonuçlarını karşılıklık olarak beklemek lazımdır.

Buğüne kadar süren süreç şu sonuç gösteriyor: Pazar günü yapılacak referandumda partilerin kimi mensupları kararlarını verirken kendilerini baskı altında hissediyorlar.
Neredeyse tüm yazarlarımız referandumdaki oylarını açıkladılar ve şaşırtıcı bir biçimde hepsinin de oylarının rengi aynıydı.


Trafik kazalarında hayat kurtaran emniyet kemerinin arka koltuklarda da takılması zorunluluğu yönetmelikte olmasına karşın uygulanamıyor.

Orduya katılması için çağrının bildirilmesine rağmen buna uymayan kişileri yönetmelikteki ordudan kaçma hükümleri uygulanmıştır.

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Word</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>-DAki</td>
<td>referandumdaki</td>
<td>Neredeye... referandumdaki oylarını açıkladılar... rengi aynıydı.</td>
</tr>
<tr>
<td>-</td>
<td>yönetmelik</td>
<td>Bizim... şirketlerin önündeki engelleri kaldırmak... düşünüyoruz.</td>
</tr>
</tbody>
</table>
| -DA    | yönetmelikte | Trafik kazalarında hayat kurtaran emniyet kemerinin... olmasına karşın...
| -DAki  | yönetmelikteki | Orduya... çağrının bildirilmesine rağmen buna... uygulanmıştır.         |

**Short and Infrequent Words**

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Word</th>
<th>Sentence</th>
</tr>
</thead>
</table>
| -      | akaç | Kemerlerin üzerinde suyu taşıyan akaç delikleri bulunan kanalların izleri...
| -DA    | ağaçta | Binlerce çocuk, onların açtığı ağaçta didiklemişlerdi dünyayı... Halkın... devam eder. |
| -DAki  | ağaçtağ | Vücut ısısı saat başı 1,5 derece düşürülür ve hedeflenen hipotermi... ulaşılana kadar ağaçtağ söğü... akımı devam eder. |
| -      | çıma | Yüzme molası için durulabilecek yerlerdir fakt deniz... dir. İki koyun... yaralanan... |
| -DA    | çımad | Çoğu aday gibi uzun zaman çımadı asılı kalan ve yardımla aşırı... indirilen adayın... kalınmaktadır. |
| -DAki  | çımadaki | Alanya'da balık ağlarını toplarken kopan çımadaki demir makarannın... üstüne... hayatın kaybet. |
| -      | cura | Sempozyumun konusu isabetli olup, üzerine gidilerek sanatçılarla ve özellikle... cura sanatçılarıyla ortak çalışmalar yapılmamakta. |
| -DA    | curada | Ustası, kalfanın çalğı çurada yerine getiremediği tavır ve eda ile ilgili olarak... yapar ve ona yol gösterir. |
| -DAki  | curadaki | O dönemde yazının gramer kurallarının yapılmadığı bilinmektedir. Bundan... yazının... yüzüyle ait olduğunu düşünmekteyiz. |
| -      | eviç | Yeden kullanamadan yapılan segah çeşnili karalar tam bir bitiş hissi... eviç perdesindeki segah... har... yeden kullanılmamakta. |
| -DA    | eviçte | Hüzzam makamı seyri esnasında yukarıda zikredilen dizi ve çeşnilere ilave olarak zaman zaman eviçte segah dörtlüsüne de yer verildiği görülmedektir. |
| -DAki  | eviçteki | Irakta meydana gelen hicaz dörtlüye eviçteki hicaz dörtlüsünün simetriği de... denilmedektir. |
| -      | inak | Fransız yazarların özelliği, kutsallaştırılmış her türlü tabuya karşı çıkmaları;... inak kalıplarının... yürümeleridir. |
| -DA    | inaka | Geçmiş çağlardaki bilimciler dünyanın düz ve evrenin merkezi olduğunu söyleyen... inaka yüzüllar boyunca ısır etmişlerdi. |
DAki inaktaki Tiyatro idolü felsefi inaktaki tartışgırktken kaynaklanır. En tehlikeli, insanın kavruyışına en büyük darbeyi vuran bu durum.


irapta Burada diyafematik solumunun irapta etkili şekilde kullanılması amacıyla alıştırma verilecektir.

iraptaki İlk görevi çocuğun düzgün beslenmesi olan süt dişlerinin sağlıklı çocuğun iraptaki gelişimini de büyük ölçüde etkilemektedir.

