



Hacettepe University Graduate School of Social Sciences

Department of English Linguistics

**A LEXICAL ANALYSIS OF FREQUENCY AND CONTEXT IN  
TRANSPOSED LETTER EFFECT IN TURKISH**

Bilgehan İLHAN

Master's Thesis

Ankara, 2025



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## KABUL VE ONAY

Bilgehan İLHAN tarafından hazırlanan ‘‘Türke’de Bozulan Harf Etkisi Üzerinde Sıklık ve Baęlama İlişkin Sözcüksel Çözümleme’’ başlıklı bu alıřma, 18 Eylül 2025 tarihinde yapılan savunma sınavı sonucunda başarılı bulunarak jürimiz tarafından Yüksek Lisans Tezi olarak kabul edilmiştir.

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## **ETİK BEYAN**

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## ABSTRACT

İLHAN, Bilgehan. *A Lexical Analysis of Frequency and Context in Transposed Letter Effect in Turkish*, Master's Thesis, Ankara, 2025.

This study examines the interaction between contextual constraints and word frequency while recognizing jumbled words in Turkish. It seeks to investigate how lexical access is affected by top-down sentence level context, and bottom up, lexical frequency, processes when word shapes are visually disturbed.

Thirty-six native speakers of Turkish participated in a self-paced reading experiment. Four experimental conditions; high frequency-strong context, high frequency-weak context, low frequency-strong context and low frequency-weak context were produced by varying two levels of frequency (high & low) and two levels of context (strong & weak) in a 2x2 within-subject design. Participants read sentences that contained the target word in a jumbled form word by word. To ensure that participants have paid attention during reading, a yes/no comprehension question following each sentence was presented. Accurate rates for the comprehension questions and reaction times for every target word were noted. According to the findings, low frequency words in weakly constraining context had the longest reaction times, whereas high frequency words in strongly constraining context had the shortest.

These results demonstrate that frequency and contextual predictability work together to influence processing, which is consistent with interactive word recognition models. The present study provides valuable data from Turkish, which is an agglutinative language, and emphasizes the significance of integrating top-down and bottom-up mechanisms during real time language comprehension. All taken together, the findings advance our knowledge of how readers process visually displaced input, particularly when frequency and context are changed at the same time

### Keywords

Jumbled words, language comprehension, bottom-up, top-down, word recognition

## ÖZET

İLHAN, Bilgehan. *Türkçe'de Bozulan Harf Etkisi Üzerinde Sıklık ve Bağlama İlişkin Sözcüksel Çözümleme*, Yüksek Lisans Tezi, Ankara, 2025.

Bu çalışma, Türkçede karışık harfli sözcüklerin tanınması sırasında bağlam kısıtlayıcılığı ve kelimelerin sık kullanımı arasındaki etkileşimi incelemektedir. Amaç, kelime biçimleri görsel olarak bozulduğunda, dikey işleme ile düşey işleme süreçlerinin sözcük erişimini nasıl etkilediğini araştırmaktır. Otuz altı anadili Türkçe olan katılımcı, kendi hızlarını belirleyebildikleri bir okuma deneyine katılmıştır. Deney 2x2 iç denekli bir tasarımla; sıklık (sık – seyrek) ve bağlam gücü (güçlü – zayıf) olmak üzere iki düzeyde oluşturulan dört deneysel koşuldan (sık-güçlü, sık-zayıf; seyrek-güçlü, seyrek-zayıf) oluşmaktadır. Katılımcılara, hedef sözcüğün karışık harfli biçimini içeren tümceler sırayla görüntülenecek şekilde sunulmuştur. Katılımcıların tümceleri dikkatle okuyup okumadıklarını kontrol etmek amacıyla her tümcenin ardından cevabı evet/hayır biçiminde olabilecek bir anlama sorusu yöneltilmiştir. Her hedef sözcük için anlama sorularına verilen cevapların oranları ve hedef sözcükler için verilen tepki süreleri kaydedilmiştir. Bulgulara göre, seyrek kullanılan sözcükler zayıf bağlam içinde en uzun tepki süresine sahipken, sık kullanılan sözcükler güçlü bağlam içinde en kısa sürede tanınmıştır. Bu sonuçlar, kelime sıklığı ile bağlamsal öngörülebilirliğin birlikte işlemeyi etkilediğini ve bunun etkileşimli sözcük tanıma modelleriyle tutarlı olduğunu göstermektedir. Çalışma, eklemeli bir dil olan Türkçeden elde edilen verilerle, gerçek zamanlı dil anlama sürecinde hem dikey işleme hem de düşey işleme mekanizmalarının entegrasyonunun önemini vurgulamaktadır. Genel olarak, bu bulgular, özellikle sıklık ve bağlam eş zamanlı değiştirildiğinde, okuyucuların görsel olarak bozulmuş dil girdilerini nasıl işlemlediğine dair bilgimizi geliştirmektedir.

### **Anahtar Sözcükler**

Karışık harfli sözcükler, dil algılama, düşey işleme, dikey işleme, sözcük tanıma

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## ABBREVIATIONS

|     |                       |
|-----|-----------------------|
| H   | High                  |
| L   | Low                   |
| FR  | Frequency             |
| SC  | Strongly Constraining |
| WC  | Weakly Constraining   |
| RT  | Reaction Time         |
| MS  | Millisecond           |
| STD | Standard              |

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## INTRODUCTION

### BACKGROUND TO THE STUDY

The study of psycholinguistics aims at examining language processing through several aspects including language production and comprehension, vocabulary preservation and access, brain activity during a language task, first language acquisition, and linguistic impairments along with their causes. Language comprehension, which can be counted as one of the main research areas of psycholinguistics, explores how human brain processes and understands spoken and written language. It examines the cognitive mechanisms involved in interpreting words, sentences, and larger texts, focusing on factors such as syntax, semantics, and context. By virtue of its complex nature with a wide range of subfields, language comprehension is widely examined cross-linguistically (Rayner, 1978; Kellerman & Smith 2016; Meyer & Schvaneveldt 1971; Schirmer, Tang, Penney, Gunter & Chen, 2005; Friederici & Mecklinger 1996; Miyamoto 2002; Wason, 1965; Bulut, Yarar & Wu, 2019; etc.).

Majorly, the field of psycholinguistics aims at answering how humans comprehend, produce and acquire language. For the comprehension side, examining how people understand spoken and written language is studied at various levels, such as interpreting speech signals, determining the meanings of words (lexical access) and parsing the grammatical structures of sentences (Eigsti & Magnuson, 2013b). For that aim, various theories, approaches and models are proposed in the literature. For instance, the interactive activation model (McClelland & Rumelhart, 1981) is one of well-known models that explains word processing. This model suggests that word recognition entails both top-down and bottom-up approaches. The first step of bottom-up processing is recognizing individual letters or phonemes and then combining them to create words. In contrast, top-down approach can be defined as the process of guessing or predicting the word by using context and/or past knowledge. For example, according to top-down approach, the brain uses contextual information to recognize a word that is partially

or totally jumbled, even if some letters are missing or out of order. This model illustrates that the intricate interplay between top-down and bottom-up approaches is what makes it possible to correctly identify words even when they are jumbled or disrupted in some way.

The dual-route model is another well-known model (Coltheart, 2005). This model claims that there are two pathways involved in word production: an indirect sublexical route and a direct lexical route. The direct route requires recovering the word straight from memory while in the indirect route, the word is sounded out letter by letter, as in the case of an unknown word. Both routes complement each other and enhance the capacity to effectively produce written and spoken words. On the other hand, connectionist model suggest that language processing is predicated on activation patterns within a network of interrelated units (Seidenberg & McClelland, 1989). Language processing in this model is based on the interaction of vast volumes of information rather than a particular rule-based system. During word processing, semantic, phonological and orthographical elements are activated and this activation is influenced by experience, context and frequency.

Jumbled words phenomenon serves as a tool used for the study areas such as lexical access and word processing. Word recognition and lexical access are impacted by jumbled words because this phenomenon forces the brain to reconstruct patterns that are known from disrupted letter sequences.

Jumbled word recognition patterns are not the same as the usual patterns of word recognition. The human cognitive system is confronting with challenges when it comes to recognizing jumbled words. More work and cognitive flexibility as well as problem-solving skills are needed in order to precisely identify/decode jumbled words than simply reading. Readers often rely on top- down processing in order to decode the original word by drawing upon their past knowledge of word frequency, grammar rules and structures. Grainger & Jacobs (1996) showed that more high frequency words are easier to recognize because of their strong representation in the mental lexicon.

Coltheart et al. (2001) further explained that words with dense orthographic neighbourhoods may introduce ambiguity making the decoding process even more difficult because of their large number of similar words.

These models can be helpful in explaining how humans can read and understand jumbled words. Readers can make use of bottom-up processing to recognize each letter, but top-down processing involves combining language and context knowledge to predict and confirm the word. A deeper comprehension of these models can be useful in explaining how people decode jumbled words. The research area of word comprehension and production has employed a variety of methodologies and languages in order to explain various language phenomena. Thus, research on the relation between production and comprehension is crucial so as to better perceive the language itself.

#### Lexical Processing Studies in Turkish

Various languages have been studied in terms of jumbled words and transposed letter effect. (Perea, Lupker, 2004; Rayner, Johnson & Liversedge 2006; Peressotti & Grainger 1999; Velan & Frost 2009; etc.) However, no research has been done in Turkish particularly on this issue.

In the area of Turkish psycholinguistics, main focus is on the processing of the language on a syntactical level. (Kabak, B. 2014; Ellis, N. C. 2002; Oğuz, M., & Kaiser, E. 2024; Kurt, D., & Deniz, N. D. 2023; Öksüz, D., Brezina, V., Monaghan, P., & Rebuschat, P. 2024; Oğuz, E., & Kırkıcı, B. 2022; Kırçalı, C. E., Uzun, İ. P., & Aydın, Ö. 2021; etc.) The main goal of research on Turkish language production and comprehension is to comprehend the linguistic and cognitive processes influenced by Turkish's distinctive characteristics, including its agglutinative morphology, flexible word order and evidentiality markers.

Using a variety of experimental designs, including priming and lexical decision tasks, studies have carefully looked at how native and non-native speakers understand morphologically complex words. Kırkıcı and Clahsen (2012) for example, has investigated how L1 and L2 speakers process inflectional and derivational morphology.

They identified unique patterns in morphological priming effects. Also, research has been done about how morphological complexity affects written production and compound word processing. The representation and accessibility of derived and compound words in the mental lexicon have also been the subject of Turkish morphological processing.

According to Pınar and Kırkıcı (2015) both native and non-native speakers of Turkish have a tendency to break down words into their morphological components during processing. Their findings suggest that morphological structure is crucial for Turkish word recognition. Likewise, an experimental investigation on the written generation of compound words in Turkish was carried out by Kırkıcı and Ataman (2019). They revealed that the conceptual creation of compound forms is actively influenced by both morphological and syntactic factors. Research also frequently examines how Turkish speakers understand sentences using case markers, word order and thematic roles, emphasizing the significance of these cues in meaning processing. According to morphological processing research, Turkish speakers understand and produce words by parsing roots and suffixes, with vowel harmony promoting predictability (Göksel & Kerslake, 2005) Ergin and Stromswold (2023) found out that overt case marking and default word order speed up and improve comprehension, underlying the cognitive interaction between syntax and semantics. It has been demonstrated that the ease of comprehension is influenced by the flexibility of Turkish syntax, specifically its SOV order (Özge et al., 2019) According to Bulut et al. (2020) processing patterns of relative clauses are shaped and constrained by a combination of syntactic structure, structural frequency and morphological information. A study has examined the morphological processing skills of emerging readers. Oğuz and Kırkıcı (2022) found out that sensitivity to suffixes appears early in reading development.

Turkish word-based research emphasizes the agglutinative structure of the language, in which words are created by joining several affixes to a root. The processing of these affixes during word production and recognition is frequently studied; results indicate that Turkish speakers use morpheme-based parsing (Göksel & Kerslake, 2005).

Research also indicates that comprehension is significantly influenced by the hierarchical structure of suffixes, where derivational suffixes are located closer to the root (Aksu-Koç, 1994). According to Kırkıcı and Clahsen (2013), word frequency effects are also noticeable, with high-frequency words and suffixes being processed more quickly. There is proof that Turkish speakers break down complicated words into their roots and suffixes when it comes to lexical access, especially when processing in real time (Başar et al., 2020). These results confirm the notion that morphological structure plays a significant role in Turkish lexical processing.

#### STATEMENT OF THE PROBLEM

Research on how Turkish speakers process sentences with jumbled words is quite restricted when compared with the number of the studies that have been carried out on other languages (Perea, Lupker, 2004; Rayner, Johnson & Liversedge 2006; Peressotti & Grainger 1999; Velan & Frost 2009; etc.)

Word processing research encounters with particular difficulties due to the agglutinative morphology of Turkish, in which words are created by adding suffixes. For example, English language has more fixed word order and research in this language is easier to apply than a language like Turkish. Turkish morphology and syntax have been studied far and wide, however, the recognition patterns of jumbled words by Turkish speakers have not been clearly and systematically examined. A detailed grasp of how Turkish speakers process jumbled sentences by using morphological cues and word order is interfered with the unavailability of research in this field. Research in this field could offer important insights into processing mechanisms cross-linguistically. It is indicated by the results of the researches in various languages that the jumbled words phenomenon may be language specific and it seems that there is not a single theory which is able to explain the phenomenon. Since no prior study has been conducted on this topic, it's important to analyze the jumble word effect in Turkish because of its characteristic agglutinative structure and word order. Additionally, insights from Turkish can facilitate cross-linguistic comparisons contributing to universal theories of language processing.

## AIM OF THE STUDY

The aim of the present study is to understand the comprehension processes of jumbled words in Turkish. For that aim, word frequency and sentence context are manipulated in order to put forward the potential effects of these on jumbled word comprehension by native speakers of Turkish. Also, this study aims to investigate how consistent the jumbled word effect will be in different conditions/context.

In relation to the above-given aim, the present study tries to answer the following questions:

### Research Questions

- 1) How does word frequency affect jumbled word recognition in Turkish?
- 2) How do strongly and weakly constraining context types affect jumbled word recognition in Turkish?

## OVERVIEWS OF THE SECTIONS

This study contains 4 chapters. The first chapter includes background to the study with related topics. This section provides a comprehensive review of previous studies on word recognition, particularly in relation to word frequency and context effects,

The second chapter includes methodology; initial data collection study and the main study. This chapter details the research design, participants, materials, and procedures used in the study. It provides information about the data collection processes and data analysis of the study.

The third chapter includes the findings and discussion of the study. It presents the statistical analysis of the four experimental conditions. Descriptive statistics, repeated measures ANOVA results, and pairwise comparisons are reported.

The fourth and the last chapter is the conclusion of the study. It examines how the findings relate to previous research, discusses their implications for psycholinguistic theory, and addresses limitations. The chapter concludes with suggestions for future research.

## CHAPTER 1

### REVIEW OF LITERATURE

In the present chapter, firstly jumbled word effect and the hypotheses concerning its comprehension in sentence processing will be explained in detail. After that, a theoretical framework including accounts that try to explain jumbled word processing from top-down and bottom-up based perspectives will be covered.

#### 1.1. JUMBLED WORDS, TRANSPOSITION AND SUBSTITUTION EFFECT

The "jumbled words" phenomenon explains how humans can often read words correctly even when their letters are jumbled, as long as the initial and final letters are positioned correctly. This outcome shows how flexible and efficient the human brain is in processing written material (Acha & Perea, 2007). For example, you may easily read "Yuor biran is amzanig!" as "Your brain is amazing!" even though the internal letters of some words are reversed. When two adjacent letters are switched (for example, judqe instead of judge), readers can still recognize the word. This phenomenon is known as the transposition effect. Although people's ability to correctly interpret jumbled words varies, the transposed letter effect is commonly brought up in discussions on how the brain effectively processes language (Rayner et al., 2006). According to Perea and Lupker (2003), this effect is strong and well-established in masked priming tests, indicating flexibility in the location encoding of characters. However, when a letter in a word is changed to another letter (judge instead of judge, for example), this is known as the substitution effect, and it usually results in poorer recognition rates than transpositions. This is due to the fact that substitutions reduce orthographic resemblance with the underlying word by altering both the letter's identity and location.

The jumbled words employed in this study, on the other hand, were more degraded than ordinary transposition primes since they frequently involved multiple internal letter transpositions rather than simply one exchange. As a result, even while positional uncertainty is present in both phenomena, jumbled words put greater strain on

reconstruction processes and are more likely to use top-down mechanisms, particularly in poor contextual circumstances.

Jumbled word processing has been widely studied to understand how readers recognize and comprehend words when their letters are scrambled or transposed. This effect suggests that word recognition is significantly faster when internal letters are scrambled but the first and last letters remain in place. Perea and Lupker (2003) discovered that if the first and last letters remain in their usual locations, readers can identify jumbled words. Word detection has substantial implications for understanding how visual word recognition operates and according to this research, letter locations play an essential function in word detection.

Grainger and Whitney (2004) showed that people have a tendency to misunderstand words with jumbled letters than those with completely distinct letters. They suggest that the human cognitive system could potentially be able to handle some letter changes in structure. This realization prompted additional investigation into the phenomenon within the framework of orthographic processing. The impact of transposed letters on reading speed and comprehension was then studied by Rayner et al. (2005), who showed that readers can process transposed words quickly, especially when the scrambled letters are at the beginning or end of the word, suggesting that readers use word shape and contextual information to facilitate word recognition even when the internal letters are jumbled. Davis (2010) came to the conclusion that words with usual letter patterns are easier to comprehend when they are jumbled than words with unusual letter patterns. His observation suggests that language expertise and past knowledge factors are important in decoding jumbled words.

