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THE PROCESSING OF COMPOUNDS IN ADULT SECOND LANGUAGE LEARNERS OF ENGLISH AND TURKISH

Dr. Serkan UYGUN

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ABSTRACT

The Processing of Compounds in Adult Second Language Learners of

English and Turkish

The purpose of this study is to investigate the processing of compound words in English and Turkish with monolingual and sequential bilingual adults with intermediate and advanced level proficiency. The present study includes two different but parallel experiments on compound word recognition, one in English and one in Turkish. By using a masked priming experiment, the processing of English and Turkish compounds by monolingual and sequential bilinguals is examined. The stimuli involve transparent-transparent compounds (e.g., *headache*; *kuzeydoğu* 'northeast', *kuzey* 'north', *doğu* 'east'), partially-opaque compounds (e.g., *grapefruit*; *büyükelçi* 'ambassador', *büyük* 'big', *elçi* 'delegate'), pseudocompounds (e.g., *mandate*; *fesleğen* 'basil', *fes* 'fez', *leğen* 'bowl/pelvis'), and monomorphemic words (e.g., *crocodile*; *kaplumbağa* 'turtle'). The results of the English study demonstrate that English monolinguals decomposed compound words. When semantic transparency of the compound is examined, the findings suggest that both constituents are activated in transparent-transparent compounds whereas only the second constituent is accessed in partially-opaque compounds, indicating the influence of semantic transparency on compound processing. No priming is observed for intermediate level sequential bilinguals, suggesting that they do not employ decomposition. Advanced level sequential bilinguals also employ decomposition for compounds, but semantic transparency plays a crucial role because constituent 1 is accessed in transparent-transparent compounds, yet no priming effect is obtained for partially-opaque compounds, implying dual-route access for English compounds. The Turkish study shows that monolingual Turkish participants recognize compound words on the basis of their constituents (i.e. via decomposition); however, the effect of semantic transparency is also observed in the group. Transparent-transparent compounds are accessed by recognizing the second constituent (i.e. the head of the compound) while both constituents are activated for partially-opaque compounds. In contrast, neither the advanced nor the intermediate-level sequential bilingual groups show native-like processing revealing whole-word access.

Key Words: L1 morphological processing, L2 morphological processing, English and Turkish compounds, masked priming, psycholinguistics

KISA ÖZET

İngilizce ve Türkçeyi İkinci Dil Olarak Öğrenen Yetişkinlerin

Bileşik Sözcükleri İşlemlemesi

Bu çalışmanın amacı İngilizce ve Türkçe bileşik sözcüklerin tek dilli ve orta ve ileri düzeydeki iki dilli yetişkinler tarafından nasıl işlemlendiklerini araştırmaktır. Çalışma İngilizce ve Türkçe bileşik sözcüklerin zihinde nasıl temsil edildiklerini ölçen birbiriyle paralel iki farklı testten oluşmaktadır. Maskelenmiş çağrıştırma tekniği ile sözcük tanıma testi uygulanarak İngilizce ve Türkçe bileşik sözcüklerin tek dilli ve iki dilli katılımcılar tarafından zihinlerinde nasıl işlemlendikleri araştırılmıştır. Testte yer alan sözcük türleri şu şekildedir: 10 adet anlam kayması olmayan bileşik sözcük (örn. *headache* 'baş ağrısı', *head* 'baş', *ache* 'ağrı'; *kuzeydoğu*), 10 adet kök sözcüklerden ilki ya da ikincisinin temel anlamdan uzaklaştığı bileşik sözcük (örn. *grapefruit* 'greyfurt', *grape* 'üzüm', *fruit* 'meyve'; *büyükelçi*), 10 adet iki kök içeriyormuş gibi algılanabilen ancak bileşik olmayan sözcük (örn. *mandate* 'emir', *man* 'adam', *date* 'tarih'; *fesleğen*) ve 60 adet ek içermeyen yalın sözcük (örn. *crocodile* 'timsah'; *kaplumbağa*) kullanılmıştır. İngilizce testinin sonuçlarına göre tek dilli katılımcılar bileşik sözcükleri biçimbirimsel ayrıştırma yöntemiyle işlemlemektedir. Bileşik sözcüklerde anlam kaymasının işlemlemede etkisi görülmüştür çünkü anlam kayması olmayan bileşik sözcüklerde bileşik sözcüğü oluşturan her iki çağrıştırıcı sözcük işlemlenirken, kök sözcüklerden ilki ya da ikincisinin temel anlamdan uzaklaştığı bileşik sözcüklerde sadece ikinci çağrıştırıcı sözcük işlemlenmiştir. Orta düzeyde İngilizce bilen iki dilli katılımcılarda çağrıştırıcı sözcüklerin işlemlenmediği, yani bileşik sözcüklerin bütünsel listeme yöntemiyle zihinde temsil edildiği bulunmuştur. İleri düzeyde İngilizce bilen iki dilli katılımcıların da bileşik sözcükleri biçimbirimsel ayrıştırma yöntemiyle işlemledikleri görülmüştür, fakat anlam kaymasının bileşik sözcüklerin işlemlenmesinde önemli bir etkisinin olduğu görülmüştür. Anlam kayması olmayan bileşik sözcüklerde birinci çağrıştırıcı sözcüğün işlemlendiği görülürken kök sözcüklerden ilki ya da ikincisinin temel anlamdan uzaklaştığı bileşik sözcüklerde ise çağrıştırıcı sözcüklerin işlemlenmediği tespit edilmiştir. Bu da ileri düzeyde İngilizce bilen iki dilli katılımcıların ikili işlemleme yöntemini kullandıklarını göstermektedir. Türkçe testinde tek dilli katılımcılar bileşik sözcükleri biçimbirimsel ayrıştırma yöntemiyle işlemlerken bu katılımcı grubunda da anlam kaymasının etkisi gözlemlenmiştir. Anlam kayması olmayan bileşik sözcüklerde ikinci kökü tanıma üzerine biçimbirimsel ayrıştırma yöntemi kullanılırken kök sözcüklerden ilki ya da ikincisinin temel anlamdan uzaklaştığı bileşik sözcüklerde ise bileşik sözcüğü oluşturan her iki sözcükte aktive edilmektedir. Orta ve ileri düzeyde Türkçe bilen iki dilli katılımcıların ise tek dilli katılımcıların aksine bileşik sözcükleri bütünsel listeme yöntemiyle zihinlerinde temsil ettikleri görülmüştür.