ışkı Görüntülemekte olduğunuz resim ışkı kategorisinde yer almaktadır. Bu kategoride toplam 15 resim bulunmaktadır.

ışkıda Sınırlı ölçülerde Orman Bakanlığından satın alabildiğimiz geyik boynuzu özellikle ışkıda görselliğe önem veren kullanıcılara tarafından tercih edilmektedir.

ışkıdaki Olaya karışan iki kişi mahkemeye çıkarıldı. Tutuklanan iki kişinin üzerinde bulunan ışkıdaki izlerin sonuçlarının kriminalden gelmesi bekleniyor.

ivgi Doğrama işlerini yaparken ivgi aşağı dönük olarak ürünün içine yerleştirilir. Dilimleme için ise tam tersi yapılmalıdır.

ivgide Ayrıca boydaki yapay bileme taşının ivgide oluşturduğu yüzey ile köşüre taşının oluşturduğu yüzey kesinlikle aynı değildir.

ivgideki Ne yazık ki tüm şüpheler onun üzerinde toplanıyordu. Biricik umudu ivgideki parmak izleriyle onunkilerin uyuşmamasıydı.

kete En üstteki bezeyi de yağladıktan sonra kete yaparken olduğu gibi her tarafından katlayarak dikdörtgen yapın.

ketede Bu yöntemi her türlü ketede kullanarak geliştiribilirsiniz. Fotoğraflardan da anlayacağınız üzere gereken içe yarıştır.

ketedeği Hazırlanan bu malzeme ketedeği kıyma yerine yufkanın içine konulacak sıcak üstünde pişirilir.

loça Ülkedeği iç savasştan kaçan dörtlü genç, yurt dışında giden şilebe gizlice binerek loça deliğine saklanmış ve okyanusu geçmişti.

loçada Salih denen bu adamın, yorgun bedenini serin suların kollarına bırakması uzun sürmüştü. Geminin motorları durdu ve boşalan zincir loçada dayanılmaz bir ses bıraktı.

loçadaki Az önce vira edilen çapanın loçadaki yerine oturmasıyla komutan emri verdi ve zincir denize bırakıldı.

maun Kısa zamanda el yapımı maun mobilya alanında dünyanın önde gelen üreticilerinden birine dönüştüler.

maunda Aşır bir ağaç olarak değerlendirilen maunda özgürl ağaç, türlerine göre değişiklik gösterir.

maundaki Az önce vira edilen çapanın maundaki yerine oturmasyla komutan emri verdi ve zincir denize bırakıldı.

pişi Hamur kızartması ya da diğer adıyla pişi bizde genellikle mayalı yapılmaktı. Hatta bazı yörenin biri, fırından aldığını ekmek hamuru pişirmeyi severdi.
### Suffixes