Despite readers being sensitive to a word's letter order, Schneider and O'Regan (1988) suggested that letter transposition influenced their ability to visually identify words. Their study suggests that familiarity to a word and context might lessen this sensitivity. Forster (1973) proposed that word recognition is related with top-down regulations in addition to individual letter identification. This illustrates how top-down model interacts with the recognition of jumbled words.

The flexibility of the human language processor in recognizing and processing jumbled words is demonstrated by these studies. They indicate that although orthographic patterns and letter positions are essential for recognizing words, knowledge of the background and context are just as essential for helping readers understand jumbled words. These investigations could potentially offer essential information about how languages with unique morphological and orthographic features are evaluated.

A distinct problem arises with morphosyllabic and logographic writing systems like Chinese and Japanese. Individual characters in these languages frequently stand in for entire words or morphemes and recognition of these characters depends on their underlying visual structure (D'Arcais et al., 1995). Because visual form and semantic content are closely related, altering the character order can seriously hinder comprehension. Accordingly, contextual prediction and visual orthographic processing are more important for jumbled word recognition in Chinese and Japanese than phonological decoding (Dylman & Kikutani, 2017).

Turkish, with its agglutinative nature, presents a distinctive challenge for word recognition, particularly when words are jumbled. There is no study which directly investigates the jumbled word effect in Turkish, however, there are several studies which investigate Turkish word processing, especially the role of morphological complexity. A notable study by Durgunoğlu (2003) observes the extent to which the word morphological features of Turkish affect word recognition. The cognitive processes involved in identifying Turkish morphologically complicated words is aimed at in this study. Aydın (2014) also looks at the function of morphological awareness in reading comprehension with a focus on bilingual children who speak Turkish and English. Her study examines the importance of morphological awareness for reading proficiency in Turkish and emphasizes the cognitive impact of understanding morphological structures for word reading and comprehension. Xanthos, et al. (2011) also enhances the knowledge of the function of morphological structure in the

processing of Turkish. This study analyzes the ways Turkish speakers use morphology in understanding syntactic frameworks and how morphologically complex concepts facilitate sentence comprehension in order to obtain a better recognition. Their findings are valuable in better understanding how language learners and native speakers process

complex word formations by displaying how Turkish speakers perceive morphologically complicated words. These studies contribute to the field of linguistics on the relationship between word processing and Turkish morphological complexity by looking at both cognitive and developmental elements.

## **1.2. JUMBLED WORD PERCEPTION AND COGNITIVE PROCESSING**

In the explanation of the jumbled word phenomenon, mainly two methods are discussed: bottom-up processing and top-down processing. Bottom-up processing distinguishes individual letters and their positions, while top-down processing predicts and rebuilds the word using expectations, context and knowledge. (McClelland & Rumelhart, 1981). Top-down mechanisms help readers make sense of these scrambled inputs by relying on familiar word shapes, sentence context, and linguistic knowledge (Rayner et al., 2005). Scientific studies suggest this phenomenon is rooted in the brain's use of both bottom-up and top-down processing. Context is important because sentences inquire semantic and syntactic clues that help with word decoding and prediction. In grammatically correct sentences, the jumbled words phenomenon is easier to comprehend than single phrases (Rayner et al, 2006). This finding may show how readers fill in gaps by using sentence-level meaning. Besides, the brain's ability to approximately encoding letter positions also helps maintain the reading system's adaptability. When words are jumbled, word frequency and familiarity also have a great influence on comprehension. It's simpler to identify them because readers use their mental lexicon to glue them back together. Bottom-up recognition and top-down prediction pair up to quickly and mostly correctly identify jumbled words. (Reichle et al. 2009) However, top-down and bottom-up processing are not the only models which help understanding the jumbled word effect. How jumbled words are comprehended is further tried to be explained by a number of other theoretical frameworks. These frameworks stress cognitive, linguistic and neurological mechanisms to make clear various facets of the phenomenon. The Parallel Distributed Processing (PDP) Model, for instance, highlights how the human brain uses multiple layers of neurons to process words. By depending on insufficient data such as letter patterns and word familiarity, these networks activate several word alternatives at once and this process allows for flexible reading of jumbled words. (Rumelhart & McClelland, 1986).

The interactive activation model by McClelland and Rumelhart (1981) explains how indirect communication across letter, attribute and word levels enable the recognition of jumbled words. They explain jumbled word phenomenon with the accurate reconstruction by the significant feedback that the existing initial and final letters give to lower processing levels. The mental lexicon plays an important role as well. While trying to decode jumbled words, readers use stored word forms along with their frequency, meaning and structure. High-frequency words are found to be easier to recognize because of the fact that their activation is easier due to their mental representations (Perea & Lupker, 2003). Working memory resources are most likely used while recognizing words that are jumbled or have orthographical disruptions since non-canonically arranged letters must be remembered, manipulated and integrated. Readers must create and assess alternate lexical options while retaining partial representations in memory when input deviates from known orthographic patterns.

This procedure is similar to verbal working memory functions, particularly the processing and short-term storage of sequential language data (Baddeley, 2003; Acheson & MacDonald, 2009). Higher levels of orthographic distortion such as transposed or jumbled letters have also been proposed to increase the demand on short-term storage and attentional control mechanisms in previous models of visual word recognition (Whitney, 2001; Norris & Kinoshita, 2012). According to this viewpoint, working memory is essential for connecting intact lexical-semantic knowledge with disrupted visual input.

The open bigram model, presented by Grainger and Whitney (2004) also describes how the brain analyzes relative locations of letter pairs as opposed to fixed vertical structures. This model tries to explain the enabling of the reconstruction of words that have been switched around. The relationship between mental and visual processes in word identification is the main topic of these concepts. This makes room for the advancement of both top-down and bottom-up approaches.

### **1.2.1. The Influence of Frequency and Context on Jumbled Words**

An important concept in linguistics and psycholinguistics is the word frequency. The term word frequency describes how frequently a specific word appears in a text, speech or linguistic corpora. It provides information about the frequency of the words speakers and

readers encounter in contexts. Relative frequency, such as the rate of occurrences per million, or absolute counts, such as the number of times a word appears in a certain dataset, can be used to convey it. Word frequency is instrumental in language processing due to affecting word recognition, recall and comprehension. In English, high-frequency words such as “the” or “and” lead to stronger representations as they are encountered more frequently than low-frequency words. Thus, they are processed more rapidly and precisely. Forster and Chamber’s (1973) results supported this phenomenon in their study when they tested if word frequency has an impact on lexical judgement tasks in which participants decide whether a sequence of letters compose a word or not. A couple of more research look at how word frequency affects how scrambled words are processed. They highlight how regular exposure to a word improves its decoding capacity even when it is jumbled. The human mind contains robust and effective representations of high frequency words. This makes them easier to detect because of their familiarity. But it can be more difficult to identify words that are rarely used in language when their letters are scrambled. Processing is more difficult since their mental models are usually weaker.

In their study conducted in 2003, Perea and Lupker studied how often a word is encountered affects the recognition of jumbled words. (“jugde” instead of “judge”). They discovered that high-frequency words are processed more quickly and precisely than low-frequency words even when the internal letters are jumbled. Regular exposure seems to improve word representation in the mind, this finding indicates. As a result, it becomes simpler for readers to identify their disrupted forms. Also, Rayner et al. (2006) observed how word frequency affected the reading of a jumbled text. According to the study, readers had less trouble understanding high-frequency terms that were jumbled. The propensity of the brain to use stored language patterns to rebuild known word forms is probably the cause of this ease. These findings show how contextual cues and regularity interact in supporting processing.

Kinoshita and Norris (2009) offered additional data by investigating the relationship between word frequency and letter transpositions. Their results concluded that high-frequency words outperform low-frequency words with an extensive amount, even when the letters are jumbled. The findings of their study suggests that mental lexicon adapts to the orthographic problems more effectively when words are highly encountered as readers can reach their mental representations with less reliance on precise visual input. Keuleers et al. (2012) used masked priming in examining frequency effects, where briefly given prime words change the recognition of target words. According to their findings, high-frequency primes caused target words to be activated more quickly and strongly. This highlights that regular exposure makes lexical entries stronger. The fact that frequently used words are easier to recall, implies that they can be reassembled with greater ease when displayed in jumbled form. Also, more frequently encountered words are processed more quickly due to repeated exposure to language, which makes them more ingrained in memory. This repeated exposure along with stronger brain activation patterns give rise to faster retrieval during reading or speech (Brysbaert & New, 2009). There is numerous research that back up this theory. It has been shown by Balota and Chumbley (1984) that in lexical judgement tests, words that appear more often in the language are distinguished more quickly than those that are less frequent. Low-frequency words, however, are harder to recognize because their representations are weaker and they are difficult to activate (Rayner et al., 2006). The fact that participants in lexical judgement tasks replied more rapidly to high-frequency words supports this notion (Forster & Chambers, 1973).

Frequent exposure makes mental images stronger, which facilitates the retrieval and processing of high-frequency words. The outcomes on lexical judgement tasks mentioned above are in line with this perspective. Context is another crucial factor in identifying jumbled words. Higher-level cues from context help decode and comprehend insufficient language input. Context offers crucial top-down cues that help interpret disrupted input. Context helps in reducing the number of possible outcomes by restricting irrelevant alternatives and activating words that make sense grammatically and semantically (Marslen- Wilson & Welsh, 1978). In this regard, in the sentence “I can’t find my phone” the neighbouring words establish an expectation for the word “find”. This facilitates the resolution of the jumbled word.

McClelland and Rumelhart's (1981) suggested approach, the word superiority effect, is consistent with this phenomenon. Context also promotes semantic priming. In semantic priming, the activation of the sentence with related themes speeds up the decoding of jumbled input. For instance, in the statement "The teacher came to the school" the word "teacher" primes the meaning of "school" making it easier to recognize. Besides, research indicates that jumbled words are much easier to read if their first and last letters are in place. This demonstrates that context provides readers to fill in the gaps with regular items, which lessen the cognitive load (Rayner et al. 2006). Readers are able to fix errors and process texts more quickly thanks to these tools. For example, although the words are jumbled in "I'm raeidng a bokok" the meaning can still be extracted. The role of context is also supported by the interactive activation model, which shows how contextual information limits word selection and improves recognition (McClelland & Rumelhart, 1981)

The effect of context as well as frequency in recognizing jumbled words is widely studied in different languages. Paciorek and Rączaszek-Leonardi (2009) revealed that context and frequency significantly have an impact on the ability to recognize jumbled words. Their findings imply that top-down processes are involved in decoding jumbled words. Starling and Snyder (2018) searched into how previous sentence context and variation type have an impact on the ability to recognize jumbled words. Their findings underlie the significance of contextual information by noting that meaningful context facilitates the recognition of jumbled words.

### **1.3. STRUCTURAL FEATURES OF TURKISH IN THE CONTEXT OF WORD RECOGNITION**

Turkish has special characteristics that could affect how visually disrupted words are interpreted because it is an agglutinative and morphologically rich language. Even when letter order is changed, the clear orthography, in which every grapheme consistently maps to a phoneme, enables effective bottom-up decoding (Göksel & Kerslake, 2005). In contrast, deep orthographic languages like Hebrew or English have irregular spelling patterns that necessitate a greater dependence on top-down mechanisms like morphological familiarity or lexical frequency (Velan & Frost, 2007).

Readers can support initial decoding in Turkish by using phonological regularity, which is especially important when they come across jumbled word forms. However, due to the agglutinative structure of Turkish, words frequently have a root and several suffixes that represent grammatical relationships (Aksan et al., 2012). Particularly in low frequency circumstances this structural feature may make it more difficult to recognize jumbled forms since it lengthens words and produces dense morpho- syntactic units. Therefore, Turkish seems to offer useful and rich linguistic data for investigating the joint effects of top-down and bottom-up processes on word recognition in the presence of visual disturbance.

Turkish has a very straightforward orthography in addition to its complex morphology. Turkish readers can rebuild words phoneme-by- phoneme, even in the face of visual distortion, and are less reliant on whole word identification or irregular spelling knowledge than readers of languages with richer orthographies, such as English (Durgunoğlu & Öney, 1999). Turkish readers are acknowledged to have good phonological and morphological awareness from a young age in addition to its straightforward orthography. This helps them decode in reading activities (Babayiğit & Stainthorp, 2007). According to studies, the regularity of sound-letter mapping helps even beginning Turkish readers absorb new or distorted words by improving their reliance on sublexical components.

In contrast, readers of deep orthographies like English are more likely to rely on irregular spelling patterns or whole word memorization (Harrison & Krol, 2007). Turkish readers can employ these sublexical decoding techniques to recreate distorted data using their phonemic awareness and morphological expertise while recognizing jumbled words. Furthermore, because of its morphosyntactic structure and frequent usage of affixation, Turkish is a language where context is essential for word identification. Readers frequently rely on sentence level information to clear up ambiguity or reconstitute partially damaged material because numerous grammatical indicators are encoded in suffixes (Bozşahin, 2002).

Contextual constraints such as jumbled words can offer robust top-down support to make up for diminished bottom-up input in visually impaired settings. Turkish is a very instructive language for investigating how interactive processing functions during real time reading and word recognition because of its dual dependency on both contextual semantics and systematic phonology (Babayiğit & Stainthorp, 2007; Bozşahin, 2002; Ziegler & Goswami, 2005).

The variable word order in Turkish is another linguistic feature that is important for word recognition. Subject-object-verb (SOV) is the standard sentence structure in Turkish, however, if morphological markers are maintained, syntactic elements can be rearranged without changing the main idea (Kornfilt, 1997). Because readers are used to anticipating or reconstructing interrupted lexical units inside a sentence using grammatical cues and semantic information, this syntactic flexibility strengthens the function of contextual prediction. This is especially helpful in experimental circumstances where contextual constraint acts as a compensatory strategy due to disrupted visual information. A special framework for investigating word recognition models is offered by the interplay between Turkish morphology and context. According to interactive activation models, recognition is influenced by contextual predictability as well as lexical frequency (McClelland & Rumelhart, 1981). Turkish is an ideal test case for investigating how readers process disrupted input in real time because it has both extensive top-down structuring by morphological and syntactic complexity and obvious bottom-up clues via phoneme-grapheme consistency. Therefore, researching the recognition of jumbled words in Turkish can provide important cross-linguistic support for existing ideas of visual word processing. Head-final and left-branching syntactic structure are two more characteristics of Turkish that may greatly influence the recognition of jumbled words. Subject–Object–Verb (SOV) is the canonical word order in Turkish, which means that verbs and other syntactic heads usually come at the end of clauses. Adjectives, adverbs, and relative clauses are examples of modifiers that come before the constituents they modify (Kornfilt, 1997; Göksel & Kerslake, 2005).

Because of this syntactic arrangement, readers must process and store a significant quantity of morphosyntactic information in working memory until they come across the head or verb at the end of the sentence. Readers frequently use predictive processing techniques to create predictions about future lexical and grammatical aspects during this process (Bozşahin, 2002).

When the visual form of words is disturbed, the anticipatory processing that is a part of understanding Turkish sentences may provide compensatory mechanisms. Turkish readers can use the syntactic and semantic clues that come before the distorted word to piece together its likely identity when it comes to jumbled words, where the letter order has been changed. Top-down activation of potential lexical elements prior to the appearance of the final element is facilitated by the sentence structure, which allows a left-to-right buildup of semantic and syntactic context (Öztürk & Papafragou, 2008). This ability to integrate contextual information at several levels can assist compensate for poor bottom-up input in visually demanding settings, including when words are jumbled. Additionally, Turkish words are suitable for studying the relationship between word form and meaning because they are typically orthographically simple yet morphologically complex. Turkish retains a very regular, one-to-one correspondence between phonemes and graphemes in contrast to English, which frequently has irregular spellings (Oflazer, 1995). This makes it possible to accurately represent written words phonologically even when their visual form is altered. Native speakers may be therefore be able to activate lexical representations more quickly than readers of orthographically deep languages since jumbled Turkish words may be phonetically convincing. This interplay of simple orthography with complicated morphology presents a unique test case for models of interactive word processing.

## **CHAPTER 2**

### **METHODOLOGY**

This chapter describes the study's methodology, including the research design, participants, materials and procedures used to examine how contextual constraint and word frequency affect the recognition of jumbled words in Turkish. It provides justification for the experimental design, which includes the use of a within subject 2x2 design and a self-paced reading assignment.

#### **2.1. MATERIALS**

##### **2.1.1. Word Frequency Selection**

The Turkish National Corpus (TNC), a thorough and well-balanced corpus with over 50 million words spanning a variety of genres and registers of modern Turkish, provided the word frequencies used in this investigation (Aksan et al., 2012). The frequency count of each word was determined by counting how many times it appeared in the corpus. Based on a predetermined threshold frequency, words were divided into high-frequency and low-frequency groups. Low-frequency words are those that occur relatively infrequently, and high-frequency words are those that are often employed in ordinary speech. This categorization made it possible to investigate how word frequency affected the experiment's recognition procedures. In psycholinguistic research employing Turkish language stimuli, the use of TNC data is consistent with accepted procedures (Brysbaert & New, 2009; Aksan et al., 2009).

Table 2.1 Frequency Values of the Target Words Based on the Turkish National Corpus

|          |        |
|----------|--------|
| İnsan    | 46.733 |
| Çocuk    | 23.710 |
| Kadın    | 31.432 |
| Adam     | 24.873 |
| Para     | 22.492 |
| Dünya    | 30.661 |
| Havlu    | 320    |
| Saksı    | 278    |
| Karınca  | 574    |
| Tebeşir  | 126    |
| Mıknatıs | 170    |
| Çoban    | 1211   |

Note: Frequency values represent the number of occurrences per 50 million words, based on the Turkish National Corpus (Aksan et al., 2012).

Word frequencies were based on the TNC, with high-frequency words ranging from 20,000–50,000 and low-frequency words from 100–1,200 (Aksan et al., 2012).