Anahtar kelimeler: Anadilde biçimbirimsel yapıların işlemlenmesi, ikinci dilde biçimbirimsel yapıların işlemlenmesi, İngilizce ve Türkçede bileşik sözcükler, maskelenmiş çağrıştırma tekniği ile sözcük tanıma testi, ruhdilbilim

CHAPTER 1

INTRODUCTION

1. 1. Background to the Study

A person encounters a multitude of words during a day and when these words are read, a number of processes occur in the mind. For example, the person must recognize the word and identify its meaning. One question that has been on the forefront of research is how the mental lexicon is organized; in other words, how the words are represented and how these representations are accessed by readers.

The representation of a word in the mental lexicon depends on several factors. One of these factors is the structure of the word, namely if the word is monomorphemic or multimorphemic. Monomorphemic words (e.g., *farm*) consist of a single morpheme which is the smallest unit of meaning. On the other hand, there are also multimorphemic words. One form of multimorphemic words is the inflected form (e.g., *farms*) in which a suffix is added to the end of the word without changing its syntactic class or meaning. A second form of multimorphemic words is the derived form (e.g., *farmer*). In the derived form, an affix is added to the word and this affix can change the syntactic class and the meaning of the word. The last form of multimorphemic words involves compounding (e.g., *farmland*). Compound words consist of two free stems which can stand alone as a word. When two lexemes are combined to create a compound word, the lexeme(s) can either retain or lose the original meaning(s).

The representation of monomorphemic words is quite straightforward since they are nondecomposable items and are stored in the mental lexicon as whole units. However, multimorphemic words have a more complex structure which can modulate the processing and representation of these words. The investigation of multimorphemic words provides an opportunity to study the representation of complex linguistic structures in the mental lexicon. Due to several reasons, among the three types of multimorphemic words, compounds are the most suited complex form to explore the question of whether morpheme representations are involved in the processing of complex words. First of all, compounding is one of the most universal processes to create complex words (Dressler, 2006). Secondly, compounds may consist only of two free morphemes (without any affix) yet inflected and continuous derived forms always include an affix. Finally, while the position of the affix is usually predictable in inflected and derived forms, the position of the constituents in a compound word can be unpredictable (e.g., *bookworm – yearbook*) which allows researchers to test the contribution of each constituent in the processing and representation of compounds.

Different models have been proposed for the processing of multimorphemic words. The Decomposition Model (Taft and Forster, 1975) proposes that a morphologically complex form is parsed into constituent morphemes prior to lexical access suggesting that affixes and words are represented separately. In contrast, The Full-listing Model (Butterworth, 1983) assumes that multimorphemic words are stored as whole units and they are not decomposed into their constituents. However, neither of these opposing models has received unequivocal support from experiments because various lexical factors such as frequency and semantic relationship between the multimorphemic forms and their constituents have been observed to play a decisive role in processing complex forms. As a result, hybrid models that take these factors into account in the processing and representation of multimorphemic words were posited (e.g., Caramazza, Laudanna and Romani, 1988; Schreuder and Baayen, 1995).

Researchers have focused on two important points in raising the question of how compounds are processed. The first aim was to explore if one of the constituents had a significant impact in processing compound words. The results of the studies have suggested diverging results. While some researchers emphasized the significance of the first constituent

(Taft and Forster, 1976; Lacruz, 2005), other studies found empirical evidence for the importance of the second constituent (Juhasz, Starr, Inhoff and Placke, 2003; Marchack, 2011; Duñabeitia, Perea and Carreiras, 2007). There are also studies that documented the prominent role of both constituents (Andrews, Miller and Rayner, 2004; Janssen, Pajtas and Caramazza, 2014). All these studies indicated that compound words were decomposed by accessing one or both constituents.

Another major question in compound processing was whether the semantic transparency of the constituents influenced the processing pattern. Some studies supported the claim that both constituents in compounds were activated regardless of semantic transparency providing further evidence for the presence of decomposition in processing compounds (Libben, Gibson, Yoon and Sandra, 2003; Shoolman and Andrews, 2003; Frisson, Niswander-Klement and Pollatsek, 2008). On the other hand, some researchers claimed that transparent compounds were decomposed but opaque compounds were stored as unanalysed whole units, proposing a dual-route model in compound processing (Sandra, 1990; Zwitserlood, 1994; MacGregor and Shtyrov, 2013).

A body of research that is directly relevant for the present investigation involves Finnish, an agglutinative language like Turkish. Processing studies on Finnish compounds have revealed a significant role of first constituent frequency in the extent of decomposition (Bertram and Hyönä, 2003; Bertram, Pollatsek and Hyönä, 2004; Pollatsek and Hyönä, 2005). Researchers also wanted to identify the role of compound length because Finnish compounds consist of long constituents when compared to English. Bertram and Hyönä (2003), Bertram, Pollatsek and Hyönä (2004) and Bertram and Hyöna (2007) found that long Finnish compounds were decomposed whereas short compounds were accessed via full-listing presenting additional evidence for dual-route.

A handful of studies have sought to describe the processing of compounds with bilingual speakers. While some studies revealed that compounds in L2 were processed via decomposition (Wang, 2010; Ko, Wang and Kim, 2011; Li, Jiang and Gor, 2015), Ko (2011) found evidence for full-listing and Mayila (2010) suggested dual-route for L2 compound processing.