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Word</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>-DA</td>
<td>pişide</td>
<td>Hamurun üçte birini pişide kullanıktan sonra çoğundan börek yaptık. Aynı hamurdan açma börek yapmak isterseniz diğer tarife bakabilirsiniz.</td>
</tr>
<tr>
<td>-DAki</td>
<td>pişideki</td>
<td>Sotelenmiş kırmızı biberle peynirin pişideki buluşması tadanla mükemmel bir lezzet sunuyor.</td>
</tr>
<tr>
<td>-</td>
<td>şose</td>
<td>Asfaltlanma çalışmalarını öncesinde şose olduğu için birçok kazaya neden olan yolun asfaltlanması köy sakinlerini sevindirmişti.</td>
</tr>
<tr>
<td>-DA</td>
<td>şosede</td>
<td>İleride, Ahı Dağı’nın yamaçlarından kivrıl kivrıl inerek uzanan şosede keskin bir işık huzmesi belirip kayboldu.</td>
</tr>
<tr>
<td>-DAki</td>
<td>şosede</td>
<td>Evlerin açık kapağından sızan sarı huzmeler eğer az biraz aydınlık saçmasaydı köhne şosedeği deliklerde senelemek ithet bile değildir.</td>
</tr>
<tr>
<td>-</td>
<td>süje</td>
<td>Estetik olaylar da, tpki bilgi olaylarında olduğu gibi bizlere süje hakkında bilgi verir ve onun objeye arasındaki ilişkiyi gösterir.</td>
</tr>
<tr>
<td>-DA</td>
<td>süjede</td>
<td>Ekminezi, psikolojik ayrışma içindeki süjede geçmiş yaşamlarında yer alan izlenimlerin tekrar canlanması sağlanan yöntemdir.</td>
</tr>
<tr>
<td>-DAki</td>
<td>süjede</td>
<td>Bu, sekreterin işini en çok kesen unsurdur. Bir önceki süjedeği unsura göre halledilmesi daha güçtür.</td>
</tr>
<tr>
<td>-</td>
<td>tapa</td>
<td>Koyun ve kuzu yününden yapılan keçeleri avcılar tapa olarak veya çobanlar kepenecek olarak kullanırlar.</td>
</tr>
<tr>
<td>-DA</td>
<td>tapada</td>
<td>Emniet giocklärinizi takın; çeşitli, çivi ve tahta yardımıyla plastik tapada dikkatlice bir delik açın.</td>
</tr>
<tr>
<td>-DAki</td>
<td>tapadaki</td>
<td>Top mermisi, funyesi taki olduğu halde yere düşme bile patlamaz ki! Patlaması için kovanın ateşlenip tapadaki mekanizmayı harekete geçirmesi lazım.</td>
</tr>
<tr>
<td>-</td>
<td>ulam</td>
<td>Oyun içinde pek çok farklı ulam altında incelenebilecek pek çok yetenek vardır.</td>
</tr>
<tr>
<td>-DA</td>
<td>ulamda</td>
<td>Yazının yapıştırında metinlerarası ulamda değerlendirilebilecek çok sayıda olgu bulmak olasıdır.</td>
</tr>
<tr>
<td>-DAki</td>
<td>ulamdaki</td>
<td>Yarışmaya katılan maketçilerin maketlerinden sadece en yüksek dereceyi aldığı ulamdaki maketi ödüllendirilecektir.</td>
</tr>
</tbody>
</table>