The overall frequency distribution in the Turkish National Corpus (TNC; Aksan et al., 2012) was used to establish frequency cut-offs for high and low frequency categories. Since they were among the top 5–10% of the most frequently used terms, words with frequencies between 20,000 and 50,000 were deemed high-frequency. On the other hand, words that fell in the bottom 10% of the frequency distribution and had frequencies between 100 and 1,200 were categorized as low-frequency. Similar percentile-based techniques in frequency research (e.g., Brysbaert & New, 2009; Balota et al., 2007) are consistent with this methodology.

### **2.1.2. Open Bigram Model**

The Open Bigram Model is one of the most well-known explanations of orthographic processing in the early phases of visual word recognition (Grainger & van Heuven, 2003; Grainger & Whitney, 2004). The open bigram model suggests that letter pairs (bigrams), which can be neighboring or non-adjacent, serve as the main representational units, in contrast to models that presume exact positional coding of individual letters. The bigrams TA, AB, BL, LE would be activated, for example, by the word table. This method explains why people can accept some internal letter scrambling or letter transpositions without completely losing their capacity to recognize words. For instance, because so many of its bigrams have been preserved, readers can identify taeb1 as a table. Words with retained bigram overlap are recognized more quickly than those with disrupted bigrams, according to masked priming studies (Grainger & Whitney, 2004), which provide strong empirical support for the hypothesis.

In the present study, the open bigram framework was directly applied to the selection of jumbled word forms. For each target noun, several scrambled versions were generated by permuting internal letters, and their bigram profiles were compared with those of the original word. The scrambled form with the highest number of overlapping bigrams was selected as the final stimulus, ensuring consistency with the orthographic representations assumed by the open bigram model. All potential permutations with internal letter transpositions were created in order to identify the best jumbled form for each target

word (for example, for "insan," iasnn, iansn, isann, inasn, isnan).

The open bigrams of the original words (such as "in," "ns," "sa," and "an") were taken out and contrasted with the open bigrams of each scrambled version. The variant that kept the most of the original bigrams was chosen (for example, "iansn" kept "in" and "an"). One version was chosen at random if there were an equal number of overlapping bigrams in multiple versions.

So, the Open Bigram Model of visual word recognition (Grainger et al., 2006), which holds that letter pairs, not single letters, act as representational units in early orthographic processing, served as the foundation for this selection procedure. It should be noted that this method is consistent with the tenets of the SERIOL model (Whitney, 2001), which offers a neurological framework for the creation of bigram representations, even if the Open Bigram Model was mainly utilized to direct the selection of jumbled forms.

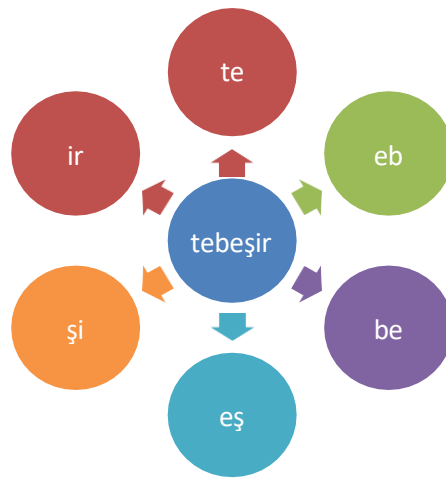


Figure 2.1 Bigrams of the Target Word "tebeşir"

In the Figure 2.1 above, open bigrams of the original word "tebeşir" is shown. The word is represented as a sequence of adjacent letter pairs: te, eb, be, eş, şi, ir.

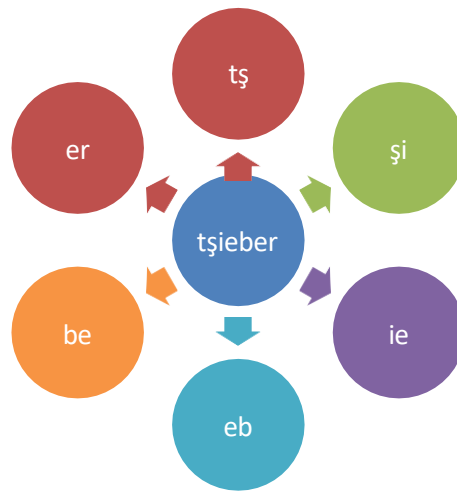


Figure 2.2 Bigrams of the Selected Jumbled Version of the Target Word “tebeşir”

In the Figure 2.2 above, open bigrams of the jumbled word "tşieber" is shown. Although the internal letters are scrambled, three bigrams ("şi", "eb" and "be") are preserved from the original word, which was not possible in other jumbled versions.

The original word "tebeşir" has the bigrams te, eb, be, eş, şi, ir, as shown in Figures 2.1 and 2.2, although its jumbled counterpart "tşieber" still contains şi, eb and be. Other jumbled "tebeşir" substitutes had fewer or no bigrams that overlapped. This selection method is based on the Open Bigram Model (Grainger & van Heuven, 2003), which holds that partial word identification is supported even in the presence of orthographic distortion and that letter pair representations are essential to early visual word recognition.

## **2.2. MATERIALS**

### **2.2.1. Sentence Completion Task for Context Determination**

A sentence completion task is created to identify the strong and weak contexts for high frequency and low frequency words in order to examine the impact of top-down and bottom-up word recognition models. Psycholinguistic research frequently uses sentence completion tasks to investigate contextual predictability and lexical access (McRae et al., 1998; Federmeier, 2007).

### **2.2.2. Participants**

40 native Turkish speakers participated in an initial study to assess the design of the self-paced reading task and the appropriateness of the experimental materials with undergraduate students aged 18 to 25 who had normal or corrected-to-normal eyesight and no known neurological or language problems made up the participants because prior research has demonstrated that educated adult populations offer trustworthy linguistic data for context-based lexical processing (Schwanenflugel & Shoben, 1985).

Participation in the study was entirely voluntary, and no financial or academic compensation was provided. These individuals did not participate in the primary experiment. All participants gave their informed consent, and their answers were utilized only to improve the experimental materials, such as context validation and target word selection.

### **2.2.3. Data Collection Procedure**

The task required participants to complete 24 sentence beginnings that were presented to them. Methods applied in previous research on sentence comprehension and word prediction are followed. Each phrase root was designed to intuitively foresee a missing word. (Kutas & Federmeier, 2011).

Participants were asked to provide three words (nouns) that immediately sprung to mind to complete each phrase. Lexical category constraints are essential for word recognition and prediction, so these words had to be nouns to maintain consistency in word class and prevent verbs or adjectives from influencing sentence structure (Rayner & Clifton, 2009).

#### **2.2.4. Data Analysis**

Strong and weak contexts were determined by analyzing the participant responses. According to previous research on the effects of contextual constraints, a strong context was determined as the one in which most participants used the same words, demonstrating a clear expectation for a particular lexical item (Staub, 2015). Conversely, a weak background produced a variety of reactions, indicating a less consistent lexical expectation, which has been demonstrated to slow word processing and recognition in ERP and eye-tracking studies (Duffy et al., 2001).

In the main jumbled word recognition experiment, the contexts in which high frequency and low frequency words would be tested were chosen based on the sentence completion task. As stressed in earlier studies on language processing, this approach made sure that context strength was empirically ascertained rather than assumed, enabling a more thorough investigation of the interplay between lexical frequency and contextual influence in word recognition (Levy, 2008).

The response counts and percentages for the target words in both weakly and strongly constraining contexts are shown in the following tables. Participants were expected to supply the target words more often in the strongly constraining context because the sentence structure strongly influenced their responses to these particular sentences.

The sentence stems were intended to direct participants toward a particular lexical item in the strongly constraining context. The findings show that for a large number of the target words, participants gave the expected answers. This pattern implies that lexical retrieval becomes more predictable and results in high response consistency among participants when context strongly supports a given word. The effectiveness of contextual constraints was demonstrated by the fact that response rates for both high frequency and

low frequency words varied, with some low frequency words still eliciting high agreement among participants.

Table 2.2. Response Counts and Percentages of Words in Strongly Constraining Context

| Word     | Frequency | Context | Response<br>Count | Response<br>Percentage (%) |
|----------|-----------|---------|-------------------|----------------------------|
| İnsan    | H         | SC      | 26                | 65.0                       |
| Zaman    | H         | SC      | 15                | 37.5                       |
| Çocuk    | H         | SC      | 38                | 95.0                       |
| Kadın    | H         | SC      | 30                | 75.0                       |
| Devlet   | H         | SC      | 10                | 25.0                       |
| Adam     | H         | SC      | 22                | 55.0                       |
| Para     | H         | SC      | 37                | 92.5                       |
| Dünya    | H         | SC      | 26                | 65.0                       |
| Macera   | L         | SC      | 2                 | 5.0                        |
| Vitamin  | L         | SC      | 13                | 32.5                       |
| Havlu    | L         | SC      | 30                | 75.0                       |
| Saksı    | L         | SC      | 23                | 57.5                       |
| Karınca  | L         | SC      | 35                | 87.5                       |
| Tebeşir  | L         | SC      | 33                | 82.5                       |
| Mıknatıs | L         | SC      | 29                | 72.5                       |
| Çoban    | L         | SC      | 29                | 72.5                       |

In the Table 2.2 given above, the “high frequency words” are labelled as “H”, while the “low frequency ones” are labelled as “L”. Also, the constraining contexts are labelled as “SC” that stands for “strongly constraining” and “WC” as weakly constraining.

Table 2.3 Response Counts and Percentages of Words in Weakly Constraining Context

| Word     | Frequency | Context | Response<br>Count | Response<br>Percentage (%) |
|----------|-----------|---------|-------------------|----------------------------|
| İnsan    | H         | WC      | 0                 | 0                          |
| Zaman    | H         | WC      | 3                 | 7.5                        |
| Çocuk    | H         | WC      | 0                 | 0                          |
| Kadın    | H         | WC      | 2                 | 5                          |
| Devlet   | H         | WC      | 0                 | 0                          |
| Adam     | H         | WC      | 0                 | 0                          |
| Para     | H         | WC      | 0                 | 0                          |
| Dünya    | H         | WC      | 1                 | 2.5                        |
| Macera   | L         | WC      | 0                 | 0                          |
| Vitamin  | L         | WC      | 0                 | 0                          |
| Havlu    | L         | WC      | 2                 | 5                          |
| Saksı    | L         | WC      | 0                 | 0                          |
| Karınca  | L         | WC      | 0                 | 0                          |
| Tebeşir  | L         | WC      | 0                 | 0                          |
| Mıknatıs | L         | WC      | 0                 | 0                          |
| Çoban    | L         | WC      | 0                 | 0                          |

In the Table 2.3 given above, the same labelling that are used for Table 2.2 for “high frequency words”, “low frequency words”, “strongly constraining” and “weakly constraining” contexts are also implemented.

### **2.2.5. Sentence Completion Task Findings**

Sentences that did not strongly lead to a single lexical choice were included in the weakly constraining context. According to the findings, some uncommon words like *havlu*, *karınca*, and *tebeşir* got a lot of answers, suggesting that the context successfully limited the participants' options. On the other hand, in the condition with weak constraints, participants were somewhat less inclined to produce the target words, because it was intended to provide less cues. Response rates for the target words were considerably lower in this condition, with *zaman*, *kadın*, *dünya*, and *havlu* occurring at low frequencies, only a small percentage of participants gave answers that matched the target words. These results support the idea that word retrieval is more predictable under strong contextual constraints and more varied under weak contextual constraints. This initial data gathering study's results are in line with previous research showing that word retrieval is more varied under weak contextual constraints and more predictable under strong ones. The idea that strong contextual constraints improve word predictability and weak constraints result in more varied lexical retrieval has been consistently supported by prior research. Research by Rayner and Well (1996) using eye-tracking methods demonstrated that words in highly constraining contexts are processed more easily, indicating facilitated lexical access. Similarly, DeLong, Urbach, and Kutas (2005) provided evidence that readers come up with strong expectations in predictive contexts. However, Altmann and Kamide (1999) discovered that eye movements in a visual-world paradigm indicate that weakly constraining contexts produce a wider variety of lexical predictions. Additionally, Lupker (1984) showed that when the context provides a weak constraint, word retrieval relies more on general semantic activation rather than specific lexical priming. This leads to response variability. Together, these studies support the notion that weak contextual constraints allow for a variety of options, enhancing response diversity, whereas strong contextual constraints direct lexical access toward particular expected words.

## **2.3. PILOT STUDY**

### **2.3.1. Participants**

Ten Turkish native speakers took part in the pilot study. Participants had no history of neurological or language-related problems and were undergraduate students between the ages of 19 and 25. Every participant's vision was either normal or corrected to normal.

Prior to the trial, each participant provided informed consent, and participation was entirely voluntary. Participants in the pilot study were not allowed to participate in the main investigation.

### **2.3.2. Data Collection Tool**

The PsychoPy program was used for the pilot study, which used a self-paced reading paradigm. Participants pressed the space bar at the end of each sentence to go through the stimuli, which were shown word by word. Each word's reaction time was noted, and each sentence was followed by a yes/no comprehension question to gauge processing accuracy. Sentence structures and resources were the same as those utilized in the main experiment.

### **2.3.3. Data Collection Procedure**

Prior to gathering data for the main study, the pilot was designed to assess how well the experimental design worked. The items of the pilot study were not randomized, in contrast to the main experiment. The same fixed item order was given to each participant: high-frequency strong-context items came first, then high-frequency weak-context items, low-frequency strong-context items, lastly low-frequency weak-context items. In order to monitor possible order effects and make sure the experimental structure functioned well, this blocked structure was purposefully implemented.

### **2.3.4. Data Analysis**

The analysis of reaction time data from the pilot study revealed a systematic order effect due to the fixed presentation sequence. In opposition to the theoretical expectations, participants' reading times were fastest for low frequency-weak context items displayed

at the end ( $M = 371.83$  ms) and slowest for high frequency-strong context items presented at the beginning ( $M = 761.5$  ms). With low frequency-strong context items average 457.27 ms and high-frequency weak-context items averaging 511.6 ms, the intermediate conditions displayed a similar downward trend. The absence of randomization, which introduced cumulative influences including weariness, task adaptation, and positional priming, is probably the cause of this reversal of expected results. These findings confirmed that in order to prevent order-dependent biases and guarantee that observed effects accurately represent variations across experimental conditions, item order in the main experimental design must be randomly assigned.

## **2.4. MAIN STUDY**

### **2.4.1. Participants**

A total of 36 native speakers of Turkish participated in the experiment. Participants were undergraduate students at Hacettepe University between the ages of 18 and 25. All had normal or corrected-to-normal vision and reported no history of neurological or language-related disorders. The participants had no prior knowledge of the purpose of the study. There was no academic or financial compensation for taking part in the study; participation was completely voluntary., and informed consent was obtained from all individuals in accordance with institutional ethical standards. The participants spoke Turkish as their first language and individuals whose first language was not Turkish were excluded from the study to ensure linguistic consistency. To further prevent acquaintance influences with the materials, participants who had earlier taken part in the preliminary data collection study that was done to develop the experimental stimuli were excluded from the main experiment.

### **2.4.2. Materials for the Main Study**

Twelve target nouns, evenly split between high and low frequency categories, were chosen for the experiment based on how frequently they appeared in the Turkish National Corpus (TNC). The high frequency items were all disyllabic and morphologically simple words: *insan*, *çocuk*, *kadın*, *adam*, *para* and *dünya*. Two of these six words are inanimate

(*para, dünya*), while the other four items are animate (*insan, çocuk, kadın* and *adam*).

*Havlu, saksı, karınca, tebeşir, mıknaş* and *çoban* were the low frequency words. With three trisyllabic (*karınca, tebeşir, mıknaş*) and three disyllabic (*havlu, saksı, çoban*) words, these were likewise morphologically simple. Four of the low frequency items were inanimate (*havlu, saksı, tebeşir, mıknaş*), whereas two are animate (*karınca, çoban*). All words were selected to be morphologically simple, avoiding attached or compound forms, even if there was no rigorous control over syllabic structure or semantic animacy. Since prior studies have demonstrated that morphological boundaries influence how jumbled words are read, morphological consistency was controlled in the present study (Christianson, Johnson, & Rayner, 2005). Potential confounds resulting from morphological complexity were reduced by making sure that all target objects were monomorphemic nouns. Furthermore, Rayner et al. (2006) stressed that only content words were employed as targets in their work on scrambled word reading, supporting the notion that recognition is influenced by lexical category and semantic weight.

This suggests that the study purposefully restricted its stimuli to content terms like nouns. This methodological decision supports a focus on frequency and contextual constraint as the main factors and minimizes heterogeneity in grammatical function by limiting lexical items of the study to nouns. Accordingly, the experimental word lists are consistent in morphological structure and lexical category, which prior research indicates is crucial in studies of visual word recognition involving transposed letters, even though they do not fully exhibit uniformity in phonological or semantic features (Rayner et al., 2006; Christianson et al., 2005). All of the target words were morphologically simple, which provided consistency on that level, even though there was not complete consistency between items in terms of syllable structure or semantic aspects. Rayner et al. (2006), who stress the value of employing content words and managing morphological complexity in jumbled word studies, support this design decision. They observe that reading times and understanding are influenced by morphological boundaries (Christianson, Johnson, & Rayner, 2005). Despite including examples of verbs, nouns, and modals in their stimuli, Rayner et al. make it clear that not all of these kinds were examined, suggesting that rigorous lexical category control might not be necessary for examining the overall impact of letter transposition on content word identification.

Morphological uniformity was the primary control criterion in the present study, despite some differences in syllable count (all high-frequency items were disyllabic, whereas low-frequency items included both disyllabic and trisyllabic words) and animacy (four animate and two inanimate nouns were included in high-frequency items).

The idea that morphological structure can play a more important role in word identification tasks than syllabic structure in languages with complex morphology, such as Turkish, provided support for the above-mentioned design (Rayner et al., 2006).