The present study raises the question of how compound words in English and Turkish are processed by bilingual speakers with intermediate and advanced proficiency levels in comparison to monolingual speakers and identify potential differences between native and nonnative speakers in recognizing compound words.

1. 2. Statement of the Problem

English and Turkish compounds share a myriad of linguistic similarities. In both languages, compounding is a highly productive word formation process and compound words are right-headed. In addition, both languages have compounds consisting of two root forms usually made up of two nouns or an adjective plus a noun, which are classified as nominal compounds. These linguistic features make English and Turkish perfect languages to compare compound processing in monolinguals as well as in bilinguals. Comparing Turkish and English monolingual data will enable us to explore cross-linguistic similarities and differences in processing compounds. Similarly, processing data from Turkish-English bilinguals will reveal whether late L2 learners diverge from native speakers despite structural similarities in compounds in Turkish and English.

A substantially high number of studies have been conducted to investigate English compound processing with native speakers and these studies have generally found decompositional processing pattern for compounds. However, semantic transparency has been found to be a crucial factor that may affect the parsing route of compounds. L2 English compound studies are usually conducted with Chinese-English and Korean-English advanced level participants and the number of studies hinders the researchers to provide conclusive evidence in L2 English compound processing.

Evidence for compound processing in Turkish remains scarce because there is only one study that focused on Turkish compounds. Özer (2010) examined the production of Turkish compounds in a morphological priming paradigm by means of a picture naming task and concluded that Turkish compounds were represented in the mental lexicon by being decomposed into their constituents. However, to the best of my knowledge, no study has yet looked at the recognition of Turkish compounds by using a masked priming paradigm. In addition, compound processing in L2 learners of Turkish has not been investigated before.

The present study was designed in light of this background, to particularly compensate for the lack of sufficient empirical evidence for compound processing in Turkish and English as L1 and L2.

1. 3. Purpose of the Study

The present study includes two different but parallel experiments on compound word recognition, one in English and one in Turkish. Since only root-root compounds are used in the English study, the Turkish study also includes root-root compounds. The first aim is to examine the processing of English compounds by monolingual English speakers and Turkish-English bilinguals. The second aim is to explore how Turkish compounds are accessed by Turkish monolinguals and Turkish-English bilinguals.

Specifically, the studies reported here explore the role of constituency, semantic transparency, and of morphological structure in accessing compound words in English and Turkish by both monolingual and bilingual speakers. In other words, both Turkish and English studies explore the same issues. The relevant research questions are formulated as follows.

1. How do native speakers process compounds? More specifically,
    a. Does either constituent 1 or constituent 2 presented as primes lead to shorter reaction times (RTs) than unrelated primes in processing compounds and noncompounds?
    b. Is there a difference between transparent-transparent and partially-opaque compounds in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?
    c. Is there a difference between pseudocompound and monomorphemic words in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?
2. How do sequential bilinguals process compounds in their L2?
    a. Does either constituent 1 or constituent 2 presented as primes lead to shorter reaction times (RTs) than unrelated primes in processing compounds and noncompounds?
    b. Is there a difference between transparent-transparent and partially-opaque compounds in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?
    c. Is there a difference between pseudocompound and monomorphemic words in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?

3. Is there a difference among the monolinguals and sequential bilinguals in processing compounds?
4. What pedagogical implications will these studies have in teaching compounds?

1. 4. Overview of Methodology

1. 4. 1. Participants

For the English compound study, 63 monolingual English speakers (38 female and 25 male), 51 intermediate level (32 female and 19 male) and 51 advanced level (31 female and 20 male) Turkish-English sequential bilinguals were recruited.

For the Turkish compound study, 73 monolingual Turkish speakers (57 female and 16 male), 36 intermediate level (21 female and 15 male) and 35 advanced level (24 female and 11 male) English-Turkish sequential bilinguals participated in the experiment.

1. 4. 2. Setting

The present study was conducted in Istanbul, Turkey.

1. 4. 3. Data Collection Instruments

The data collection instruments in the English study included a background questionnaire, an English proficiency test and a masked priming task. The background questionnaire was prepared to collect demographic and linguistic information from the participants. The English proficiency test of Yeditepe University determined English proficiency level of the bilingual participants. Finally, E-prime 2.0 (Schneider, Eshman and Zuccolotto, 2002) was used for a masked priming lexical decision task.

For the Turkish study, besides a background questionnaire and a masked priming lexical decision task, a semantic transparency judgment test and a Turkish placement test were employed. The transparency judgment test was used to decide on the semantic transparency level of certain Turkish compound words. The Turkish placement test of Istanbul University Language Center determined the Turkish proficiency level of the bilingual participants.

1. 4. 4. Data Analysis

Descriptive statistics and repeated measures ANOVA were conducted on the mean RTs of the items. Following Shoolman and Andrew's (2003, p. 259) study, the mean RTs to the two sets of compounds (transparent and partially-opaque) was compared with the mean RTs to the noncompound words (pseudocompounds and monomorphemic items) to determine the effect of morphological structure. Fully-transparent compounds were compared with partially-opaque compounds to evaluate the semantic contributions. In addition, pseudocompound words were compared with monomorphemic words to assess the lexical status of constituents. Finally, to test the overall priming effect, the mean RTs to the targets appearing after the first and second constituent primes were compared to those appearing after the unrelated prime. Furthermore, priming effects obtained from the first and second constituent primes were compared to evaluate any constituency-based differential processing pattern.