### Long and Infrequent Words

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Word</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>anakronizm</td>
<td>Bugünün ihtiyaçlarının, sorunlarının ve yaklaşımlarının tarih yazımına yansıması anakronizm hataları kolaylaştırılmaktadır.</td>
</tr>
<tr>
<td>-DA</td>
<td>anakronizmdme</td>
<td>Prens Igor operasının bu bölümünün doğru çevrilmiş hali, Rusların yaptığı anakronizmdme işaret edilecek olunursa Peçenek danslardır.</td>
</tr>
<tr>
<td>-DAki</td>
<td>anakronizmdeki</td>
<td>Felsefesinden yola çıktığım anakronizmdeki biçimiyile farklı zaman dilimleri arasında ziplamalar yapmak bana heyecan veriyor.</td>
</tr>
<tr>
<td>Suffix</td>
<td>Word</td>
<td>Sentence</td>
</tr>
<tr>
<td>--------</td>
<td>--------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>-</td>
<td>endüksiyon</td>
<td>Motorlarda devir sayıları endüksiyon bobinin bağlanıyor ve ateşleme sayısından yola çıkarak dakikadaki devir sayısını görüyoruz.</td>
</tr>
<tr>
<td>-DA</td>
<td>endüksiyonda</td>
<td>Bobinin hareketi sayesinde oluşan endüksiyonda şiddet sürekli değişir yani artar veya azalır.</td>
</tr>
<tr>
<td>-DAki</td>
<td>endüksiyondaki</td>
<td>Magnetik dedektörler metalik varlıklara karşı duyarlı olup, oluşturulan bir magnetik endüksiyondaki değişim bunların çalışma prensibini oluşturur.</td>
</tr>
<tr>
<td>-</td>
<td>hipnotizma</td>
<td>Hiç çalışmadan, hatta uyurken dersleri dijital hipnotizma metodu ile öğrenip sınıfta birincisi olmak mümkün.</td>
</tr>
<tr>
<td>-DA</td>
<td>hipnotizmada</td>
<td>En basit olarak ağırlı kesimin bile çok yan etkisi vardır. Bugüne kadar hipnotizmada herhangi bir komplikasyon veya bu metoda bağlılık görülmemiştir.</td>
</tr>
<tr>
<td>-DAki</td>
<td>hipnotizmadaki</td>
<td>Gevşeme halinin konforu nedeniyle hipnotizmadaki kişiler bu keyifli ortamdan çıkmama konusunda tercih kullanırlar.</td>
</tr>
<tr>
<td>-</td>
<td>jeodinamik</td>
<td>Raporda, bölgenin imarında jeodinamik karakterinin de dikkate alınması uyarısıda bulunuldu.</td>
</tr>
<tr>
<td>-DA</td>
<td>jeodinamikte</td>
<td>Atmosfer adı verilen hava küresi jeodinamik karakterinin de dikkate alınması uyarısıda bulunuldu.</td>
</tr>
<tr>
<td>-DAki</td>
<td>jeodinamikteki</td>
<td>Bu yenilemenin sebebi tarihsel jeodinamikteki bilgi birikiminin daha anlamlı ve güvenilir hale gelmesindendir.</td>
</tr>
<tr>
<td>-</td>
<td>kançılarya</td>
<td>O yıl ikametgahın bahçesinde yeni bir bina inşa edilene kadar ikametgah binası kançılarya olarak da kullanılmaya devam etmiştir.</td>
</tr>
<tr>
<td>-DA</td>
<td>kançılaryada</td>
<td>Bünyesinde Askeri Ataşelik de bulunan Büyükçililiğimiz, Temmuzda yeni taşınan adresindeki kançılaryada hizmet vermektedir.</td>
</tr>
<tr>
<td>-DAki</td>
<td>kançılaryadaki</td>
<td>Temizlikçi bir annenin yetiştir舀dı Alman Başbakanı, kent merkezinde bulunan kançılaryadaki küçük daireye taşınabilir.</td>
</tr>
<tr>
<td>-</td>
<td>mazhariyet</td>