Target words also had different syntactic roles in different sentences; depending on the sentence structure, they could be subjects, objects, or predicate nominals (e.g., “*Parkta oyun oynayan çocuk birden kaybolunca herkes aramaya başladı*” – subject; “*Geçen gün gelen işçi patates çuvallarını çocuk taşıır gibi taşıdı*” – object). In order to maintain the phrases' naturalness and semantic plausibility, this variety was required. Complete homogeneity in grammatical function and syntactic position might have caused oddness in meaning of the sentences restraining a natural interpretation. Thus, the current study used a context-sensitive strategy, which is consistent with earlier research that has given ecological validity precedence over total structural uniformity (Rayner et al., 2006; Staub, 2015).

Furthermore, as the main goal of the experiment was to analyze lexical access rather than grammatical processing, the grammatical positions were not regarded as a confounding element. Previous studies show that readers can recognize jumbled words in a variety of syntactic contexts, particularly when semantic and contextual clues are strong (Luke & Christianson, 2016). The ecological validity and cross-language generalizability of the findings are thus enhanced by this design decision, which strikes a balance between experimental control and linguistic realism (Ziegler & Goswami, 2005).

### **2.4.3. Data Collection Tool**

PsychoPy, an open-source program frequently used in cognitive and psychological research, was utilized to build the experiment. Participants' word- by-word reading times were measured using a self-paced reading paradigm. During every trial, subjects read

sentences word by word. They had to hit the spacebar to reveal the following word. Every word's reaction time was measured in milliseconds.

A question, which can be answered as either 'yes' or 'no' followed each experimental sentence pertaining to the content of the sentence to ensure that participants were aware of the content of the sentences (see Appendix 5 for the complete set). In order to answer these questions, participants pressed the "E" key for "yes" and the "H" key for "no". This stage allowed for comprehension monitoring without interfering with the experiment's progress.

To prevent participants from becoming aware of the experimental manipulation, each comprehension question was followed by a filler sentence with a similar syntactic structure (i.e., active voice, simple sentence). These filler sentences helped maintain a balance in the experiment and minimized potential strategic reading behavior.

In total, the experiment consisted of 24 experimental sentences, each of which was followed by a comprehension question and a filler sentence, resulting in 72 trials per participant. All stimuli were displayed on a standard laptop computer with keyboard, in a quiet testing environment. The data were collected automatically by PsychoPy and exported in .csv format for further analysis.

#### **2.4.4. Data Collection Procedure**

Before the experiment began, each participant received a personal greeting before being seated in a quiet room facing a laptop computer. They were informed that word by word reading of sentences was their task, they needed to press spacebar to continue to the next word and answer yes/no questions on the keyboard by pressing "e" or "h". Participants were given both verbal and written instructions and they were told to go at their own speed while reading each word. Three practice trials were initially given to the participants so they could become acquainted with the task. The analysis did not contain these practice questions. When the main experiment started, a yes/no question and a filler sentence were presented after each of the 24 experimental trials.

A self-paced reading paradigm was used to present a sentence word by word in each trial. The screen showed a comprehension question just after the presentation of the experimental sentence. In response, participants pressed “e” for “yes” or “h” for “no”. To lessen predictability and keep readers interested, a filler sentence appeared just after the response. A target sentence, a yes/no sentence and a filler sentence made up each combination of sets.

Every participant received these sets at random, which helps account for any potential biases or order effects. Each participant experienced a distinct sentence sequence thanks to the randomization of the order. Since participants are not exposed to the same phrase structure in an order that has been set, this also improves the data’ generalization.

With instructions and short breaks if needed, the entire procedure lasted 5 to 10 minutes. At the end of the procedure, participants received a summary of the event and were thanked for attending.

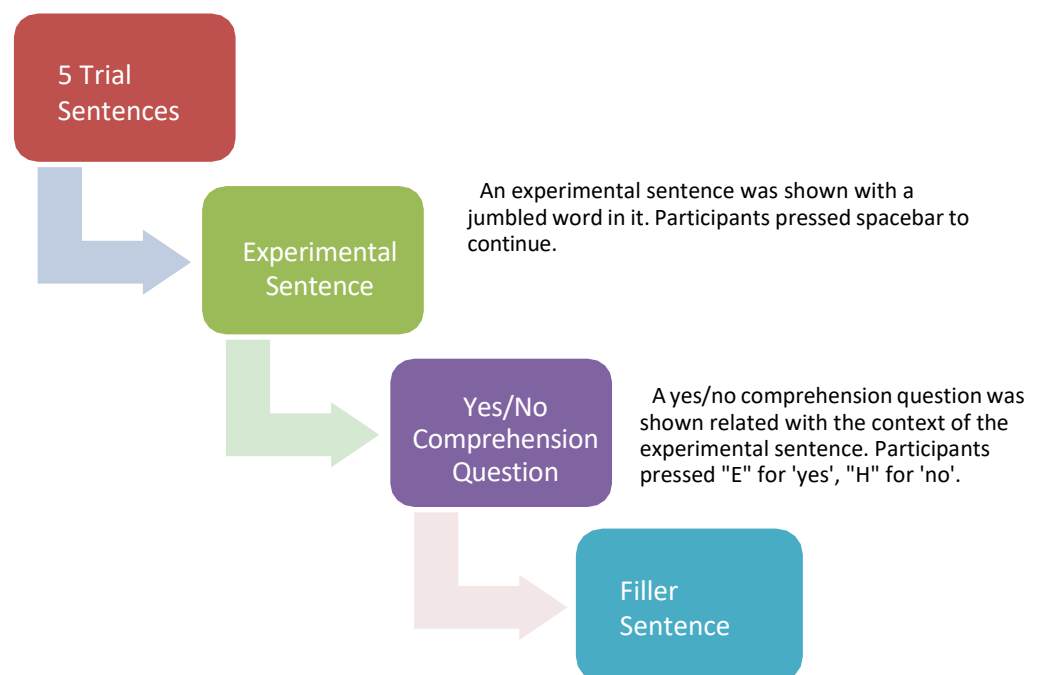


Figure 2.3 Timeline of a Single Trial in the PsychoPy experiment

### 2.4.5. Data Analysis

With the influence of top-down and bottom-up processing models taken into account, the data analysis for this study settled on analyzing participants' response times to evaluate their ability to recognize jumbled words. Participants completed word recognition tasks, a widely used method in psycholinguistics to assess lexical access and cognitive processing speed (Rayner, 1998; Balota, Yap, Cortese, & Watson, 2008), which resulted in the collection of raw data. These variables were noted for every trial;

- Reaction time (RT): The duration that a participant takes between the presentation of the word (or a jumbled version of it) and the received response.
- Word Frequency: The frequency of the word in the language corpus.
- Context Type: If the word was presented in a strong or weak context.
- Word Type: Whether the word was a target, yes/no, or filler word.

Only legitimate responses were included in the study after the data was filtered to guarantee that there were no missing values. Responses that are less than 100 ms. or more than 3000 ms. are not included, aligning with standard reaction time cutting procedures (Ulrich & Miller, 1994).

Based on the experimental settings, the mean response time for each participant in four different categories was identified as part of the data analysis. Each participant's mean reaction time was then calculated independently for each of these groups. This step was essential since it made it possible to conduct how participants performed under diverse experimental settings;

- 1- High frequency word in a context, which is strongly constraining
- 2- High frequency word in a context, which is weakly constraining
- 3- Low frequency word in a context, which is strongly constraining
- 4- Low frequency word in a context, which is weakly constraining

After calculating the average reaction time for each participant in each category, the average reaction time for each of the four categories was determined for every participant. This made it possible to compare reaction speeds across categories in detail.

The study shed light on how experimental modifications impacted participants' response times by calculating the mean of the individual participant averages for each category.

An overall picture of how participants reacted under various experimental situations was provided by the mean reaction times for each of the four categories.

## CHAPTER 3

### FINDINGS AND DISCUSSION

Several important results about the impact of word frequency and context on participants' performance were drawn from the reaction times. Each participant's average reaction time was determined for each of the four experimental categories, which included two context levels (strong & weak) and two word frequency levels (high & low). This methodology made it possible to systematically examine the ways in which contextual support and lexical frequency affect how visually impaired, jumbled, words are processed. The study sought to determine if contextual cues are required to promote accurate lexical access, particularly when words are given in jumbled form, or whether frequency alone is adequate for speedy recognition by analyzing reaction times across the four categories. An extensive examination of the interplay between top-down and bottom-up processes during word recognition was made possible by the association of these two variables.

The results of the self-paced reading experiment are presented in this chapter along with a thorough analysis of the data in light of the theoretical framework and research goals. Descriptive statistics and inferential analyses such as understanding accuracy and reaction times across four experimental conditions are presented first.

After analyzing the individual and combined effects of word frequency and contextual constraint, the present chapter interprets the statistical results in the perspective of interactive word recognition models. To further highlight the subtle patterns seen in the data, item-level observations are also included. The possible implications of the findings and their connection to earlier cross-linguistic studies are also examined.

The raw data from the self-paced reading experiment, including comprehension accuracy rates and individual reaction times, will be thoroughly given in Section 3.1.

A comparison of these findings under the four experimental settings, with an emphasis on the impact of contextual constraint and lexical frequency, will be provided in Section

### 3.1. FINDINGS

In the present section, the raw data belonging to four different conditions gathered out of a self-paced reading experiment will be presented.

#### 3.1.1. Findings of Condition 1 – High Frequency Words in Strongly Constraining Context

Below are the words used in the High Frequency Words in Strongly Constraining Context condition. This section looks at each word separately in terms of recognition accuracy and reaction times. Each of the six words is investigated in its own subsection. The main focus is on whether the observed facilitative effect is consistent across all items. Since both the variables frequency and context constraint are high, it is anticipated that lexical access will be facilitated, leading to quicker and more accurate recognition of jumbled forms.

##### 3.1.1.1. İnsan

“İnsan” is the first word examined in this category. Its contextual sentence, mean RT, comprehension question and its accuracy rate is given below in Table 3.1 As can be seen from Table 3.1, its mean response time is 453,47 ms, suggesting rather quick comprehension. Additionally, this item’s comprehension question answers were flawless; all participants correctly answered the yes/no comprehension question, resulting in a 100% accuracy rating.

Table 3.1 Reaction Time and Comprehension Accuracy for the Word "insan" in a Strongly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Strong)</b>                                     | <b>Mean RT<br/>(ms)</b> | <b>Accuracy (%)</b> |
|----------------------------|--|-------------------------|---------------------|
| <b>İnsan (“iansn”)</b>     | Karmaşık bir düşünce sistemine sahip olan iansn, gelişmiş bir varlıktır. | 453,47                  | 100                 |

### 3.1.1.2. Çocuk

In this condition, “çocuk” is the second word analyzed. This high-frequency word’s jumbled form was recognized in an average reaction time of 402.72 ms, suggesting a quick and effective identification process. Additionally, participants showed error-free comprehension, answering the yes-no question with 100% accuracy.

Table 3.2 Reaction Time and Comprehension Accuracy for the Word "çocuk" in a Strongly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Strong)</b>                                      | <b>Mean RT (ms.)</b> | <b>Accuracy (%)</b> |
|----------------------------|---|----------------------|---------------------|
| <b>Çocuk<br/>(“çouck”)</b> | Parkta oyun oynayan çouck<br>birden kaybolunca herkes<br>aramaya başladı. | 402,72               | 100                 |

### 3.1.1.3. Kadın

“Kadın” is the third word examined in this case. Participants’ average reaction time of 423.61 ms. allowed them to identify the jumbled form of this high- frequency word, demonstrating effective processing when there is strong contextual support. 35 out of 36 participants correctly answered the comprehension question, yielding a 97.22% accuracy rate.

Table 3.3 Reaction Time and Comprehension Accuracy for the Word "kadın" in a Strongly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Strong)</b>                        | <b>Mean RT<br/>(ms.)</b> | <b>Accuracy<br/>(%)</b> |
|----------------------------|---|--------------------------|-------------------------|
| <b>Kadın<br/>(“kdam”)</b>  | Toplumda erkek kadar<br>kdam da üretim içinde<br>olmalıdır. | 423,61                   | 92,22                   |

#### 3.1.1.4. Adam

“Adam” is the fourth word under the high frequency-strong condition. This word’s rapid recognition was demonstrated by its average reaction time of 413.52 ms, which was probably bolstered by both contextual predictability and frequency. All of the participants properly answered the comprehension question, which required a “no” response, resulting in a 100% accuracy rate.

Table 3.4 Reaction Time and Comprehension Accuracy for the Word "adam" in a Strongly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Strong)</b>                | <b>Mean RT (ms.)</b> | <b>Accuracy<br/>(%)</b> |
|----------------------------|---|----------------------|-------------------------|
| <b>Adam<br/>(“aadm”)</b>   | Karşıdan karşıya bir kadınla<br>bir aadm geçiyordu. | 413,52               | 100                     |

#### 3.1.1.5. Para

Using “para” as the fifth target word in this condition, participants processed the jumbled version of this word with an average reaction time of 432.55 ms, indicating fluent lexical access. All participants correctly supplied the correct answer, yielding a 100% accuracy rate.

Table 3.5 Reaction Time and Comprehension Accuracy for the Word "para" in a Strongly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Strong)</b>                  | <b>Mean RT (ms.)</b> | <b>Accuracy<br/>(%)</b> |
|----------------------------|---|----------------------|-------------------------|
| <b>Para<br/>(“praa”)</b>   | Banka hesabımda biriken<br>praa ile tatile gideceğim. | 432,55               | 100                     |

### 3.1.1.6. Dünya

“Dünya” is the last word in the high frequency-strong condition. With an average reaction time of 385.75 ms, this word processed the fastest out of the six items. All participants successfully responded to the corresponding comprehension question, yielding a 100% accuracy rate.

Table 3.6 Reaction Time and Comprehension Accuracy for the Word "dünya" in a Strongly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Strong)</b>                    | <b>Mean RT<br/>(ms.)</b> | <b>Accuracy<br/>(%)</b> |
|----------------------------|---|--------------------------|-------------------------|
| <b>Dünya<br/>("dnüya")</b> | Diğer gezegenlere kıyasla<br>dnüya en özel<br>olanıdır. | 385,75                   | 100                     |

The overall results of the high frequency-strong condition showed that jumbled words were processed accurately and efficiently. The average reaction time of this category is 418.61 ms. This result combines high word frequency and strong contextual context with great contextual predictability.

With five items attaining 100% comprehension accuracy and with one item falling just short at 97.22%, the accuracy rates for all six items in this condition were also exceptionally high. Table 3.7, which is given below, shows the summary of the high frequency words used in this category along with their mean RTs and accuracy rates, resulting with the overall mean of this condition.

Table 3.7 Reaction Times and Comprehension Accuracy for Words in the High Frequency– Strong Context Condition

| <b>Word</b>  | <b>Mean RT (ms.)</b> | <b>Accuracy</b> |
|--------------|----------------------|-----------------|
| <b>İnsan</b> | 453,47               | 100             |

|                     |               |       |
|---------------------|---------------|-------|
| <b>Çocuk</b>        | 402,72        | 100   |
| <b>Kadın</b>        | 423,61        | 97,22 |
| <b>Adam</b>         | 413,52        | 100   |
| <b>Para</b>         | 432,55        | 100   |
| <b>Dünya</b>        | 385,75        | 100   |
| <b>OVERALL MEAN</b> | <b>418,61</b> | -     |

### **3.1.2. Findings of Condition 2 – High Frequency Words in Weakly Constraining Context**

Below are the words examined in the high frequency-weak context condition. Each word's recognition speed and comprehension accuracy are evaluated separately in this section. The words were presented in weakly constraining contexts with little or no predictive indicators, despite their high frequency. The goal of this configuration is to separate the frequency effect when there is no significant contextual support.

Finding out if high-frequency words by themselves, without the support of a strong sentence structure, are adequate to make jumbled forms easier to recognize is the aim of this investigation. The accuracy rates and reaction times for each of the six items will demonstrate the strength of word familiarity in situations where prediction is not substantially influenced by contextual information.

### 3.1.2.1. İnsan

The high frequency-weak context condition again starts with the word “insan”. In this instance, despite the word’s high frequency, it was used in phrase with a weak context. This item had an average reaction time of 555.52 ms, All participants gave accurate answers to the yes-no question, yielding 100% accuracy rate.

Table 3.8 Reaction Time and Comprehension Accuracy for the Word "insan" in a Weakly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Weak)</b>         | <b>Mean RT (ms.)</b> | <b>Accuracy (%)</b> |
|----------------------------|--|----------------------|---------------------|
| <b>İnsan<br/>("iansn")</b> | Hayatta en sevdiğim şey<br>iansn tanımdır. | 555,52               | 100                 |

### 3.1.2.2. Çocuk

“Çocuk”, the second word in this category, was used in a sentence with few contextual cues. The average reaction time for participants to identify the jumbled form of this high-frequency term was 614.52 ms. 35 out of 36 participants correctly answered the comprehension question for this item, resulting in an accuracy rate of 97.22%.

Table 3.9 Reaction Time and Comprehension Accuracy for the Word "çocuk" in a Weakly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Weak)</b>                                      | <b>Mean RT (ms.)</b> | <b>Accuracy (%)</b> |
|----------------------------|---|----------------------|---------------------|
| <b>Çocuk<br/>("çouck")</b> | Geçen gün gelen işçi<br>patates çuvallarını<br>çouck taşır gibi taşıdı. | 614,52               | 97,22               |

### 3.1.2.3. Kadın

“Kadın” is the third word examined in the high frequency-weak context condition. An average reaction time of 594.55 ms. was obtained despite the high frequency of the word due to the absence of significant contextual cues. One participant provided an incorrect response to the comprehension question to this statement, yielding a 97.22% accuracy percentage.