1. 5. Organization of the Study

This study comprises nine chapters including this introduction chapter presented as Chapter 1. The second chapter provides information about the linguistic structure under investigation, namely compounding by focusing on its definition and types together with the properties and types of English and Turkish compounds. Chapter 3 focuses on the models of morphological processing and representation of multimorphemic words mainly describing psycholinguistic methods used to investigate the mental lexicon and different processing patterns including decomposition, full-listing and hybrid (dual-route) models. Chapter 4 provides a detailed literature review on the processing of multimorphemic words in the L1 in Germanic, Romance and agglutinative languages and Chapter 5 reports studies investigating the processing of multimorphemic words in the L2. The subsequent chapter, Chapter 6, details the parallel studies conducted in English and Turkish and describes the research questions and predictions together with the methodology of the studies, namely, the participants, tasks, materials, procedure and data analysis in detail. Chapter 7 reports on the results of English and Turkish studies. Chapter 8 provides a detailed discussion of the findings in both studies. Finally, Chapter 9 provides concluding remarks followed by implications, limitations and suggestions for further research. References and appendices are provided at the end of the study.

1. 6. Definitions of Significant Terms

Constituent 1: is the first lexeme of a compound (e.g., *tooth* in *toothbrush*, *yüksek* 'high' in *yüksekokul* 'high school').

Constituent 2: is the second lexeme of a compound (e.g., *brush* in *toothbrush*, *okul* 'school' in *yüksekokul* 'high school').

Decomposition: is the model proposed by Taft and Forster (1975), which claims that the constituent morphemes rather than the whole word are listed in the mental lexicon.

Dual-route: is the model (Caramazza, Laudanna and Romani, 1988; Schreuder and Baayen, 1995 among many others) that suggests the frequency and semantic transparency of the constituents can affect the way multimorphemic words are processed.

Full-listing: is the model proposed first by Butterworth (1983), which assumes that complex words have their own representations in the mental lexicon implying no morphological decomposition in word recognition.

Masked priming: is a psycholinguistic experimental technique in which a series of hash marks are presented on the screen for 500 msec followed by a morphologically, orthographically-, phonologically- or semantically-related prime for a very short time (around 40-60 msec) followed by a target word on which participants are required to make a word/nonword decision.

Mental lexicon: is an imaginary mental dictionary that contains information about a word's phonological, morphological, orthographic, semantic, and syntactic features.

Morphological processing: is the study of how simple and complex words are accessed and retrieved from the mental lexicon during word recognition or production.

Monomorphemic word: is the root form of a word that cannot be decomposed (e.g., *crocodile* and *kağlumbağa* 'turtle').

Multimorphemic word: is a complex word form consisting of a root and (an) affix(es) or two root words.

Opaque-opaque: indicates that both constituents of a compound have lost their original meanings (e.g., *hogwash* and *karakol* 'headquarters', *kara* 'black', *kol* 'arm').

Opaque-transparent: indicates that the first constituent of a compound has lost its original meaning (e.g., *strawberry* and *büyükelçi* 'ambassador', *büyük* 'big', *elçi* 'delegate).

Parsing: is a psycholinguistic term that refers to online computation of linguistic structures during word recognition.

Partially-opaque (partially-transparent): indicates that either the first or the second constituent has lost its original meaning (e.g., *eggplant* and *baykuş* 'owl', *bay* 'mister', *kuş* 'bird').

Priming effect: is the effect observed when a prime word facilitates the recognition of the target word.

Pseudocompound: is a word that consists of two constituents that can stand alone as free morphemes but does not serve that function in a word context (e.g., *mandate* and *fesleğen* 'basil', *fes* 'fez', *leğen* 'bowl').

Reaction time: is the duration in which the participant makes a decision as to whether a (visually) presented word on the screen is a word or not in a given language.

Sequential bilingual: an individual who began learning a second/foreign language after the age of 10. In that sense, the term is used interchangeably with "(late) L2 learner".

Semantic transparency: refers to the degree of semantic relationship between the multimorphemic forms and their constituents.

Transparent-opaque: indicates that the second constituent of a compound has lost its original meaning (e.g., *jailbird* and *kafatası* ‘skull’, *kafa* ‘head’, *tas* ‘cup’).

Transparent-transparent: indicates that both constituents of a compound retain their original meanings (e.g., *carwash* and *güneydoğu* ‘southeast’, *güney* ‘south’, *doğu* ‘east’).

CHAPTER 2

LINGUISTIC STRUCTURE UNDER INVESTIGATION

2. 1. What is a Compound?

Natural languages make use of a number of formal means for the formation of complex lexemes: compounding, affixation, reduplication, conversion, stem alternation, stress and tone (Bauer, 1983). The most common morphologically complex forms in languages consist of inflection, derivation and compounding. According to Dressler (2006, p. 23), compounding is the "widespread morphological technique" for word formation. The process of compounding has been defined by various linguists over time. For example, Libben (2006, p. 2) also considers compounding to be the universally fundamental word formation process as it offers the easiest and most effective way to create and transfer new meanings. Booij (2005a, p.75) claims that "compounding is the most frequent way of making new lexemes in many languages" (see also Booij, 2011).

The defining property of compounding is that it combines lexemes into larger words. More specifically, compounding is the combination of two lexemes, one of which (i.e., the nonhead) modifies the meaning of the other (e.g., Bauer, 1983, 2001, 2006; Plag, 2003; Delahunty and Garvey, 2010).

Although compounding and derivation have been considered to be important processes in creating morphologically complex forms, there are also certain characteristics that distinguish them from each other. First of all, Booij (2005b, p. 109) emphasizes that compounding consists of the combination of two or more lexemes whereas continuous derivation is characterized by the addition of an affix (i.e., a bound morpheme) to a lexeme. For example, the English word *artist* is formed by the free form *art* and an affix, the bound morpheme *–ist*. In contrast, a compound word consists of two stems (e.g., *football* is formed by the stems of *foot* and *ball*). Secondly, as noted in Anderson (1992, p. 292-297), derivation involves a set of operations on lexemes to derive new lexemes. These operations have a phonological aspect (i.e., addition of a phonological string or some other phonological operations), a semantic aspect (i.e., change in the meaning) and a syntactic aspect (i.e., the syntactic (sub)category of the new lexeme) and all these operations are part of the "word formation rule". When a new word is formed by a derivational rule, its new phonological, syntactic and semantic properties are specified by that rule. In contrast, compounding forms part of syntax and combines lexical stems into compounds by applying "word structure rules". This distinction allows the compounds to have a word internal structure. To illustrate, there are rules for adding linking elements into German compounds that must have access to the internal structure (e.g., in the German compound *schwanengesang* 'swan song', the two lexemes *schwan* and *gesang* are joined by the element *–en* which serves as a "glue" in the compound).