<td>Çağdaş uyguluk düzeyine mazhariyet çabamızda bilim, teknoloji ve insan kaynağa yapılan yatırımlar büyük öneme deşifteştir.</td>
</tr>
<tr>
<td>-DA</td>
<td>mazhariyette</td>
<td>Varlık ve hayat şerefine mazhariyette aralarında gölgeli asıl arasındaki fark kadar farklı var. Bunun bir misalini rüyada yaşamayı mı yoksa?</td>
</tr>
<tr>
<td>-DAki</td>
<td>mazhariyetteki</td>
<td>Engelli kişilerin bilgiye mazhariyetteki skandalarını azaltmayı amaçlayan proje, engelli vatandaşlar için büyük kolaylık sağlar.</td>
</tr>
<tr>
<td>-DA</td>
<td>müphemiyette</td>
<td>Küreselleşme süreciyle ilişkili yapısal değişiklikler, para politikasını kuşatan müphemiyette artırıp ve kargaşanın genişlesmesine neden olur.</td>
</tr>
<tr>
<td>-DAki</td>
<td>müphemiyetteki</td>
<td>Bundan dolayı siyasi belirsizlik arttu ve işin teorisinden bildiğimiz gibi siyasi müphemiyetteki artış fazlalarda mutlaka karşılık bulur.</td>
</tr>
<tr>
<td>Suffix</td>
<td>Word</td>
<td>Sentence</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>-</td>
<td>Raporlarla</td>
<td>Kanun taslağı çalışmalarıyla gündeme gelen ve tartışımalara neden olan yeminli murakıplık sisteminin kaldırılmasının denetim sisteminde risk oluşturacağı belirtildi.</td>
</tr>
<tr>
<td>-DA</td>
<td>Raporlarda</td>
<td>Mali müşavirlikten bağımsız saylabilecek olan ve hatta yeni bir meslek olarak kabul edilen murakıplık avukatlar için de bir olana da yararlabılır.</td>
</tr>
<tr>
<td>-DAki</td>
<td>Raporlardaki</td>
<td>Denetçilerin çoğunluğunun murakıplıktaki konulardaki fazla olması halinde tanzim edilmiş en devlet olarak kabul edilen murakıplıkta avukatlar için de bir olana da yararlabılır.</td>
</tr>
<tr>
<td>-</td>
<td>Müşakkafat</td>
<td>Müdürlüğün uygulamaya itiraz nedeni müşakkafat olarak kabul edilen mülkün kendilerine devrinin istemesidir.</td>
</tr>
<tr>
<td>-DA</td>
<td>Müşakkafatta</td>
<td>Daha sonraları vakıfların elindeki müşakkafatta gayrimüslimlerin otурması dikkate geçer.</td>
</tr>
<tr>
<td>-DAki</td>
<td>Müşakkafattaki</td>
<td>Yeni kazanç kanununun müşakkafattaki iradı gayrisafilerin esas tutulacağı dikkate alınarak tanzim edildiği süphe yoktur.</td>
</tr>
<tr>
<td>-</td>
<td>Ornito renk</td>
<td>Yeni Zelanda asıllı Amerikalı bir aktrist, sette yemek yediği sofrada mutlaka haşlanmış ornito renk kullanmış.</td>
</tr>
<tr>
<td>-DA</td>
<td>Ornito renkte</td>
<td>Yavrularda bulunan dişler ergin ornito renkte yerini kemikleri çıkartır.</td>
</tr>
<tr>
<td>-DAki</td>
<td>Ornito renkteki</td>
<td>Yapılan bir araştırmaya göre, insan beyinde yaşlanmayı yavaşlattığı bilinen ornito renkteki faydaları kilo vermeye de yardımcı olduğunu belirler.</td>
</tr>
<tr>
<td>-</td>
<td>Sarfinazar</td>
<td>Avrupalı tarihiçere müracaat edildi ama bazıları makalelerini gönderdikleri halde sarfinazar ederek geri çektiler, tehdit aldıklarını söyledi.</td>
</tr>
<tr>
<td>-DA</td>
<td>Sarfinazarda</td>
<td>Yasayla, tarafların arabulucuya başvurma, süreci devam ettirme, sonuçlandırmaya veya bu süreçten sarfinazarda serbest olması güvenceye alındı.</td>
</tr>