Table 3.10 Reaction Time and Comprehension Accuracy for the Word "kadın" in a Weakly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Weak)</b>                                   | <b>Mean RT<br/>(ms.)</b> | <b>Accuracy (%)</b> |
|----------------------------|--|--------------------------|---------------------|
| <b>Kadın<br/>("kdam")</b>  | Alışveriş merkezinde<br>gördüğüm kdam güzel bir<br>elbise giyiyordu. | 594,55                   | 97,22               |

### 3.1.2.4. Adam

“Adam” is the fourth target word in this condition. Despite being a high- frequency word, participants’ average reaction time was 570.97 ms. The comprehension question for this word resulted in 97.22%.

Table 3.11 Reaction Time and Comprehension Accuracy for the Word "adam" in a Weakly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Weak)</b>               | <b>Mean RT (ms.)</b> | <b>Accuracy (%)</b> |
|----------------------------|--|----------------------|---------------------|
| <b>Adam<br/>("aadm")</b>   | Yıllardır görmediği adm<br>birden karşısındaydı. | 570,97               | 97,22               |

### 3.1.2.5. Para

“Para” is the fifth word examined in this condition. With an average reaction time of 571.77 ms, participants were able to identify the jumbled form of this high- frequency word. The accuracy percentage was 97.22% since one participant gave the wrong answer to the related question.

Table 3.12 Reaction Time and Comprehension Accuracy for the Word "para" in a Weakly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Weak)</b>                             | <b>Mean RT<br/>(ms.)</b> | <b>Accuracy<br/>(%)</b> |
|----------------------------|--|--------------------------|-------------------------|
| <b>Para<br/>(“praa”)</b>   | Kış spor merkezi olarak praa kazandıran bir işletmeye sahibiz. | 571,77                   | 97,22                   |

### 3.1.2.6. Dünya

In the high frequency-weak context condition, “dünya” is the last word, with an average reaction time of 642.88 ms, this item had the highest average in the category. The percentage of this word’s comprehension question is 97.22% since one participant gave an incorrect answer.

Table 3.13 Reaction Time and Comprehension Accuracy for the Word "dünya" in a Weakly Constraining Context

| <b>Word<br/>(High Fr.)</b> | <b>Context Sentence<br/>(Weak)</b>                    | <b>Mean RT (ms.)</b> | <b>Accuracy<br/>(%)</b> |
|----------------------------|---|----------------------|-------------------------|
| <b>Dünya<br/>(“dnüya”)</b> | O firmalar hepimizin üzerinden dnüya kadar kazanıyor. | 642,88               | 97,22                   |

The accuracy rates of comprehension questions and mean reaction times for each of the six target items that were presented in the high frequency word in weak condition are shown in Table 3.14. It displays the mean processing time of each jumbled word and the

accuracy of the participants' responses to the associated comprehension question. A broad picture of performance across items in this context is given by the overall mean reaction time for the entire condition, which is likewise shown at the bottom of the table.

Table 3.14 Reaction Times and Comprehension Accuracy for Words in the High Frequency–Weak Context Condition

| <b>Word</b>         | <b>Mean RT (ms.)</b> | <b>Accuracy (%)</b> |
|---------------------|----------------------|---------------------|
| <b>İnsan</b>        | 555,52               | 100                 |
| <b>Çocuk</b>        | 614,52               | 97,22               |
| <b>Kadın</b>        | 594,55               | 97,22               |
| <b>Adam</b>         | 570,97               | 97,22               |
| <b>Para</b>         | 571,77               | 97,22               |
| <b>Dünya</b>        | 642,88               | 97,22               |
| <b>OVERALL MEAN</b> | <b>579,59</b>        | -                   |

### **3.1.3. Findings of Condition 3 – Low Frequency Words in Strongly Constraining Context**

The words examined in the low frequency-strong context condition are listed below. Each word is assessed in this category based on how well participants were able to identify its jumbled form when it was used in a sentence context that was supportive. Despite words in this condition being uncommon and less familiar to readers, the sentences in which the words appeared were intended to provide strong syntactic and

semantic constraints. This configuration makes it possible to investigate how contextual predictability, related with top-down processing, might make it easier to recognize uncommon words. This section attempts to analyze whether a strong context can make up for the processing difficulty usually associated with low frequency words by examining the comprehension accuracy and reaction times for each word.

### 3.1.3.1. Havlu

“Havlu” is the first word looked at in the low frequency-strong context condition. Despite being a low-frequency term, it was used in a sentence that contained powerful contextual clues, which probably helped with lexical access. With an average reaction time of 526.83 ms, participants were able to identify its jumbled form, which is comparatively quick for a term with a lower frequency level. This item’s accuracy percentage was 97.22% with one of the participants providing a false response to the comprehension question.

Table 3.15 Reaction Time and Comprehension Accuracy for the Word “havlu” in a Strongly Constraining Context

| <b>Word<br/>(Low Fr.)</b>   | <b>Context Sentence<br/>(Strong)</b>                            | <b>Mean RT<br/>(ms.)</b> | <b>Accuracy<br/>(%)</b> |
|-----------------------------|---|--------------------------|-------------------------|
| <b>Havlu<br/> (“hlavu”)</b> | Havuzdan çıktıktan sonra<br>hemen bir hlavu alıp<br>kurulandım. | 526,83                   | 97,22                   |

### 3.1.3.2. Saksı

“Saksı” the second word in this category, was used in a sentence that was intended to offer strong semantic support. With an average reaction time of 528.31 ms. participants were able to identify the word’s jumbled form despite its low frequency. The accuracy rate was 97.22% with one participant providing an erroneous response to the comprehension question.

Table 3.16 Reaction Time and Comprehension Accuracy for the Word "saksı" in a Strongly Constraining Context

| <b>Word<br/>(Low Fr.)</b> | <b>Context Sentence<br/>(Strong)</b>                         | <b>Mean RT (ms.)</b> | <b>Accuracy (%)</b> |
|---------------------------|--|----------------------|---------------------|
| <b>Saksı ("skası")</b>    | Yeni aldığım çiçekleri penceredeki skası içine yerleştirdim. | 528,31               | 97,22               |

### 3.1.3.3. Karınca

"Karınca" is the third word used in this context. Despite being a low-frequency word, it seems that efficient recognition was made possible by its placement in a phrase that is highly supportive. The average reaction time for this word was 525.83 ms. Every participant provided a valid response to the comprehension question, resulting in 100% accuracy rate.

Table 3.17 Reaction Time and Comprehension Accuracy for the Word "karınca" in a Strongly Constraining Context

| <b>Word<br/>(Low Fr.)</b>      | <b>Context Sentence<br/>(Strong)</b>                      | <b>Mean RT<br/>(ms.)</b> | <b>Accuracy (%)</b> |
|--------------------------------|---|--------------------------|---------------------|
| <b>Karınca<br/>(“kaincra”)</b> | Yere düşen kırıntıları taşıyan bir kaincra sürüsü gördük. | 525,83                   | 100                 |

### 3.1.3.4. Tebeşir

"Tebeşir" is the fourth word analyzed in this condition. It was recognized with an average reaction time of 523.44 ms, indicating that processing of the word was greatly aided by the strongly constraining context. There were no wrong answers; all participants successfully answered the related comprehension question.

Table 3.18 Reaction Time and Comprehension Accuracy for the Word "tebeşir" in a Strongly Constraining Context

| <b>Word<br/>(Low Fr.)</b>      | <b>Context Sentence<br/>(Strong)</b>        | <b>Mean RT<br/>(ms.)</b> | <b>Accuracy (%)</b> |
|--------------------------------|---|--------------------------|---------------------|
| <b>Tebeşir<br/>("tşieber")</b> | Karatahtada silgi ve<br>tşieber kullanılır. | 523,44                   | 100                 |

### 3.1.3.5. Mıknatıs

"Mıknatıs" is the fifth target word in this condition. Participants sorted its jumbled forms with an average reaction time of 543.91 ms, despite the fact that it is rarely used in common Turkish. The accuracy rate was 100% since every participant answered the comprehension question accurately.

Table 3.19 Reaction Time and Comprehension Accuracy for the Word "mıknatıs" in a Strongly Constraining Context

| <b>Word<br/>(Low Fr.)</b>        | <b>Context Sentence<br/>(Strong)</b>                                 | <b>Mean RT<br/>(ms.)</b> | <b>Accuracy<br/>(%)</b> |
|----------------------------------|--|--------------------------|-------------------------|
| <b>Mıknatıs<br/>("mntıkais")</b> | Zıt kutuplar taşıyan<br>mntıkais parçaları<br>birbirini hızla çekti. | 543,91                   | 100                     |

### 3.1.3.6. Çoban

In the low frequency-strong context condition, "çoban" is the last word. With an average reaction time of 535.08 ms, the word was processed reasonably effectively despite its low frequency. The accuracy rate was 97.22% with one person answering the comprehension question wrong.

Table 3.20 Reaction Time and Comprehension Accuracy for the Word "çoban" in a Strongly Constraining Context

| <b>Word<br/>(Low Fr.)</b>  | <b>Context Sentence<br/>(Strong)</b>            | <b>Mean RT<br/>(ms.)</b> | <b>Accuracy<br/>(%)</b> |
|----------------------------|---|--------------------------|-------------------------|
| <b>Çoban<br/>(“çbaon”)</b> | Sürüyü otlatması için yeni bir çbaon gerekiyor. | 535,08                   | 97,22                   |

According to the findings of the low frequency-strong condition, its average reaction time was 530.36 ms. In this condition, comprehension accuracy rate was generally high. Two of the six items had one wrong answer each, resulting in accuracy rates of 97.22%, while four of the items achieved perfect scores (100%). Below, Table 3.21 demonstrates the summary of each word's mean reaction time as well as the overall reaction time of this category.

Table 3.21 Reaction Times and Comprehension Accuracy for Words in the Low Frequency- Strong Context Condition

| <b>Word</b>         | <b>Mean RT (ms.)</b> | <b>Accuracy (%)</b> |
|---------------------|----------------------|---------------------|
| <b>Havlu</b>        | 526,83               | 97,22               |
| <b>Saksı</b>        | 528,31               | 97,22               |
| <b>Karınca</b>      | 525,83               | 100                 |
| <b>Tebeşir</b>      | 523,44               | 100                 |
| <b>Mıknatıs</b>     | 543,91               | 100                 |
| <b>Çoban</b>        | 535,08               | 97,22               |
| <b>OVERALL MEAN</b> | <b>530,56</b>        | -                   |

### 3.1.4. Findings of Condition 4 – Low Frequency Words in Weakly Constraining Context

Below are the words analyzed in the low frequency words in weak context condition. Words that are introduced in sentence settings with weak constraints and low frequency fall into this category.

It is anticipated that this condition will present the biggest cognitive strain for participants during jumbled word recognition because of the lack of contextual predictability and the unfamiliarity of the lexical items.

This section attempts to evaluate participants' ability to recognize and understand unknown jumbled words when they are given both frequency-based familiarity and sentence level help by measuring their reaction times and understanding accuracy for each of the six words. The results of this condition provide a crucial point of reference for comprehending the boundaries of bottom-up and top-down recognition models.

#### 3.1.4.1. Havlu

“Havlu” is the first word inspected in the low frequency words in weak context condition. Due to its low frequency and placement in a sentence with no strong context, this word seems to be a significant challenge for the participants. The average reaction time for identifying its jumbled form was 790.33 ms, The accuracy rate was 97.22%, with one person answering the comprehension question inaccurately.

Table 3.22 Reaction Time and Comprehension Accuracy for the Word "havlu" in a Weakly Constraining Context

| <b>Word<br/>(Low Fr.)</b>  | <b>Context Sentence<br/>(Weak)</b>                                   | <b>Mean RT (ms.)</b> | <b>Accuracy<br/>(%)</b> |
|----------------------------|--|----------------------|-------------------------|
| <b>Havlu<br/>(“hlavu”)</b> | Telefonun sesiyle yataktan fırladığında üzerindeki hlavu yere düştü. | 790,33               | 97,22                   |

#### 3.1.4.2. Saksı

“Saksı”, the second word in this category, was used in a sentence with little to no contextual support. With an average reaction time 871.36 ms, participants processed its jumbled form, leading it to being one of the slowest recognized items.

Low frequency of the word and the lack of strong contextual clues probably made comprehending more challenging. The accuracy rate for the comprehension question was 94.44%, as two participants provided wrong answers.

Table 3.23 Reaction Time and Comprehension Accuracy for the Word "saksı" in a Weakly Constraining Context

| <b>Word<br/>(Low Fr.)</b> | <b>Context Sentence<br/>(Weak)</b>   | <b>Mean RT (ms.)</b> | <b>Accuracy<br/>(%)</b> |
|---------------------------|--|----------------------|-------------------------|
| <b>Saksı (“skası”)</b>    | Ürünümüz sızdırmayı önleyen<br>skası biçimindeki bir<br>malzemeyle kaplanmıştır. | 871,36               | 94,44                   |

#### 3.1.4.3. Saksı

“Karıncı” is the third word examined in this condition. This word was also one of the more slowly identified items in the low frequency words in weak category, with an average reaction time of 843.97 ms.. Additionally, three participants gave the comprehension question the wrong answer, giving in the lowest accuracy rate in this category to date, 91.67%.

Table 3.24 Reaction Time and Comprehension Accuracy for the Word "karınca" in a Weakly Constraining Context

| <b>Word<br/>(Low Fr.)</b>     | <b>Context Sentence<br/>(Weak)</b>              | <b>Mean RT<br/>(ms.)</b> | <b>Accuracy (%)</b> |
|-------------------------------|---|--------------------------|---------------------|
| <b>Karıncı<br/>("kancra")</b> | Onun yanında insanlar<br>kancra gibi kalıyordu. | 843,97                   | 91,67               |

#### 3.1.4.4. Tebeşir

"Tebeşir" is the fourth word in the low frequency words in weak context condition. Overall understanding performance was strong even though processing had an average reaction time of 851.47 ms, The accuracy rate for the comprehension question was 97.22%, with only one participant providing an erroneous response.

Table 3.25 Reaction Time and Comprehension Accuracy for the Word "tebeşir" in a Weakly Constraining Context

| <b>Word<br/>(Low Fr.)</b>      | <b>Context Sentence<br/>(Weak)</b>                | <b>Mean RT (ms.)</b> | <b>Accuracy<br/>(%)</b> |
|--------------------------------|---|----------------------|-------------------------|
| <b>Tebeşir<br/>("tşieber")</b> | Gülerek arkadaşının kafasına<br>tşieber fırlattı. | 851,47               | 97,22                   |

#### 3.1.4.5. Mıknatıs

With an average reaction time of 1051.75 ms, the last word in the low frequency words in weak context condition, "mıknatıs" had the slowest reaction time of any category. The accuracy rate was 94.44%, with two individuals providing false answers to the comprehension question.

Table 3.26 Reaction Time and Comprehension Accuracy for the Word "mıknatıs" in a Weakly Constraining Context

| <b>Word<br/>(Low Fr.)</b>        | <b>Context Sentence<br/>(Weak)</b>                           | <b>Mean RT (ms.)</b> | <b>Accuracy (%)</b> |
|----------------------------------|--|----------------------|---------------------|
| <b>Mıknatıs<br/>("mıknatıs")</b> | Mutluluk ve olumlu enerji<br>mıknatıs etkisi<br>yapmaktadır. | 1051,75              | 94,44               |

#### 3.1.4.6. Çoban

"Çoban" is the last word considered in this condition. Its average reaction time is 818.66 ms. by the participants. The accuracy rate for the comprehension question was 94.44%, with two people giving false answers.

Table 3.27 Reaction Time and Comprehension Accuracy for the Word "çoban" in a Weakly Constraining Context

| <b>Word<br/>(Low Fr.)</b>  | <b>Context Sentence<br/>(Weak)</b>                               | <b>Mean RT (ms.)</b> | <b>Accuracy (%)</b> |
|----------------------------|--|----------------------|---------------------|
| <b>Çoban<br/>("çoban")</b> | Oyunda başrol<br>oynayan çoban<br>herkesin ilgisini<br>çekmişti. | 818,66               | 94,44               |

The low frequency words in weak context produced the slowest and most laborious word recognition out of the four study conditions. The average reaction time for all six words was 834.025 ms. In this condition, accuracy rates somewhat decreased. No item achieved 100% accuracy and three of the six had accuracy rates below 97.22%, even though the majority of items stayed very high. The average reaction time for each word and the total reaction time for this category are summarized in Table 3.28.

Table 3.28 Reaction Times and Comprehension Accuracy for Words in the Low Frequency-Weak Context Condition

| <b>Word</b>         | <b>Mean RT (ms.)</b> | <b>Accuracy (%)</b> |
|---------------------|----------------------|---------------------|
| <b>Havlu</b>        | 790,33               | 97,22               |
| <b>Saksı</b>        | 871,36               | 94,44               |
| <b>Karınca</b>      | 843,97               | 91,67               |
| <b>Tebeşir</b>      | 851,47               | 97,22               |
| <b>Mıknatıs</b>     | 1051,75              | 94,44               |
| <b>Çoban</b>        | 818,66               | 94,44               |
| <b>OVERALL MEAN</b> | <b>834,025</b>       | -                   |

### 3.2. COMPREHENSION ACCURACY ANALYSIS

The answers to the yes/no questions that followed each sentence were used to measure comprehension accuracy, which made sure that participants were reading the statements carefully and comprehending what they meant. With a lowest accuracy rate of 92% and maximum accuracy rate of 100%, the average accuracy rate for all participants was  $M=.9769$  (97%). So, participants' accuracy rates ranged from 92% to 100%, with a mean of 97.69%.

This high overall accuracy suggests that participants were paying attention to the task at hand and consistently understood the experimental stimulation's content. Table 3.29 below shows the statistical values of the yes/no comprehension questions.

Table 3.29 Descriptive Statistics for Comprehension Accuracy

| <b>Statistic</b>      | <b>Value</b> |
|-----------------------|--------------|
| <b>N</b>              | 36           |
| <b>Minimum</b>        | .92 (92%)    |
| <b>Maximum</b>        | 1.00 (100%)  |
| <b>Mean</b>           | .9769 (97%)  |
| <b>Std. Deviation</b> | .2528        |

*Note.* Accuracy reflects the proportion of correct responses to yes/no comprehension questions.