In addition, Ten Hacken (1994, as cited in Sepp, 2006) proposes that compound elements can either be the head or non-head of the structure, but affixes are of a different nature. For instance, derivational suffixes are always placed in the final position of a derived word, so the position of the suffix is quite predictable. However, in compound words, the position of each constituent is unpredictable because, for example the lexeme *book* is the first constituent in the English compound *bookstore* and the second constituent in *bankbook*.

2. 2. Types of Compounds

There are two important features that determine the types of compounds in general: headedness and semantic features.

An important property of compounds is that they are usually headed. According to Delahunty and Garvey (2010), the head of a compound is the constituent modified by the compound's other constituents. Katamba (1994) also notes the importance of headedness in compounds which means that one of the constituents that make up the compound is syntactically dominant. The syntactic head is usually the semantic head of the compound and the non-head element specifies some characteristics of the head. In addition, Koester and Schiller (2008) express that one constituent of a compound has a distinguished status in determining the compound's syntactic category and semantic class. For example, in the compound *football*, the head is *ball* which is modified by *foot*. In the same vein, Scalise and Fábregas (2010) note three types of information that the head of a compound imposes, namely the compound's grammatical category, semantics and morphological properties.

It has been observed that while most of the compounds are universally right-headed, there are also left-headed compounds (Booij, 2005a). Scalise and Vogel (2010, p. 9) present the frequency of compound types with different head positions and conclude that 66.7% of languages are right-headed while 6.8% are left-headed. For example, most of the Germanic languages (e.g., English, German and Dutch) have right-headed compounds. Despite few in number, there are also languages with left-headed compounds (e.g. Maori spoken in New Zealand) (Booij, 2005a, p. 78). In addition, it is also possible for several languages to have both right and left-headed compounds. This is the case for Romance languages such as Italian, French and Spanish (Booij, 2010). El Yagoubi, Chiarelli, Mondini, Perroni, Danieli and Semenza (2008, p. 561) note that Italian noun-noun compounds may be either right-headed (e.g., *astronave* 'spaceship') or left-headed (e.g., *capobanda* 'band leader'). Furthermore, Jarema (2006, p. 56) indicates that French adjective-noun compounds can be right-headed (e.g., *garçon manqué* 'tomboy') or left-headed (e.g., *grasse matiné* 'sleep-in').

Linguists also distinguish at least three different semantic relations between the head and modifier of compounds (Delahunty and Garvey, 2010, p.135): First, the compound represents a subtype of whatever the head represents. For instance, a *traffic-cop* is a kind of cop, a *teapot* is a kind of pot, and a *fog-lamp* is a kind of lamp. That is, the head names the type, and the compound names the subtype. These are called 'endocentric compounds'. Second, the compound names a subtype, but the type is not represented by either the head or the modifier in the compound. For example, *deadhead, redhead,* and *pickpocket* represent types of people by denoting some distinguishing characteristics. There is typically another word, not included as a constituent in the compound that represents the type of which the compound represents the subtype. In the case of *deadhead, redhead,* and *pickpocket*, this other word is a *person*, so a *pickpocket* is a person who steals money from other people's pockets. These are called 'exocentric compounds'. Third, there are compounds in which both elements are heads; each contributes equally to the meaning of the whole and neither is subordinate to the other. For instance, compounds like *bitter-sweet* can be paraphrased as both X and Y (e.g., "bitter and sweet"). Other examples include *teacher-researcher* and *producer-director*. These are referred to as 'coordinative compounds'. In their classification, Bisetto and Scalise (2011, p. 64-65) note subordinate and attributive compounds. In subordinate compounds, there is a complement relation between the two constituents (e.g., in the compound *taxi driver*, *taxi* is the complement of the deverbal head). The complement relation between the two constituents is of a subordinative type. Attributive compounds are formed either by an adjective and a noun (e.g., *blue cheese*) in which the adjective expresses a property and is in a modifier relation to the noun or by two nouns (e.g., *swordfish*) in which the non-head is often used metaphorically, expressing an attribute of the head.

The second important feature of compounds is the semantic property which refers to the compositional meaning of a compound. For instance, if the compound is fully-transparent, it means the semantic properties of the compound can be fully composed. Less lexicalization means more transparency but more lexicalization means more opacity. More transparency implies more motivation to identify the compound via its constituents (Dressler, 2005, p. 271).

Based on this approach, four fundamental degrees of semantic transparency are observed in compounds: transparency of both members (e.g., *door-bell*), transparency of the head member, opacity of the non-head member (e.g., *straw-berry*), opacity of the head member, transparency of the non-head member (e.g., *jail-bird*) and opacity of both members (e.g., *hum-bug*). This transparency scale presupposes that transparency of the head is more important than the transparency of the non-head (Dressler, 2005, p. 272) since the head assigns the relevant semantic, syntactic and morphological properties of the whole compound (Dressler, 2006, p. 31).

In sum, the interpretation of a compound word relies on the head structure of the compound and the semantic transparency of the constituents (Plag, 2003, p. 193). An endocentric compound such as *teapot* is easier to interpret because it is a type of *pot*. However, the same interpretation cannot be applied to exocentric compounds because *pickpocket* is not a kind of *pocket*. In addition, semantic transparency of the constituents, especially the head constituent eases the interpretation of compounds since a compound word inherits its basic properties (i.e., semantic, syntactic and morphological) from its head.