<tr>
<td>-DAki</td>
<td>Sarfinazardaki</td>
<td>Sınırlayıcı faktör ancak bizim kendi inancımız ve kötü alışkanlıklarımızdan sarfinazardaki niyet ve azmimiz olacaktır.</td>
</tr>
<tr>
<td>-</td>
<td>Senatörlük</td>
<td>Ülkenin önünde, başkanın icraatları nedeniyle yargılanmasına engel olan düzenleme ve kendisini dokunulmazlık zırhı ile saran, hayat boyu sürecek senatörlük engelleri bulunuyor.</td>
</tr>
<tr>
<td>-DA</td>
<td>Senatörlükte</td>
<td>Efşane başkan, başında olduğu kurumu soyum düşkına çeviren sonra da kurtuluşu senatörlükte arayıp dokunulmazlığa sığınan değil.</td>
</tr>
<tr>
<td>-DAki</td>
<td>Senatörlükteki</td>
<td>Üstelik, programa davet edildikten sonra hayli tedirgin olan kişinin senatörlükteki çalışma alanı uyum ve sivil toplum.</td>
</tr>
<tr>
<td>-</td>
<td>Stronsiyum</td>
<td>Doğal deniz suyu bulunan stronsiyum seviyelerini akvaryum içerisinde dengeye getiren araç, bu seviyeyi korumaktadır.</td>
</tr>
<tr>
<td>-DA</td>
<td>Stronsiyumda</td>
<td>Pişirmiş bir stronsiyumda ürünün yapısı gereği tam standardi tutturmak mümkün değildir.</td>
</tr>
<tr>
<td>-DAki</td>
<td>Stronsiyumdaki</td>
<td>Modifiye olmadığı durumlarda gaz seviyesi önemli ölçüde değişmez. Sodyum ile modifiyede stronsiyumdaki kadar şiddetli olmasa da gaz absorbsini biraz yükselttiği görülmiştir.</td>
</tr>
<tr>
<td>Suffix</td>
<td>Word</td>
<td>Sentence</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>-</td>
<td>tahtırevan</td>
<td>İstanbul’un dar sokaklarında hanımlar ancak sedan sandalyesi adı verilen bir çeşit tahtırevan aracılığıyla dolaşabilirdi.</td>
</tr>
<tr>
<td>-DA</td>
<td>tahtırevanda</td>
<td>Örneğin, elçinin kızını tahtırevanda betimleyen eserinde olduğu gibi yabancı elçiler ve elçilik çevresinden de siparişler almıştır.</td>
</tr>
<tr>
<td>-DAki</td>
<td>tahtırevandaki</td>
<td>Yanlarında bir de beyaz giysili kadın var. İyi giyimli dört atlı atlarдан inerek tahtırevandaki kadını indirmeye gittiler.</td>
</tr>
<tr>
<td>-</td>
<td>taşeronluk</td>
<td>Teknik olarak ehil olmayan kişiler taşeronluk yaptığı için müşteri mağduriyeti yaşanıyor.</td>
</tr>
<tr>
<td>-DA</td>
<td>taşeronlukta</td>
<td>Bu kazanım hükümeti düzenlemeye yapmaya sevk etti. Dolayısıyla, şimdi gündemde taşeronlukta yapılacak yeni düzenleme var.</td>
</tr>
<tr>
<td>-DAki</td>
<td>taşeronlukta</td>
<td>Teknik ekip, mevcut heyetin taşeronlukta çalışması boyunca böyle bir sorumluluğu almak istemediğine dikkat çekiyor.</td>
</tr>
<tr>
<td>-</td>
<td>tekdüzelik</td>
<td>Yaşamın halihazırdaki tekdüzelik kıskacında kıvrandığı ülkelerde futbol, ekranlarda keyifle hüküm sürmektedir.</td>
</tr>
<tr>
<td>-DA</td>
<td>tekdüzelikte</td>
<td>Her birimiz, her sabah aynı sıkıcı tekdüzelikte çalıştığımız bu büyük binalara geliyoruz.</td>
</tr>
<tr>
<td>-DAki</td>
<td>tekdüzelikteki</td>
<td>Medeni insanın genişleyen dünyasında estetik değerler, sanayi devriminin getirdiği tekdüzelikteki bunalımlı durumun da tedavisini sağlıyor.</td>
</tr>
</tbody>
</table>
### APPENDIX C