The examination of the current study on the relationship between accuracy rates and reaction times provides insight into the mental processes behind the recognition of jumbled words. In general, participants processed low-frequency words in weak contexts more slowly and inaccurately. Increased processing speed was linked to more confident and successful word identification, according to a moderately negative association found between accuracy and reaction time. Crucially, slower reaction times under low-accuracy circumstances could be a sign of heightened lexical competition or a dependence on post-lexical inference techniques.

The ability of participants to correct for orthographic abnormalities through lexical inference and top-down contextual support may be the reason for the generally high accuracy rates of the experiment. This implies that sufficient semantic constraint was provided by the existence of a cohesive sentence frame to enable precise recognition.

It's interesting to note that high accuracy was not necessarily correlated with longer reaction times, suggesting that participants were frequently able to identify the jumbled word effectively without requiring a lengthy lexical search. In other situations, though, longer reaction times for accurate answers might indicate a thorough verification procedure prior to selecting a response.

Participants were generally able to correctly identify the jumbled words despite orthographic disruption from letter transpositions, especially in strong settings, indicating that top-down semantic restrictions successfully supported recognition. Successful lexical access through the combination of visual and semantic signals is indicated by the increased accuracy and steady reaction times under strong context situations. However, decreased accuracy was the result of less top-down support in weak situations, suggesting that bottom-up signals were sometimes not strong for successful recognition. The findings are consistent with the Interactive Activation Model (McClelland & Rumelhart, 1981), which holds that the interplay between letter-level and word-level processes drives word recognition. Correct detection was probably made easier by top-down feedback from semantic and syntactic context in situations when letter transpositions interfered with bottom-up signals. The high accuracy rates in spite of orthographic noise demonstrate this. Furthermore, the findings on reaction times indicate that when this interaction was effective, participants recognized information quickly and accurately; when it was interrupted, they either slowed down or made mistakes, depending on the context.

### **3.3. DISCUSSION OF FINDINGS**

A comparative analysis of the four experimental conditions will be discussed in this section in detail. The main topic of discussion is how participants' reaction times and comprehension accuracy were affected by lexical frequency and contextual constraints in each condition. The intensity and direction of these effects are assessed by interpreting the results of the repeated measures ANOVA and the ensuing pairwise comparisons, item-level observations are also taken into account to show how each experimental group's individual words pattern. The combined goal of these is to clarify how top-down and bottom-up processes interact in scrambled word recognition and what that means for more general theories of lexical access and sentence processing.

Because there were two categorical independent variables in the experimental design—word frequency (high vs. low) and context type (strong vs. weak)—a two-way analysis of variance (ANOVA) was performed. Because it enables the simultaneous testing of main effects and interaction effects,

A repeated measures of ANOVA was conducted to examine the impact of contextual constraint and lexical frequency on participants' reaction times under four experimental conditions. The assumption of sphericity was broken, according to Mauchly's Test of Sphericity ( $\chi^2(5) = 103.68, p < .001$ ).

Greenhouse-Geisser corrections were therefore used. According to the data analysis, participants responded at considerably different speeds depending on the condition, which showed a significant main impact of condition on reaction time. ( $F(1.23, 43.87) = 167.25, p < .001$ ) with a large effect size (partial  $\eta^2 = .827$ ).

Table 3.30 Greenhouse-Geisser Corrected Repeated Measures ANOVA Results for Reaction Times Across Conditions

| Source    | df            | F      | p      | Partial $\eta^2$ |
|-----------|---------------|--------|--------|------------------|
| Condition | 1.225, 43.872 | 167.25 | < .001 | .827             |

*Note.* Greenhouse-Geisser correction was applied due to violation of sphericity.

Table 3.30 above displays the findings of the repeated measures ANOVA, which indicated that the experimental condition had a statistically significant main effect on reaction times ( $p < .001$ ). The study showed that participants' response times changed significantly depending on the combination of word frequency and contextual constraint. This significant result implies that participants' speed at identifying jumbled words was significantly impacted by the experimental treatments. The presented statistics are guaranteed to take into consideration any possible distortions in the variance-covariance structure of repeated measurements data by the application of the Greenhouse-Geisser adjustment. The high effect size value suggests that the experimental condition accounts for a significant amount of the variation in reaction times. The notion that contextual constraint and lexical frequency interact to influence processing speed in scrambled word recognition tasks is well supported by this finding.

Table 3.31 Pairwise Comparisons Between Conditions (Bonferroni-adjusted)

| <b>1st Condition</b> | <b>2nd Condition</b> | <b>Mean Difference</b> | <b>Std. Error</b> | <b>p-value</b> | <b>95% CI (Lower-Upper)</b> |
|----------------------|----------------------|------------------------|-------------------|----------------|-----------------------------|
| <b>High-Strong</b>   | High-Weak            | -160.99                | 23.08             | < .001         | -225.53 to -96.45           |
| <b>High-Strong</b>   | Low-Strong           | -111.96                | 20.07             | < .001         | -168.09 to -55.84           |
| <b>High-Strong</b>   | Low-Weak             | -415.42                | 30.50             | < .001         | -500.70 to -330.14          |
| <b>High-Weak</b>     | Low-Strong           | 49.02                  | 6.17              | < .001         | 31.76 to 66.29              |
| <b>High-Weak</b>     | Low-Weak             | -254.43                | 11.52             | < .001         | -286.64 to -222.22          |
| <b>Low-Strong</b>    | Low-Weak             | -303.46                | 13.33             | < .001         | -340.74 to -266.17          |

*Note.* Bonferroni correction applied. All comparisons are statistically significant at  $p < .001$

Table 3.31 above shows that according to pairwise comparisons using Bonferroni adjustment, there were significant differences in reaction times between all four conditions.

All conditions differed significantly from one another ( $p < .001$  in all comparisons), according to pairwise comparisons with Bonferroni adjustment. Compared to the high frequency-weak (mean difference = 160.99 ms.) low frequency-strong (111.96 ms.) and low frequency-weak (415.42 ms.) conditions, the high frequency-strong condition had noticeably faster reaction times. In contrast to all other conditions, the low frequency-weak condition exhibited the slowest reactions.

Regarding the function of frequency and contextual strength in lexical processing, pairwise comparisons from the main experiment showed a pattern that was generally in line with the expectations. The fastest processing time was noted for high-frequency words presented under strong context situations, which were read substantially faster than all other conditions.

On the other hand, as compared to the high frequency-strong context condition, the reading durations for low frequency words in weak settings were the slowest, with the biggest mean difference of 415.42 ms ( $p < .001$ ). Strong context aided processing for both high- and low-frequency words when the role of context was examined at a fixed frequency level: high frequency words were read 160.99 ms faster in strong context than in weak context ( $p < .001$ ), and low frequency words were read 303.46 ms faster in strong context than in weak context ( $p < .001$ ). According to top-down processing theories, contextual information helps make up for decreased lexical accessibility. These findings support the facilitative effect of context, which is particularly noticeable for low-frequency items (McClelland & Rumelhart, 1981; Grainger & Jacobs, 1996).

Additionally, the frequency impact was noticeable in both kinds of contexts. High frequency words were read 111.96 ms faster than low frequency words in strong context ( $p < .001$ ), and the frequency impact was even more pronounced in weak context (254.43 ms,  $p < .001$ ). These findings show that frequency and context clearly interact to improve word recognition speed both separately and in combination.

### **3.3.1. Comparison of High-Strong Condition versus High-Weak Condition**

There was a significant difference in reading times between high frequency words in strong and weak context circumstances (Mean Difference = -160.99 ms,  $p < .001$ ). The notion that contextual information helps with word recognition, even for high-frequency items, is supported by the fact that words presented in strong contexts were read more quickly. Interactive activation models (McClelland & Rumelhart, 1981) contend that top-down contextual cues can increase lexical entry activation and decrease processing effort. This is in line with these models. Even when high-frequency words are already readily available, recognition seems to be accelerated even more when a supportive context is present.

### **3.3.2. Comparison of High-Strong Condition versus Low-Strong Condition**

A considerable advantage for high frequency words was found when comparing high frequency and low frequency words in strong context (Mean Difference = -111.96 ms,  $p < .001$ ). The intrinsic frequency effect still holds true, even though strong context helps

with word recognition: high frequency words are processed more quickly independent of context. This aligns with models that prioritize lexical accessibility based on frequency (Seidenberg & McClelland, 1989). The findings imply that when frequency and context are supportive, top-down contextual cues interact with frequency effects rather than completely overriding them, resulting in cumulative facilitation.

### **3.3.3. Comparison of High-Strong Condition versus Low-Weak Condition**

Out of all paired data, this comparison produced the highest overall effect, with a mean difference of -415.42 ms ( $p < .001$ ). The greatest differential in lexical accessibility and contextual support was demonstrated by the fact that high frequency words in strong contexts were read far more quickly than low frequency words in weak contexts. This result supports the notion that context and frequency have a cumulative effect on processing efficiency. Since their interaction displays the entire range of variability in reading performance, it also highlights the significance of adjusting both factors at the same time.

### **3.3.4. Comparison of High-Weak Condition versus Low-Strong Condition**

It's interesting to note that low frequency words were read much more slowly than high frequency words in weak contexts, while being presented in strong contexts (Mean Difference = -49.02 ms,  $p < .001$ ). This implies that although context can facilitate the processing of low-frequency words, it could not be enough to offset the prepotent impact of frequency. The outcome suggests that lexical frequency may surpass the observed outcomes as a whole. This is consistent with dual-route models, which hold that in time-sensitive reading tasks, frequency effects the direct lexical route more than contextual information.

### **3.3.5. Comparison of High-Weak Condition versus Low-Weak Condition**

With a mean difference of -254.43 ms ( $p < .001$ ), the frequency effect was greatest when comparing high frequency and low frequency terms in weak context settings. The structure of the mental lexicon takes center stage when there are no significant contextual clues present, emphasizing the importance of word frequency in lexical decision-making. This finding emphasizes how, in situations where context lacks predictive value, readers

rely more on bottom-up clues, such as orthographic familiarity and prior exposure. As a result, high-frequency words continue to have a significant edge in situations with little predictability.

### **3.3.6. Comparison of Low-Strong Condition versus Low-Weak Condition**

For low-frequency words, the influence of context was more pronounced, with a mean difference between strong and weak context conditions of -303.46 ms ( $p < .001$ ). This finding supports the compensating function of context in lexical access, particularly in cases where the word is not used often. Because they have weaker mental representations in the lexicon, low-frequency words are more responsive to contextual cues (Grainger & Jacobs, 1996). According to the data, a rich semantic context can greatly shorten processing times for low-frequency input by assisting the reader in locating the appropriate lexical target.

To provide a clear visual comparison of overall processing performance across the four experimental settings Chart 3.1 below displays the mean reaction times for each category. This chart illustrates the independent and interactive effects of lexical frequency and contextual constraint on participants' recognition of jumbled words.

The individual and combined effects of contextual constraint and lexical frequency on participants' ability to recognize jumbled words are depicted in this chart. While low-frequency items in weak contexts result in slower and more laborious recognition, strongly restricting contexts and high-frequency words enable faster processing, as seen by the variance in reaction times across conditions. The picture provides additional evidence for the observed statistical differences and facilitates a more intuitive comprehension of the interaction effects covered in the subsequent sections by graphically representing these patterns.

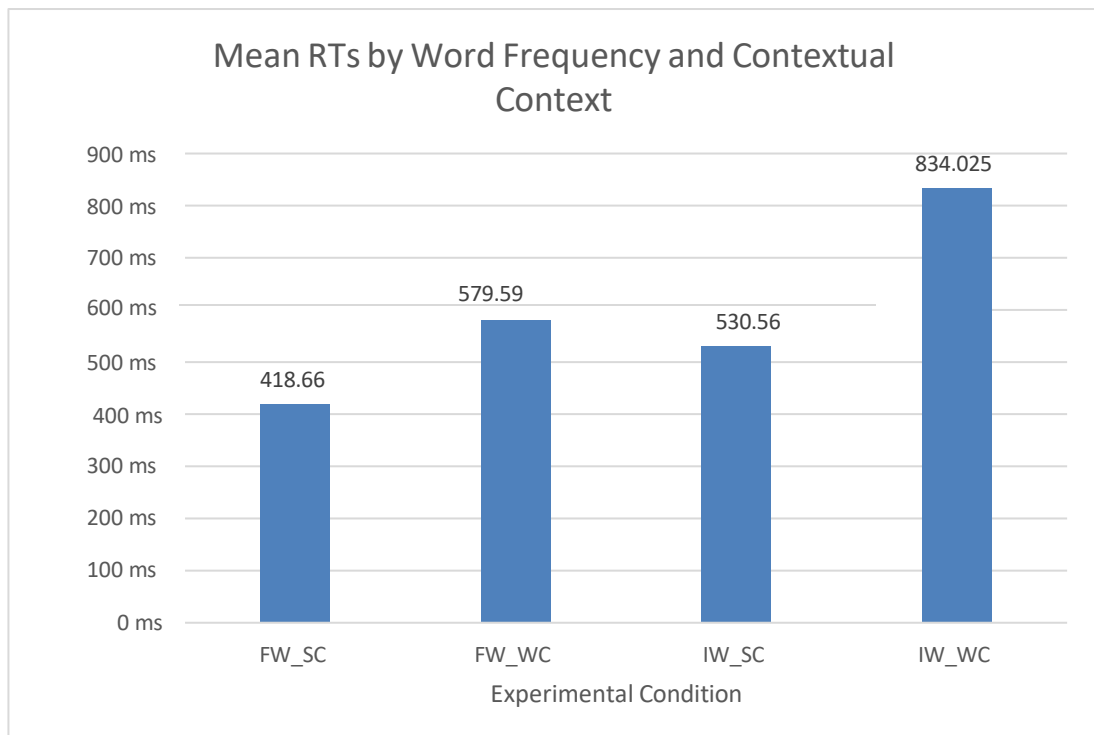


Chart 3.1 Mean RTs by Word and Frequency and Contextual Context

High frequency-strong context condition produced the fastest reaction times, whereas the low frequency-weak context condition produced the slowest replies, as Chart 3.1 shows. The results from the high frequency-weak context category suggest that when compared to the high frequency-strong context condition, even though the words were high in frequency, the absence of strong contextual cues led to considerably longer reaction times.

The average reaction time for this category is 579.59 ms, which means increased cognitive effort in processing jumbled words when sentence context gave limited assistance. This implies that lexical familiarity and contextual constraints interact to provide effective word recognition and frequency by itself is insufficient to make up for the absence of top-down predictive information. With five out of six items receiving 97.22% and one item reaching 100% comprehension accuracy in this category remained largely high. Even though there was only a slight decrease in accuracy, it shows that participants' capacity to deduce meaning from the sentence when contextual cues were less strong was slightly diminished.

These findings demonstrate how even well-known words can become difficult to recognize in the absence of helpful context, highlighting the significance of sentence level predictability in promoting lexical access in jumbled instances. The notion that lexical access is aided by the alignment of top-down (contextual constraint) and bottom-up (word frequency) procedures is supported by such quick processing in the high frequency word in strong condition. The predictive clues in the sentence context most likely assisted readers by enabling them to easily and with little cognitive strain clarify jumbled formations. The observed patterns provide more evidence for the facilitative effects of contextual predictability and word familiarity on lexical access as well as supporting the quantitative findings already mentioned. High lexical frequency and strong contextual constraint both have a facilitative impact, as seen by the high frequency word strong condition, which consistently produced faster response times than all other conditions. The low frequency word in weak condition also elicited the slowest replies, indicating that the lack of both familiarity and predictive context increased cognitive effort. Further demonstrating the interaction role of frequency and context in processing visually disrupted words are the notable distinctions between remaining condition pairs (high-weak vs. low-strong, for example). In other words, the distinctions between the intermediate condition pairs, such as high frequency word in weak context and low frequency word in strong context, further emphasize the interactive nature of frequency and context in word recognition, in addition to the obvious differences between the extreme conditions, such as high frequency word in strong context and low frequency word in weak context. These discrepancies imply that processing efficiency is not entirely determined by either variable alone, but rather by their combined influence, particularly in the case of visual input disruption.

Turkish is an agglutinative language with a rich and productive morphological structure, which sets it apart from many Indo-European languages. Multiple suffixes can be added to words to create syntactically complex forms that are more difficult to break down than in more isolating languages like English (Durgunolu & Öney, 1999).

Furthermore, Turkish readers rely more on sequential phonological and morphological processing than on general visual word shapes for word recognition, in contrast to logographic languages like Chinese (Perfetti & Tan, 1998). Because both top-down and

bottom-up mechanisms are likely to be active at the same time, Turkish presents a special situation for testing interactive word recognition models. As a result, Turkish provides a useful language framework for investigating how frequency and context interact to resolve visual disturbance.

The present findings are consistent with interactive word recognition theories, in which lexical access is supported by a combination of top-down and bottom-up mechanisms (McClelland & Rumelhart; 1981; Seidenberg & McClelland, 1989; Grainger & Holcomb, 2009). For example, the simultaneous interaction between letter level input and word level expectations is explained by the interactive activation model (McClelland & Rumelhart, 1981). Likewise, connectionist theories (e.g., Seidenberg & McClelland, 1989) highlight how word recognition is shaped by experience-based activation across orthographic, phonological and semantic networks. This perspective is further supported by neurocognitive evidence, which shows that contextual information is integrated early in the word processing process (Grainger & Holcomb, 2009). The significance of both top-down and bottom-up mechanisms in visual word recognition has been emphasized by numerous psycholinguistic research, especially when the input is visually jumbled or degraded. Word recognition is a dynamic interaction between incoming visual information, which refers to bottom-up mechanism, and higher level contextual or lexical expectations, which refers to top-down mechanism, based on the interactive activation model put out by McClelland and Rumelhart (1981). According to this approach, readers may quickly identify even jumbled words by using contextual information to forecast and rebuild the correct form. The idea that semantic expectations can direct recognition even before complete lexical access is attained is supported by neuropsychological data presented by Grainger and Holcomb (2009) for the early involvement of contextual information during visual word recognition.