2. 3. Compounds in English

Compounding together with inflection and derivation is one of the most frequently used word formation process in English. It is suggested that the raw material of English compounds is a root, a lexeme or a phrase in the non-head position, and a root or a lexeme in the head position (Trias, 2010, p. 109). Furthermore, although it has been proposed that most English compounds are right-headed, Carstairs-McCarthy (2002, p. 64-65) states that there are also some headless (i.e., exocentric) compounds in English. For example, the compound *loudmouth* is not a kind of *mouth*; therefore, it is classified as headless. Other examples include *pickpocket*, *stickleback*, *sabretooth*, *redneck* and *greenback*.

According to Carstairs-McCarthy (2002), there are three types of compounds in English: compound verbs, compound adjectives, and compound nouns:

Firstly, the class of compound verbs is quite uncommon in English (Conti, 2006, p. 15). Compound verbs are less usual than verbs derived by affixation. Nevertheless, a variety of types exist which may be distinguished according to their structure: Verb–Verb (VV): *stir-fry*, *freeze-dry*, Noun–Verb (NV): *hand-wash*, *steam-clean*, Adjective–Verb (AV): *dry-clean*, *whitewash*, and Preposition–Verb (PV): *underestimate*, *outrun*, *overcook* (Carstairs-McCarthy, 2002, p. 60).

The second class constitutes adjective compounds and it represents a minority group with respect to nominal compounds (Conti, 2006, p. 15). Compound adjectives include the following types: Noun–Adjective (NA): *sky-high*, *coal-black*, *oil-rich*, Adjective–Adjective (AA): *grey-green*, *squeaky-clean*, *red-hot*, and Preposition–Adjective (PA): *underfull*, *overactive* (Carstairs-McCarthy, 2002, p. 61).

Finally, the largest class of compounds in English includes compound nouns. The CELEX database list 1437 noun-noun compounds (Libben, 2005, p. 269). Noun-noun compounds in English are usually endocentric (Conti, 2006, p. 13-14). The main types of compound nouns are: Verb–Noun (VN): *swearword*, *drop hammer*, *playtime*, Noun–Noun (NN): *hairnet*, *mosquito net*, *butterfly net*, Adjective–Noun (AN): *blackboard*, *greenstone*, *faint heart*, and Preposition–Noun (PN): *in-group*, *outpost*, *overcoat* (Carstairs-McCarthy, 2002, p. 62).

Furthermore, suffixes can be added to the head of the compound. According to Fabb (2001, p. 67), English has synthetic or deverbal compounds in which the head of the compound is a derived word consisting of a verb and an affix (e.g., agentive *–er* "*meat eater*" and nominal and adjectival *–ing* "*window cleaning*").

In terms of semantic properties, four types of compounds are identified based on transparency: transparent-transparent (e.g., *carwash*, both elements are transparent), opaque-transparent (e.g., *strawberry*, the head of the compound word (i.e., *berry*) is transparent, but the non-head element is not transparent), transparent-opaque (e.g., *jailbird*, the head element of the compound word is not transparent, but the other one is transparent) and opaque-opaque (e.g., *hogwash*, neither of the elements is transparent) (Libben, Gibson, Yoon and Sandra, 2003). Crucially, constituents are not transparent or opaque by themselves, but only when they are considered within a given compound (e.g., *wash* is transparent in *carwash* but opaque in *hogwash*).

According to Delahunty and Garvey (2010, p.132), in ordinary English spelling, compounds are sometimes spelled as a single word (e.g., *sawmill, sawdust*), sometimes by a hyphen (e.g., *hand-wash*) and sometimes as two words (e.g., *chain saw, oil well*). However, dictionaries may differ in their spellings.

2. 4. Compounds in Turkish

Compounding in Turkish is a productive and regular word formation process (Dede, 1978) and Turkish compounds are composed of constituents that are words (Göksel, 2009).

Most Turkish compounds are right-headed (Yükseker, 1987; Göksel and Haznedar, 2007). The first constituent of the compound defines or limits the meaning of the second constituent, which is the head of the compound (Banguoğlu, 1998). According to Göksel and Haznedar (2007, p. 8), not all compounds are right-headed. Some compounds in Turkish are left-headed and these compounds are loans from Arabic such as *tebdil-i kıyafet* '(dress) in cognito'. There are also double-headed compounds such as *gelin kaynana* '(as) daughter-in-law (and) mother-in-law'. Finally, the note variant compounds in Turkish where the order of constituents is variant. For example, *balık ızgara* or *ızgara balık* 'grilled fish' is an example of variant compounds which usually refer to dishes. In these compounds, the position of the head is not clear.

Turkish has various ways of forming compound structures such as verbal compounds, adjectival compounds, and nominal compounds (Aslan and Altan, 2006). First of all, verbal compounds consist of Noun-Verb (NV): *banyo yapmak* 'to take a bath', *yazı yazmak* 'to write', Verb-Verb (VV): *kaptıkaçtı* 'stealing by snatching', *yapboz* 'jigsaw puzzle' and Adjective-Verb (AV): *pişman olmak* 'to regret' (Kornfilt, 1997, p. 477-478).

Secondly, adjectival compounds involve Noun-Adjective (NA): *sütbeyaz* 'milk white', *eli açık* 'generous' and Adjective-Adjective (AA): *alçak gönüllü* 'humble', *aç gözlü* 'greedy' (Kornfilt, 1997, p. 479-480).

Finally, nominal compounds include Noun-Noun (NN): *babaanne* 'paternal grandmother', *anneanne* 'maternal grandmother', Adjective-Noun (AN): *büyükbaba* 'grandfather', *düz taban* 'flat footed' and Numeral-Noun (NuN): *kırkayak* 'centipede' (Kornfilt, 1997, p. 473-476).