**Stimulus Sentences for Experiment II**

Table C.1: Stimulus Sentences used in Experiment 2. Sentences are presented according to the conditions that target words belong to.

**Two Suffixed Forms (-DAki)**

<table>
<thead>
<tr>
<th>Root length</th>
<th>Bigram</th>
<th>Root</th>
<th>Word</th>
<th>Sentence</th>
<th>Before target</th>
<th>After target</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>ba</td>
<td>baş</td>
<td>baştaki</td>
<td>Emekli adamın küçük çocuğu baştaki muhabbetini bırakıp gitti.</td>
<td>Emekli adamın küçük çocuğu</td>
<td>muhabbetini bırakıp gitti.</td>
</tr>
<tr>
<td>3</td>
<td>be</td>
<td>ben</td>
<td>bendeki</td>
<td>Bu şekilde yararlı olsaydı bendeki etkileri daha çok olurdu.</td>
<td>Bu şekilde yararlı olsaydı</td>
<td>etkileri daha çok olurdu.</td>
</tr>
<tr>
<td>3</td>
<td>ça</td>
<td>çap</td>
<td>çaptaki</td>
<td>Söylediğiniz kadar büyük çaptaki halati taşmak zor olmalı.</td>
<td>Söylediğiniz kadar büyük</td>
<td>halati taşmak zor olmalı.</td>
</tr>
<tr>
<td>3</td>
<td>di</td>
<td>dil</td>
<td>dildeki</td>
<td>Gereken özen gösterilirse dildeki etkiler iyi gözlenebilir.</td>
<td>Gereken özen gösterilirse</td>
<td>etkiler iyi gözlenebilir.</td>
</tr>
<tr>
<td>3</td>
<td>ha</td>
<td>hat</td>
<td>hattaki</td>
<td>Burada bekliyordunuz fakat hattaki diğer bölgeden olur dendi.</td>
<td>Burada bekliyordunuz fakat</td>
<td>diğer bölgeden olur dendi.</td>
</tr>
<tr>
<td>3</td>
<td>ka</td>
<td>kan</td>
<td>kandaki</td>
<td>Olayı doğru anlamak için kandaki analizi yapmak gerekli.</td>
<td>Olayı doğru anlamak için</td>
<td>analizi yapmak gerekli.</td>
</tr>
<tr>
<td>3</td>
<td>ku</td>
<td>kur</td>
<td>kurdaki</td>
<td>Önemli olduğunu bilmeseydim kurdaki zamanına dikkat etmezdim.</td>
<td>Önemli olduğunu bilmeseydim</td>
<td>zamanına dikkat etmezdim.</td>
</tr>
<tr>
<td>3</td>
<td>li</td>
<td>lig</td>
<td>ligdeki</td>
<td>Durum konuşulduktan sonra ligdeki sorununuz çözüldü sayılır.</td>
<td>Durum konuşulduktan sonra</td>
<td>sorununuz çözüldü sayılır.</td>
</tr>
<tr>
<td>3</td>
<td>ma</td>
<td>maç</td>
<td>maçtaki</td>
<td>Çok çalıştığı için şimdi maçtaki başarıları saymakla bitmez.</td>
<td>Çok çalıştığı için şimdi</td>
<td>başarıları saymakla bitmez.</td>
</tr>
<tr>
<td>3</td>
<td>or</td>
<td>ora</td>
<td>oradaki</td>
<td>Öyle hassas konularda asla oradaki üretim hataları yapılmaz.</td>
<td>Öyle hassas konularda asla</td>
<td>üretim hataları yapılmaz.</td>
</tr>
</tbody>
</table>
Sağdaki Okulun topluluğu yıllarca sağdaki başarılarıyla adını duyurdu.

Soldaki Bugün katıldığımız davette soldaki konuklar açıkça konuşmadı.