Seidenberg and McClelland's (1989) connectionist models, which contend that activation flows across interconnected semantic, phonological and orthographic networks based on experience and frequency provide additional evidence for the combined role of top-down and bottom-up processes. According to these models, contextual signals and previous experience can help in decoding even when a word is unfamiliar or jumbled. Schurz et al. (2013), for example, show that during word

processing, the ventral occipitotemporal cortex combines perceptual and predictive inputs. According to findings of Schurz et al. (2013), processing jumbled words is clearly impacted by both word frequency and context strength with the largest facilitation seen when both were high.

So, these results are in line with the findings of the current study, which demonstrate that participants were able to recognize jumbled words more quickly when they were aided by strong contextual cues or high lexical frequency. This is in line with the interactive processing account.

The Dual-Route Model (Coltheart, 2005), which proposes both lexical and sublexical channels in word recognition, can also be used to understand the results. Participants probably had to use sublexical processing, mentally recreating phonological and orthographic structure of the word, instead of automatic lexical retrieval when presented with jumbled words because of orthographic disruption. Longer reaction times could be explained by this dependence on sublexical decoding, especially for low-frequency items in weak contexts. From the perspective of connectionist models (Seidenberg & McClelland, 1989), the recognition of jumbled words reflects activation across a network of interconnected units, influenced by frequency, experience, and context. The higher accuracy for high-frequency words aligns with the idea that frequently encountered items have stronger, more stable representations in the system, making them more resistant to orthographic noise. This model also explains why context helps: semantic activation can support incomplete or noisy orthographic input through parallel activation pathways. Additionally, the findings align with connectionist word recognition theories, which highlight activation patterns across dispersed networks impacted by context, experience, and frequency (Seidenberg & McClelland, 1989). High-frequency words appear to have stronger and more stable representations in the mental lexicon, as evidenced by the fact that participants were generally faster and more accurate in recognizing them. Additionally, the function that syntactic and semantic activation play in limiting lexical access in noisy environments may be reflected in the facilitative effect of strong context. These results provide credence to the connectionist theory that word recognition arises from interactive activation patterns responsive to both top-down expectations and bottom-up information rather than to a strict rule-based pathway.

Research on jumbled word recognition in a range of languages indicated that processing of disrupted words is influenced by orthographic transparency, morphological complexity and phonological structure. For instance, Turkish is a morphologically complex and orthographically transparent language with a high degree of consistency in grapheme-phoneme correspondence. Because of this transparency, even when letters are jumbled, readers can rely more on phonological decoding. Turkish speaking children succeeded better on phonological awareness tasks than their English-speaking counterparts, according to research by Durgunoğlu and Öney (1999). This was probably because Turkish has a consistent letter sound mapping. This feature might improve the recognition of Turkish scrambled words by enhancing the involvement of top-down mechanisms like contextual prediction. English, on the other hand, has a deep orthography, meaning that the correspondence between letters and sound is less clear. As a result, when it comes to recognition, English readers could rely more on visual word shape and word frequency, which is related with bottom-up cues. The importance of lexical familiarity in visual word processing was highlighted by Raman and Baluch's (2001) discovery that high frequency words in English were identified more quickly than low frequency ones. Although both languages demonstrate how context and frequency affect recognition, the ratio of top-down to bottom-up processing varies based on the structural characteristics of the language. This implies that language specific orthographic and morphological characteristics should be taken into consideration when interpreting results in jumbled word recognition.

The outcomes of the current study support and build on earlier cross linguistic studies on the recognition of jumbled words, while also pointing out specific processing tendencies in Turkish.

Consistent grapheme-morpheme correspondences help readers in languages with shallow orthographies like Spanish and German by enabling effective bottom-up decoding even in cases where word forms are broken (Ziegler & Goswami, 2005). Similar to this, Turkish promotes high phonological processing due to its straightforward orthography and agglutinative morphology. Nevertheless, the current findings show that this is insufficient on its own.

The facilitative effect of contextual constraint in the current study implies that top-down mechanisms are also essential for reconstructing Turkish words that have been jumbled, particularly for low frequency items. On the other hand, research on Hebrew and English has demonstrated a stronger dependence on morphological familiarity and lexical frequency when processing jumbled words (Kinoshia & Lupher, 2003; Velan & Frost, 2007). Besides, character structure and visual integrity are crucial in logographic languages like Chinese and Japanese, and any deviation greatly reduces recognition (Dylman & Kikutani, 2017). Turkish readers exhibit a more balanced interplay between top-down contextual inference and bottom-up decoding than readers of these other languages. This may be implying that while orthographic transparency makes basic decoding easier when the visual input is impaired as in the case of jumbled word recognition, semantic predictability becomes crucial.

Overall, the results of this study provide credence to the idea that contextual constraint and lexical frequency both have a major impact on word recognition when there is visual disruption. According to interactive word recognition models, participants reacted more quickly to high frequency words in strongly restrictive contexts (McClelland & Rumelhart, 1981). The findings are consistent with earlier research showing that especially in transparent orthographies like Turkish top-down contextual cues can make up for diminished bottom-up input (Ziegler & Goswami, 2005; Babayiğit & Stainthorp, 2007). These results support the notion that in visually impaired reading tasks, the interaction between language structure and cognitive processing is essential.

## **CONCLUSION, LIMITATIONS & SUGGESTIONS FOR FURTHER STUDIES**

### **A. CONCLUSION**

The purpose of this study is to examine the effects of contextual constraints and lexical frequency on the recognition of jumbled words in Turkish, a language with a complex morphology and orthographical transparency. By varying frequency (high frequency vs. low frequency) and context intensity (strong vs. weak), the study investigated four experimental conditions using a self-paced reading experiment using a 2x2 within-subject design.

Participants were presented with sentences containing jumbled target words, followed by comprehension questions. Whether frequency and context interact to influence recognition speed and whether Turkish readers use top-down or bottom-up processing mechanisms in response to visual disruptions of lexical items were the primary research topics. In line with these, the following research questions are answered in the present study:

- 1- How does word frequency affect jumbled word recognition in Turkish?
- 2- How do strongly and weakly constraining context types affect jumbled word recognition in Turkish?

Answering the first research question, the findings of the present study show that word frequency is essential for identifying Turkish terms that have been jumbled. High-frequency words were processed far more quickly and accurately than low-frequency words in both strong and weak contextual situations. The well-established idea in psycholinguistics that high-frequency words gain from more ingrained lexical representations in the mental lexicon as a result of frequent exposure and use is supported by this finding. These strong lexical traces support quick access and recognition in visually disrupted environments, like when words are mixed up, allowing bottom-up decoding even when there isn't perfect visual input. Low-frequency words, on the other hand, do not have this ingrained familiarity, which results in slower reaction times. Decoding these unfamiliar lexical words seems to be more difficult for readers,

particularly when the orthographic order is broken. This implies that even with a phonologically transparent alphabet of Turkish, frequency effects continue to influence bottom-up identification processes, especially when there is visual disruption.

While low-frequency words necessitate more work, either through contextual inference or sublexical methods, high-frequency words may cause their whole-word forms to be automatically activated even when letter order is broken. Overall, the study confirms that lexical frequency is still a strong bottom-up element in visual word identification and that its benefits are true even when jumbling compromises visual integrity of the word.

To continue with responding to the second research question above which was “How do strongly and weakly constraining context types affect jumbled word recognition in Turkish?”, this study shows that contextual constraints have a major impact on the ability to recognize jumbled words. Regardless of their frequency, words placed in weakly restrictive contexts were not as rapidly or precisely recognized as words provided in strongly constraining phrase contexts. The notion that top-down mechanisms, particularly contextual predictability, can help resolve orthographic disturbance during reading is supported by this finding. The sentential structure reduces the number of potential lexical choices in strongly restrictive situations before the reader has even had a chance to process the target word. When presented with skewed visual data, Turkish readers can "fill in the gaps" thanks to this predictive function. For instance, syntactic and semantic signals can be used to accurately predict a scrambled form of a word if the context suggests a specific sort of noun or verb. Readers may be especially sensitive to using morphological and syntactic information preceding the jumbled word to make accurate predictions because Turkish is a head-final language with a high usage of suffixation. Conversely, contexts with weak constraints provide insufficient grammatical or semantic clues, making readers rely more on the visual and orthographic information of the word. This dependence lengthens processing time and increases cognitive stress, particularly when the word is visually disturbed. When there are no strong expectations, ambiguity prevails and more lexical alternatives are active, which results in less effective recognition.

As a result, the results highlight the significance of top-down processing by showing that strong contextual predictability in Turkish can considerably offset visual degradation.

This emphasizes how dynamic reading is and how, sentence-level information can direct and ease lexical access in difficult perceptual situations.

After answering the main study objectives, the results must be interpreted in light of a larger theoretical and linguistic framework. This entails assessing the degree to which the observed patterns support or contradict existing visual word recognition models as well as taking into account how Turkish-specific characteristics like morphology, spelling, and syntax influences these results.

The outcomes of the study show that, participants identified high frequency words in situations with strong constraints considerably more quickly than they did low frequency words in contexts with weak constraints, with intermediate conditions falling somewhere in the middle. These results are in line with interactive word recognition models, which contend that top-down and bottom-up mechanisms operate in tandem to modify lexical access (McClelland & Rumelhart, 1981). Research indicates that readers employ predictive cues to compensate for visually impaired data, which is consistent with the strong effect of context (Staub, 2015). Crucially, pairwise comparisons among the four experimental situations shed more light on the relationship between context and frequency. Word frequency may sometimes outweigh the facilitative effect of contextual predictability, as evidenced by the fact that high frequency words in weak settings were recognized more quickly than low frequency words in strong contexts. This disparity emphasizes how important bottom-up knowledge is when top-down assistance is scarce. Furthermore, the reaction time difference between high and low frequency words was comparatively less when the context was strong, suggesting that highly predictive contexts may lessen the effect of frequency. On the other hand, frequency disparities were more noticeable in weak contexts, supporting the notion that lexical frequency is more important when semantic clues are not enough.

Rich morphological structure of Turkish and extremely regular spelling make the study an important cross-linguistic example of how language-specific characteristics influence word recognition techniques (Göksel & Kerslake, 2005; Ziegler & Goswami, 2005).

More precisely, the variations in reaction times across four conditions imply that strong contextual settings and high-frequency words both independently facilitate quicker

processing. Reaction durations were shortest under the high frequency-strong condition and longest under the low frequency-weak condition, highlighting the compounded difficulty that arises when both facilitative cues are absent. By including comprehension questions after every jumbled sentence, it was possible to evaluate both word-level recognition and sentence-level comprehension. The high accuracy scores imply that participants were typically successful in deriving meanings from the larger language context, even when the target words were manipulated.

This research supports the idea that top-down facilitation can maintain comprehension under poor visual situations and emphasizes the importance of anticipatory processing and semantic integration in reading (Luke & Christianson, 2016). In addition, because of its flexible word order and agglutinative morphology, Turkish language provides a unique viewpoint on jumbled word recognition. In order to forecast and rebuild disrupted words, readers use abundant morphosyntactic and contextual information in addition to phonological decoding, which is made easier by the transparent orthography. This supports the dual pathway theory of reading put forth by models like the dual-route cascaded model (Coltheart et al., 2001), which holds that depending on the linguistic input, both lexical and sublexical routes contribute to word recognition.

## **B. LIMITATIONS & SUGGESTIONS FOR FURTHER STUDIES**

The study has several limitations along with its contributions. First, the size and demographic variety of the participant sample were constrained, which could have an impact on generalizability. Second, there was no neuropsychological data to directly evaluate processing dynamics, only accuracy and reaction times were examined. Third, only particular sentence forms were used for the jumbled stimuli, which may not adequately represent the variety present in natural language processing. To further investigate the temporal features of recognition, future research could use ERP or eye-tracking techniques. Furthermore, a different systematic manipulation of morphological complexity may aid in determining the impact of affixation on recognition in the case of visually disrupted word form.

Whether the outcomes of the present study are unique to the Turkish language or part of a larger cross-linguistic pattern may be further revealed by comparative studies involving

other agglutinative or morphologically rich languages.

The design of the filler sentences is one significant study drawback. Filler items lacked comprehension tests, but experimental sentences were followed by yes/no comprehension questions to guarantee semantic processing. This might have led to an uneven distribution of participants' attention or level of participation across trials. In particular, participants may have been able to use other reading techniques, including skimming or fast reading, on non-critical trials because there were no verification tasks after fillers. As a result, this might have affected the overall tempo of the task or expectancy structure, which could have affected how naturally people read. Future research could guarantee consistent cognitive engagement throughout all trials by including comprehension questions for the filler items.

Future studies should also look into individual differences in the ability to recognize jumbled words, taking into account factors like working memory, vocabulary size and reading fluency. It might be important to investigate how various forms of context, such as narrative, conversational and explanatory context, affect recognition patterns as context was a major factor in this study. A developmental perspective on interactive processing could also be provided by longitudinal or developmental studies that evaluate how Turkish readers at various skill levels modify their methods for identifying disrupted data. These discoveries obviously have important educational consequences. The creation of literacy resources and teaching methods adapted to the structural characteristics of Turkish may benefit from an understanding of the roles that context and frequency play in word recognition. Teachers might think about putting a strong emphasis on contextual support in early reading resources or interventions for pupils who struggle with reading. Additionally, using models that take into consideration both frequency effects and contextual predictability could enhance digital reading environments and language technology such as spell-checkers or text prediction tools.

Overall, the results of this study support the notion that contextual restriction and lexical frequency both have a substantial impact on how visually impaired Turkish words are processed. It shows that identifying visually damaged language input involves a complex interaction between linguistic structure, cognitive techniques and contextual expectations rather than just perceptual clarity.

The study of jumbled word recognition in Turkish adds to the larger discussion about how the human mind can flexibly adjust to changes in written language in addition to offering insights unique to the language. Finally, the present study advances our knowledge of real-time language comprehension across several linguistic systems by emphasizing the interplay between universal cognitive mechanisms and language-specific structure.

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## APPENDIX 1: INITIAL DATA COLLECTION STUDY: SENTENCE COMPLETION TASK

Karmaşık bir düşünce sistemine sahip olan...

Kendimi geliştirmem için biraz daha...

Parkta oyun oynayan...

Toplumda erkek kadar...

Vergi toplamak...

Karşıdan karşıya bir kadınla bir...

Banka hesabımda biriken...

Diğer gezegenlere kıyasla...

Hayatta en sevdiğim şey...

Değerini bilen için...

Geçen gün gelen işçi patates çuvallarını...

Alışveriş merkezinde gördüğüm...

İnsanların bir arada yaşaması için...

Yıllardır görmediği...

Kış spor merkezi olarak...

O firmalar hepimizin üzerinden...

Eğlence parkında yeni aletler denemek heyecanlı ve tehlikeli bir...

Günlük sütte bol bol...

Havuzdan çıktıktan sonra hemen bir...

Yeni aldığım çiçekleri penceredeki...

Yere düşen kırıntıları taşıyan bir...

Karatahtada silgi ve...

Zıt kutuplar taşıyan...

Sürüyü otlatması için yeni bir...

Türkler Anadolu'ya giriş yaptıklarında bir...

Makarnayı çok pişirirseniz...

Telefonun sesiyle yataktan fırladığında üzerindeki...

Ürünümüz sızdırmayı önleyen...

Onun yanında insanlar...

Gülerek arkadaşının kafasına...

Mutluluk ve olumlu enerji...

Oyunda başrol oynayan...

## APPENDIX 2: CONSENT FORM FOR INITIAL DATA COLLECTION STUDY

### GÖNÜLLÜ KATILIMCI FORMU

Sayın katılımcı,

Bu çalışma “Türkçede Karışık Harfli Sözcüklerin Tanınmasını Çözümleme” isimli anadili Türkçe olan kişilerin verilen cümlelerin işlenmesini araştıran bir Yüksek Lisans Tez’inin öncül veri toplama çalışmasıdır, Hacettepe Üniversitesi İngiliz Dilbilimi Bölümü Yüksek Lisans programında, Dr. Öğr. Üyesi Taylan Akal danışmanlığında yürütülmektedir. Araştırmadan elde edilen bulgular, bahsi geçen tezde kullanılacaktır. Bu araştırma için Hacettepe Üniversitesi Sosyal ve Beşeri Bilimler Etik Kurulundan gerekli izinler alınmıştır. Bu araştırmanın amacı katılımcıların cevaplarına bağlı olarak tümcelerın güçlü veya zayıf bağlamlarını belirlemektir. Araştırmada sizden tahminen 10-15 dakika ayırmanız istenmektedir. Çalışmaya yaklaşık 40 kişi katılacaktır. Cümleler kesinlikle kişiye özel konuları içermemektedir. Bu çalışmaya katılmak tamamen gönüllülük esasına dayanmaktadır. Çalışmanın amacına ulaşması için sizden beklenen, bütün cümleleri eksiksiz, kimsenin baskısı veya telkini altında olmadan okuyup kendinizce en uygun üç sözcük (isim) ile tamamlamanızdır. Araştırmadan istediğiniz zaman çekilebilirsiniz. Bu durum size hiçbir sorumluluk getirmeyecektir. Çalışmada yanıtlarınız, çalışmada yer alan araştırmacılar ve çalışmanın veri kısmında anonim şekilde kullanılmak dışında kimseyle paylaşılmayacaktır. Çalışma sonuçları tez ve bilimsel yayınlar için kullanılacaktır. Çalışmanın tüm süreçlerinde kişisel bilgileriniz ihtimamla korunacaktır. Bu formu okuyup onaylamanız araştırmaya katılmayı kabul ettiğiniz anlamına gelecektir. Ancak, çalışmaya katılmama veya katıldıktan sonra herhangi bir anda çalışmayı bırakma hakkına da sahiptir. Bu gönüllü katılım formunu onaylamadan önce veya daha sonra çalışmayla ilgili aklınıza gelebilecek olan soruları araştırmacılara sorabilirsiniz. Araştırmacıların iletişim bilgileri formun alt kısmında verilmiştir. Araştırmaya katılmayı tercih ediyorsanız okudum anladım kutucuğunu işaretleyiniz.