Moreover, nominal compounds are divided into two groups by Göksel and Kerslake (2005, p. 94-95): bare compounds and *–(s)I* compounds. Bare noun compounds consist of two juxtaposed nouns with no suffixation to mark the relation between them (e.g., *erkek kardeş* 'brother'). Although the study does not cover the second type of compounds, it is important to note that this type of nominal compounding with *–(s)I* is a very productive way of combining two or more lexical items in Turkish. The compound marker *–(s)I* is added to the head element as in *halı atölye-si* 'carpet plant' (Kırkıcı, 2007, p.12) and it distinguishes noun-noun compounds, e.g., *yaz peri-si* 'summer fairy', from noun phrases, e.g., *çalışkan peri* 'a/the hardworking fairy' (Kunduracı, 2013, p. 10). The position of the compound marker *–(s)I* in Turkish is unusual when compared to many of the world languages because compound markers are mostly found between two constituents of a compound (Tat, 2013, p. 34). Within this context, Birtürk and Fong (2001) discuss two types of *–s(I)* constructions: definite and indefinite ones. The definite construction takes the form "Noun-GEN Noun-POSS" and generally corresponds to English "Noun's Noun" or "Noun of the Noun" type syntactic phrases (e.g., *bahçe-nin kapı-sı* 'the gate of garden'). The indefinite construction takes the form "Noun Noun-POSS" and corresponds to the English "Noun Noun" compounds (e.g., *bahçe kapı-sı* 'garden gate'). Lewis (1967, p. 42) explains that in the definite construction, the first element is a definite person or thing to which the second element belongs. The indefinite construction is used when the relationship between the two elements is merely qualificatory and not as intimate or possessive as indicated by the definite construction. Dede (1978, p. 15) states that the possessive suffix of the second constituent shows that there is a syntactic and semantic relationship between the two members of the compound. Göksel and Kerslake (2005, p. 96) note that the possessive suffix in compounds does not indicate possession, but it functions as a grammatical indicator of the compounding indicating the combination of two nouns. A comprehensive analysis of the appearance of a suffix, *-(s)I* in these types of Noun-Noun compounds in Turkish is provided in Kunduracı (2013), for whom *-(s)I* is only a formal (i.e., morphological) element of the compounding operation.

As a further note, *-s(I)* construction is used in a number of ways (Aslan and Altan, 2006, p. 58). Primarily, they refer to a certain entity (e.g. *ayakkabı* ‘shoe’, *yemek odası* ‘dining room’). They also denote different varieties of a certain kind, where the first element specifies the type of the head (e.g. *arıkuşu* ‘bee-eater’, *devekuşu* ‘ostrich’, *çörekotu* ‘black cumin’, *ökseotu* ‘mistletoe’, *toplum bilimi* ‘sociology’, *anlam bilimi* ‘semantics’). They can also signify geographical places such as cities, mountains, lakes or rivers (e.g. *Ankara şehri* ‘Ankara city’, *Van Gölü* ‘Lake Van’, *Toros Dağları* ‘Taurus Mountains’). *-s(I)* compounds are also used to denote something which is peculiar to a specific nation or city (e.g. *Türk kahvesi* ‘Turkish coffee’, *Malatya kayısısı* ‘Malatya apricot’) and certain kinds of professions (e.g., *ev hanımı* ‘housewife’, *banka müdürü* ‘bank manager’).

Turkish compounds can also consist of inflected or derived forms. Göksel and Haznedar (2007, p. 23) indicate that Turkish compounds may be in the form of an inflected verb (e.g., *kap-tıkaç-tı* ‘stealing by snatching’*, çıtkırıl-dım* ‘fragile’), an inflected noun (e.g., *kar-dan adam* ‘snowman’), or a participle (e.g., *yan-ardağ* ‘volcano’*, yurtsev-er* ‘patriotic’). In addition, Kornfilt (1997, p. 480) notes that some adjectival compounds have nominal complements that bear case morphology (e.g., *ana-dan doğma* ‘stark naked’*, kafa-dan kontak* ‘nutty’). Kornfilt (1997, p. 474) also points that either one or both of the nouns in Turkish nominal compounds can be derived forms (e.g., *oku-ma kitabı* ‘reading book’, *oku-ma iste-ği* ‘the urge to read’).

In terms of semantic properties, Turkish compounds are generally divided into four groups (Şenel, 2009, p. 103-104; Doğan, 2013, p. 405; Karacaoğlu, 2010, p. 12): transparent-transparent (e.g., *diş fırçası* ‘toothbrush’), opaque-transparent (e.g., *dereotu* ‘dill’), transparent-opaque (e.g., *rüzgargülü* ‘wind rose’) and opaque-opaque (e.g., *ayşekadın* ‘string bean).

As a final note, compounds in Turkish can be written in two types: as one word (e.g., *anneanne* ‘maternal grandmother’*, anayasa* ‘constitution’) or as two separate words (e.g., *altın bilezik* ‘golden bracelet’*, kız kardeş* ‘younger sister’) but not hyphenated (Aslan and Altan, 2006, p. 58).

2. 5. Summary

This chapter provided information about the different characteristics of compounds in English and Turkish. The table below summarizes the type of compounds available in the two languages.

Table 1.