---

### One Suffixixed Forms (-DA)

<table>
<thead>
<tr>
<th>Root length</th>
<th>Bigram</th>
<th>Root length</th>
<th>Word</th>
<th>Sentence</th>
<th>Before target</th>
<th>After target</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>ba</td>
<td>bahçe</td>
<td>bahçede</td>
<td>Emekli adamın küçük çocuğu bahçede muhabbetini bırakıp gitti.</td>
<td>Emekli adamın küçük çocuğu</td>
<td>muhabbetini bırakıp gitti.</td>
</tr>
<tr>
<td>5</td>
<td>be</td>
<td>beden</td>
<td>bedende</td>
<td>Bu şekilde yararlı olsaydı bedende etkileri daha çok olurdu.</td>
<td>Bu şekilde yararlı olsaydı</td>
<td>etkileri daha çok olurdu.</td>
</tr>
<tr>
<td>5</td>
<td>ca</td>
<td>çanta</td>
<td>çantada</td>
<td>Söylediğiniz kadar büyük çantada halati taşımak zor olmalı.</td>
<td>Söylediğiniz kadar büyük</td>
<td>halati taşımak zor olmalı.</td>
</tr>
<tr>
<td>5</td>
<td>di</td>
<td>diyet</td>
<td>diyette</td>
<td>Gereken özen gösterilirse diyette etkileri iyı gözelebilir.</td>
<td>Gereken özen gösterilirse</td>
<td>etkileri iyı gözelebilir.</td>
</tr>
<tr>
<td>5</td>
<td>ha</td>
<td>haber</td>
<td>haberde</td>
<td>Burada bekliyordunuz fakat haberde diğer bölgeden olur dendi.</td>
<td>Burada bekliyordunuz fakat</td>
<td>diğer bölgeden olur dendi.</td>
</tr>
<tr>
<td>5</td>
<td>ka</td>
<td>kayıt</td>
<td>kayıtta</td>
<td>Olayı doğru anlamak için kayıtta analizi yapmak gereklidir.</td>
<td>Olayı doğru anlamak için</td>
<td>analizi yapmak gereklidir.</td>
</tr>
<tr>
<td>5</td>
<td>ku</td>
<td>kulüp</td>
<td>kulüpte</td>
<td>Önemli olduğunu bilmeseydik kulüpte zamanına dikkat etmezdim.</td>
<td>Önemli olduğunu bilmeseydik zamanına</td>
<td>dikkat etmezdim.</td>
</tr>
<tr>
<td>5</td>
<td>li</td>
<td>liste</td>
<td>listede</td>
<td>Durum konuşulduktan sonra listede sorunumuz çözüldü sayılır.</td>
<td>Durum konuşulduktan sonra</td>
<td>sorunumuz çözüldü sayılır.</td>
</tr>
<tr>
<td>5</td>
<td>ma</td>
<td>makam</td>
<td>makamda</td>
<td>Çok çalıştığı için şimdi makamda başarıları saymakla bitmez.</td>
<td>Çok çalıştığı için şimdi</td>
<td>başarıları saymakla bitmez.</td>
</tr>
<tr>
<td>5</td>
<td>or</td>
<td>orman</td>
<td>ormanda</td>
<td>Öyle hassas konularda asla ormanda üretim hataları yapmaz.</td>
<td>Öyle hassas konularda asla</td>
<td>üretim hataları yapmaz.</td>
</tr>
<tr>
<td>5</td>
<td>sa</td>
<td>sanat</td>
<td>sanatta</td>
<td>Okulun topluluğu yıllarca sanatta başarılarıyla adını duyurdu.</td>
<td>Okulun topluluğu yıllarca</td>
<td>başarılarıyla adını duyurdu.</td>
</tr>
<tr>
<td>5</td>
<td>so</td>
<td>sofra</td>
<td>sofrada</td>
<td>Bugün katıldığımız davette sofrada konuklar açıkça konuşmadı.</td>
<td>Bugün katıldığımız davette</td>
<td>konuklar açıkça konuşmadı.</td>
</tr>
<tr>
<td>Root length</td>
<td>Bigram</td>
<td>Root</td>
<td>Word</td>
<td>Sentence</td>
<td>Before target</td>
<td>After target</td>
</tr>
<tr>
<td>-------------</td>
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<td>-------</td>
<td>---------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>7</td>
<td>ba</td>
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