· Yukarıda yer alan ve araştırmadan önce katılımcıya verilmesi gereken bilgileri okudum ve katılmam istenen çalışmanın kapsamını ve amacını, gönüllü olarak üzerime düşen sorumlulukları anladım. Çalışma hakkında yazılı açıklama yapıldı. Kişisel bilgilerimin özenle korunacağı konusunda yeterli güven verildi. Bu koşullarda söz konusu araştırmaya kendi isteğimle, hiçbir baskı ve telkin olmaksızın katılmayı kabul ediyorum.

Tarih:

Katılımcı:

Adı, soyadı:

Adres:

Tel:

İmza:

Sorumlu Araştırmacı:

Adı, Soyadı: Taylan Akal

Telefonu: 0312 2978525

E-posta: [takal@hacettepe.edu.tr](mailto:takal@hacettepe.edu.tr)

Adres: Hacettepe Üniversitesi,

Kampüsü,

İmza:

Yardımcı Araştırmacı

Adı, Soyadı: Bilgehan İlhan

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İmza: Çankaya/ANKARA

## APPENDIX 3: MAIN STUDY: EXPERIMENTAL SENTENCES

### Trial Sentences Before the Experiment

Bugün bir kdei gördüm.

Yazın gnüş kremi sürmeyi unutmamalıyız.

Odanın duvarlarına tlabo asmak yasaktı.

Aceleyle dışarı çıkarken elveidn almayı unutmuşum.

Her hafta mutlaka tiytaro oyununa giderim.

### High Frequency Words in Strongly Constraining Context

Karmaşık bir düşünce sistemine sahip olan iansn, gelişmiş bir varlıktır.

Parkta oyun oynayan çuoock birden kaybolunca herkes aramaya başladı.

Toplumda erkek kadar kdaın da üretim içinde olmalıdır.

Karşıdan karşıya bir kadınla bir aadm geçiyordu.

Banka hesabımda biriken praa ile tatile gideceğim.

Diğer gezegenlere kıyasla dnüya en özel olanıdır.

### High Frequency Words in Weakly Constraining Context

Hayatta en sevdiğim şey, iansn tanımaktır.

Geçen gün gelen işçi patates çuvallarını çuoock taşır gibi taşıdı.

Alışveriş merkezinde gördüğüm kaıdn güzel bir elbise giyiyordu.

Yıllardır görmediği aadm birden karşısındaydı.

Kış spor merkezi olarak praa kazandıran bir işletmeye sahibiz.

O firmalar hepimizin üzerinden dnüya kadar kazanıyor.

### **Low Frequency Words in Strongly Constraining Context**

Havuzdan çıktıktan sonra hemen bir hlavı alıp kurulandım.

Yeni aldığım çiçekleri penceredeki skası içine yerleştirdim.

Yere düşen kırıntıları taşıyan bir kancra sürüsü gördük.

Karatahtada silgi ve tšieber kullanılır.

Zıt kutuplar taşıyan mntıkais parçaları birbirini hızla çekti.

Sürüyü otlatması için yeni bir çbaon gerekiyor.

### **Low Frequency Words in Weakly Constraining Context**

Telefonun sesiyle yataktan fırladığında üzerindeki hlavı yere düştü.

Ürünümüz sızdırmayı önleyen skası biçimindeki bir malzemeyle kaplanmıştır.

Onun yanında insanlar kancra gibi kalıyordu.

Gülerek arkadaşının kafasına tšieber fırlattı.

Mutluluk ve olumlu enerji mntıkais etkisi yapmaktadır.

Oyunda başrol oynayan çbaon herkesin ilgisini çekmişti

## APPENDIX 4: CONSENT FORM FOR THE MAIN STUDY

### GÖNÜLLÜ KATILIM FORMU

Sayın katılımcı,

Bu çalışma “Türkçede Karışık Harfli Sözcüklerin Tanınmasını Çözümleme” isimli anadili Türkçe olan kişilerin verilen cümlelerin işlenmesini araştıran bir Yüksek Lisans Tez çalışmasıdır. Çalışma, Hacettepe Üniversitesi İngiliz Dilbilimi Bölümü Yüksek Lisans programında, Dr. Öğr. Üyesi Taylan Akal danışmanlığında yürütülmektedir. Araştırmadan elde edilen bulgular, bahsi geçen tezde kullanılacaktır. Bu araştırma için Hacettepe Üniversitesi Sosyal ve Beşeri Bilimler Etik Kurulundan gerekli izinler alınmıştır. Bu araştırmanın amacı Türkçe'de karışık sözcüklerin işlenmesinin nasıl gerçekleştiğini ve bu işlemde bağlamın ve sözcük sıklığının nasıl etki ettiğini göstermektir. Araştırmada sizden tahminen 25-30 dakika ayırmanız istenmektedir. Araştırmaya yaklaşık 40 kişi katılacaktır. Cümleler kesinlikle kişiye özel konuları içermemektedir. Bu çalışmaya katılmak tamamen gönüllülük esasına dayanmaktadır. Çalışmanın amacına ulaşması için sizden beklenen, bütün cümleleri eksiksiz, kimsenin baskısı veya telkini altında olmadan okumanızdır. Araştırmadan istediğiniz zaman çekilebilirsiniz. Bu durum size hiçbir sorumluluk getirmeyecektir. Araştırmada okuma süreleriniz, çalışmada yer alan araştırmacılar ve çalışmanın veri kısmında anonim şekilde kullanılmak dışında kimseyle paylaşılmayacaktır. Araştırma sonuçları tez ve bilimsel yayınlar için kullanılacaktır. Araştırmanın tüm süreçlerinde kişisel bilgileriniz ihtimamla korunacaktır. Bu formu okuyup onaylamanız, araştırmaya katılmayı kabul ettiğiniz anlamına gelecektir. Ancak, çalışmaya katılmama veya katıldıktan sonra herhangi bir anda çalışmayı bırakma hakkına da sahipsiniz. Bu gönüllü katılım formunu onaylamadan önce veya daha sonra çalışmayla ilgili aklınıza gelebilecek olan soruları araştırmacılara sorabilirsiniz. Araştırmacıların iletişim bilgileri formun alt kısmında verilmiştir. Araştırmaya katılmayı tercih ediyorsanız okudum anladım kutucuğunu işaretleyiniz. Yukarıda yer alan ve araştırmadan önce katılımcıya verilmesi gereken bilgileri okudum ve katılmam istenen çalışmanın kapsamını ve amacını, gönüllü olarak üzerime düşen sorumlulukları anladım. Çalışma hakkında yazılı açıklama yapıldı. Kişisel bilgilerimin özenle korunacağı konusunda yeterli güven verildi. Bu koşullarda söz konusu araştırmaya kendi isteğimle, hiçbir baskı ve telkin olmaksızın katılmayı kabul ediyorum.

Tarih:

Katılımcı;

Adı, soyadı:

Adres:

Tel:

İmza:

Sorumlu Araştırmacı:

Adı, Soyadı: Taylan Akal

Telefonu: 0312 2978525

E-posta: [takal@hacettepe.edu.tr](mailto:takal@hacettepe.edu.tr)

Adres: Hacettepe Üniversitesi,

Kampüsü,

İmza:

Yardımcı Araştırmacı

Adı, Soyadı: Bilgehan İlhan

Telefonu: 05530479751

E-posta: [bilgehanilhan@hacettepe.edu.tr](mailto:bilgehanilhan@hacettepe.edu.tr)

Adres: İngiliz Dilbilimi Bölümü, Beytepe

İmza: Çankaya/ANKARA

## APPENDIX 5: YES-NO COMPREHENSION QUESTIONS

Karmaşık bir düşünce sistemine sahip olan insan mıdır?

Parkta kaybolan çocuk muydu?

Toplumda erkek kadar kadın da üretim içinde olmalı mıdır?

Karşıdan karşıya bir kedi geçiyor muydu?

Biriken şey altın mıydı?

En özel gezegen Mars mıdır?

Bu kişi insan tanımayı sever mi?

İşçi patates çuvallarını mı taşıdı?

Alışveriş merkezinde arkadaşını mı gördü?

Yıllardır annesini mi görmemiş?

İşletme para kazandırıyor mu?

Firmalar az mı kazanıyor?

Havuzdan çıktıktan sonra denize mi girdi?

Yeni aldığı çiçekleri vazoya mı yerleştirdi?

Böcek mi gördüler?

Karatahtada tebeşir kullanılır mı?

Mıknatıslar birbirini çekti mi?

Otlamak için sürüye yeni bir çoban gerekiyor mu?

Yere düşen havlu muydu?

Malzeme üçgen şeklinde midir?

Onun yanında insanlar kısa mı kalıyordu?

Arkadaşının kafasına kalem mi fırlattı?

Mutluluk ve olumlu enerji birbirini çeker mi?

Başrol oynayan tiyatro oyuncusu muydu?

## APPENDIX 6: FILLER SENTENCES

Bilgisayarda ödev yaparken uyuyakaldım.

Bardaktan su içmek için uzanan kardeşim, yere düştü.

Aylardır izlemek istediği film vizyona girdi.

Manavdan taze meyve ve sebze alırken komşusunu gördü.

Prens ve prenses gösterişli bir törenle evlenir.

Uykunda konuştuğunda seni anlamaya çalışıyorum.

İmkansız görünmesine rağmen işi yapmaya çalıştı.

Doğada çeşitli elementler bulmak zor değildir.

Kuşlar sabah erkenden ötmeye başlayınca huzurla uyandı.

Bahar aylarında doğa yavaşça canlanıyor.

Parkta yürüyüş yapan yaşlı insanlar sağlıklı görünüyor.

Bir makine gibi çalışarak günleri birbiri ardına deviriyordu.

Ayakların üşüyorsa çorap giymen lazım.

Kitapçı raflara yeni kitaplar dizdi.

Takip ettiğimiz rehber çok eğlenceli hikayeler anlatarak hepimizi güldürdü.

Küçük kız anahtar sesini duyar duymaz irkildi.

Kahvaltıda her zaman portakal suyu içerim.

Yetenekli olmak birçok beceri gerektirir.

Otelin yemek salonunu gördüklerinde adeta büyülediler.

Sanayi toplumlarında üretim oldukça önemlidir.

Onu rahat bırakmayan üzücü anılar yüzünden kabuslar görüyordu.

Öğrencilerin davranışları öğretmeni çileden çıkardı.

Bulmaca çözümlerini hafızasını dinç tutmaya çalışıyordu.

Katıldığı yarışmada jüri üyeleri ona çok içten davrandı.

## APPENDIX 7: ORJİNALLİK RAPORU

|   |   |                              |            |
|---|---|------------------------------|------------|
|  | HACETTEPE ÜNİVERSİTESİ<br>SOSYAL BİLİMLER ENSTİTÜSÜ   | Doküman Kodu<br>Form No.     | FRM-YL-15  |
|   | FRM-YL-15<br>Yüksek Lisans Tezi Orijinallik Raporu<br>Master's Thesis Dissertation Originality Report | Yayın Tarihi<br>Date of Pub. | 04.12.2023 |
|   |   | Revizyon No<br>Rev. No.      | 02         |
|   |   | Revizyon Tarihi<br>Rev. Date | 25.01.2024 |

**HACETTEPE ÜNİVERSİTESİ  
SOSYAL BİLİMLER ENSTİTÜSÜ  
İNGLİZ DİL BİLİMİ ANABİLİM DALI BAŞKANLIĞINA**

Tarih: 24/09/2025

Tez Başlığı (Türkçe): Türkçe'de Bozulan Harf Etkisi Üzerinde Sıklık ve Bağlama İlişkin Sözcüksel Çözümleme  
Tez Başlığı (Almanca/Fransızca)\*:.....

Yukarıda başlığı verilen tezin a) Kapak sayfası, b) Giriş, c) Ana bölümler ve d) Sonuç kısımlarından oluşan toplam 120 sayfalık kısmına ilişkin, 29/09/2025 tarihinde ~~çalışma~~ tez danışmanım tarafından Turnitin adlı intihal tespit programından aşağıda işaretlenmiş filtrelemeler uygulanarak alınmış olan orijinallik raporuna göre, tezin benzerlik oranı % 17 'dir.

Uygulanan filtrelemeler\*:

- Kabul/Onay ve Bildirim sayfaları hariç
- Kaynakça hariç
- Alıntılar hariç
- Alıntılar dâhil
- 5 kelimedenden daha az örtüşme içeren metin kısımları hariç

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

Gereğini saygılarımla arz ederim.

Ad-Soyad/İmza  
Bilgehan İhan

|                   |                       |                     |
|-------------------|-----------------------|---------------------|
| Öğrenci Bilgileri | Ad-Boyad              | Bilgehan İhan       |
|                   | Öğrenim No            | N23135549           |
|                   | Enstitü Anabilim Dalı | İngiliz Dili Bilimi |
|                   | Programı              | Yüksek Lisans       |

### DANIŞMAN ONAYI

UYGUNDUR.  
(Unvan, Ad Soyad, İmza)  
Dr. Öğr. Üyesi Taylan Akal

\* Tez Almanca veya Fransızca yazılıyor ise bu kısımda tez başlığı **Tez Yazım Dilinde** yazılmalıdır.

## APPENDIX 8: ETHICS COMMISSION FORM FOR INITIAL DATA COLLECTION STUDY

Tarih: 13/01/2025 10:00  
Sayı: E-66777942-300-00003979245



00003979245



### HACETTEPE ÜNİVERSİTESİ SOSYAL VE BEŞERİ BİLİMLER ARAŞTIRMA ETİK KURULU

#### KURUL KARARI

| <u>TOPLANTI TARİHİ</u> | <u>TOPLANTI SAYISI</u> |
|------------------------|------------------------|
| 07 Ocak 2025           | 2025/01                |

Üniversitemiz Sosyal Bilimler Enstitüsü İngiliz Dilbilimi Anabilim Dalı Yüksek Lisans Programı öğrencilerinden **Bilgehan İLHAN**'ın, **Dr. Öğr. Üyesi Taylan AKAL** danışmanlığında yürüteceği **"Türkçe'de Karışık Harfli Sözcüklerin Tanınmasını Çözümleme"** başlıklı tez çalışması Üniversitemiz Sosyal ve Beşeri Bilimler Araştırma Etik Kurulunun **07 Ocak 2025** tarihinde yapmış olduğu toplantıda incelenmiş olup, etik açıdan **uygun bulunmuştur.**

Prof. Dr. İsmet KOÇ  
Kurul Başkanı

Prof. Dr. Özgür  
TEOMAN  
Kurul Üyesi

**İZİNLİ**  
Prof. Dr. Selda  
ÖZDEMİR  
Kurul Üyesi

Prof. Dr. Özge  
ÖZYLALÇIN OSKAY  
Kurul Üyesi

Doç. Dr. Pınar  
ÖZDEMİR ŞİMŞEK  
Kurul Üyesi

Prof. Dr. Tuğça POYRAZ  
Kurul Üyesi

Doç. Dr. Arife Berna  
AYTAÇ  
Kurul Üyesi

Doç. Dr. Gülçin Cankız  
ELİBOL  
Kurul Üyesi

Doç. Dr. Pınar ARPINAR  
AVŞAR  
Kurul Üyesi

Doç. Dr. Gülsüm DEPELİ  
SEVİNÇ  
Kurul Üyesi

Doç. Dr. Tülay BAĞCI  
BOSİ  
Kurul Üyesi

**İZİNLİ**  
Dr. Öğr. Üyesi Onur  
URAZ  
Kurul Üyesi

## APPENDIX 9: ETHICS COMMISSION FORM



### HACETTEPE ÜNİVERSİTESİ SOSYAL VE BEŞERİ BİLİMLER ARAŞTIRMA ETİK KURULU

#### KURUL KARARI

| TOPLANTI TARİHİ | TOPLANTI SAYISI |
|-----------------|-----------------|
| 25 Mart 2025    | 2025/06         |

Kurulumuzun 07.01.2025 tarihli toplantısında onaylanmış olan ve Üniversitemiz Sosyal Bilimler Enstitüsü İngiliz Dilbilimi Anabilim Dalı Yüksek Lisans Programı öğrencilerinden **Bilgehan İLHAN**'ın, **Dr. Öğr. Üyesi Taylan AKAL** danışmanlığında yürüteceği "**Türkçe'de Karışık Harfli Sözcüklerin Tanınmasını Çözümleme**" başlıklı tez çalışması için vermiş olduğunuz protokol revizyonu talebi dilekçeniz Üniversitemiz Sosyal ve Beşeri Bilimler Araştırma Etik Kurulunun **25 Mart 2025** tarihinde yapmış olduğu toplantıda incelenmiş olup, etik açıdan **uygun bulunmuştur**.

Prof. Dr. İsmet KOÇ  
Kurul Başkanı

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TEOMAN  
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AYTAÇ  
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ELİBOL  
Kurul Üyesi

Doç. Dr. Pınar ARPINAR  
AVŞAR  
Kurul Üyesi

Doç. Dr. Gülsüm DEPELİ  
SEVİNÇ  
Kurul Üyesi

Doç. Dr. Tülay BAĞCI  
BOSİ  
Kurul Üyesi

**İZİNLİ**  
Dr. Öğr. Üyesi Onur  
URAZ  
Kurul Üyesi