Types and features of English and Turkish compounds

	English	Turkish
Head	mostly right-headed	mostly right-headed
Verbal Compounds	Verb-Verb: *drink-drive* Noun-Verb: *babysit* Adj-Verb: *deep-fry* Prep-Verb: *outdo*	Verb-Verb: *çekyat* ‘sofa’ Noun-Verb: *alay etmek* ‘to ridicule’ Adj-Verb: *üzgün olmak* ‘be sad’ Prep-Verb: No
Adjectival Compounds	Noun-Adj: *ice-cold* Adj-Adj: *bittersweet* Prep-Adj: *overconfident*	Noun-Adj: *cin fikirli* ‘clever’ Adj-Adj: *delikanlı* ‘young man’ Prep-Adj: No
Nominal Compounds	Verb-Noun: *playground* Noun-Noun: *olive oil* Adj-Noun: *blackmail* Prep-Noun: *afterlife* Adv-Noun: No Numeral-Noun: No	Verb-Noun: No Noun-Noun: *karı koca* ‘couple’ Adj-Noun: *karaağaç* ‘elm’ Prep-Noun: No[1] Adv-Noun: *çalakalem* ‘write busily’ Numeral-Noun: *onbaşı* ‘corporal’
	No *-s(I)* construction in English	Definite *-s(I)* construction: *sokağ-ın son-u* ‘the end of the street’

[1] Turkish, as an SOV language, does not have prepositions but has postpositions. Postpositions in nominal compounds are very limited in number (e.g., *sabaha karşı* ‘towards the morning’, *milattan sonra* ‘anno domini’, *milattan önce* ‘before Christ’, *öğleden sonra* ‘afternoon’, *okul sonrası* ‘post school, *okul öncesi* ‘preschool, *tarih öncesi* ‘prehistory’).

-s(I) Construction		Indefinite *-s(I)* construction: *ders kitab-ı* 'course book'
Suffixes in Compounds	*-er*: *bookseller* *-ing*: *window-shopping* plural: *footprints*	possessive: *baş-ı bozuk* 'subversive' participle: *bilgisay-ar* 'computer' ablative: *kum-dan kale* 'sandcastle' dative: *gün-e bakan* 'sunflower' plural: *kör-ler okulu* 'school for blinds' tense: *mirasye-di* 'spendthrift'
Transparency	TT: *birthplace* OT: *butterfly* TO: *homesick* OO: *hotdog*	TT: *kahverengi* 'brown' OT: *ateş böceği* 'glowworm' TO: *atlı karınca* 'carousel' OO: *aslanağzı* 'napdragon'
Spelling	Single word: *washroom* Two words: *toy store* Hyphened: *flower-pot*	Single word: *başbakan* 'prime minister' Two words: *demir kapı* 'iron door' Hyphened: No

As noted earlier, this study examines the processing of nominal compounding in English and Turkish. Nominal compounds tested in these two languages are written as a single word and are in the root-root form without any inflections. While in English, all tested items are noun-noun compounds, Turkish items also include adjective-noun compounds. As discussed above, in English and Turkish, compounds are mostly right-headed, and they can be divided into four groups in terms of their semantic transparency.

CHAPTER 3

METHODS AND MODELS FOR MORPHOLOGICAL PROCESSING AND REPRESENTATION OF MULTIMORPHEMIC WORDS

Since the publication of the seminal work of Taft and Forster (1975) involving a lexical decision task to investigate the processing of morphologically complex words, numerous studies have been conducted in different languages via various methods to explore how monomorphemic and multimorphemic words are processed and represented in the mental lexicon. This chapter presents the main techniques used in this line of research and models of the mental lexicon emerging on the basis of processing data accumulated over the years.

3. 1. Psycholinguistic Methods Used to Investigate the Mental Lexicon

The mental lexicon is assumed to contain both monomorphemic and multimorphemic words. Different psycholinguistic methods have been developed to examine to understand how these simple and complex words are stored/represented and processed in the mental lexicon. Particularly, the question investigated has been whether or not words with complex morphology are accessed via whole-word and morpheme-based (i.e. constituent activation) processing pattern. The online methods used to examine processing at the lexical level mostly involve computer-based lexical decision tasks and eye-movement experiments although there are also studies based on electrophysiological recordings and neuroimaging. As described below, lexical decision tasks consist of simple lexical decision (without any prime) or lexical decision with overt or masked primes. These lexical decision tasks can be visual or auditory. All these different methods have made different contributions to our understanding of the patterns of lexical access/recognition. However, in this chapter, the main focus will be on simple and masked lexical decision methods that have been used to explore the processing of compound words.

As noted above, lexical decision tasks are commonly used in word recognition research. In a simple lexical decision experiment, participants are shown a string of letters on the center of a computer screen and asked to decide, as quickly and as accurately as possible, whether or not the form they see on the screen is a real word in a particular language. Participants normally respond (as yes or no) by pressing a designated key on the computer's keyboard. For example, the word *cat* would receive a 'yes' response while the letter string *blit* would receive a 'no' response as it is a nonword in English. Participants' response time (also known as reading/reaction time) is recorded via specially-written softwares (Trofimovich & McDonough, 2011, p. 26). Reaction times (RTs) and errors are used to deduce the structure of the mental lexicon. Target words and nonwords usually consist of monomorphemic and multimorphemic words (Mayila, 2010, p. 17). In this paradigm, longer RTs to morphologically complex words as compared to length- and frequency-matched monomorphemic words are taken to indicate morphological decomposition because when a multimorphemic word takes longer to access than a monomorphemic word, which differs only on the basis of morphological structure, this suggests that there is a cost that comes from morphemic computation. Simple lexical decision tasks have provided valuable information regarding the nature of lexical representation by offering methodological benefits of a strict time-sensitive measurement without the effect of sentential context. However, this method is not without its drawbacks. First of all, since lexical decision is a single response measure taken at the end stage of processing, there is the possibility that responses may be affected by various variables such as frequency, length, semantic transparency and morphological complexity (Fiorentino, 2006). In addition, while lexical decision tasks reveal some aspects of word processing, they do not resemble normal reading because there is only one word or nonword to be seen at a time

(Häikiö, 2011, p. 23). In compound studies (e.g., Taft and Forster, 1976; Andrews, 1986; Juhasz, Starr, Inhoff and Placke, 2003), lexical decision tasks have been used by manipulating the constituent frequency as well as transparency of compound words to identify to what extent these features influence the speed and accuracy in compound processing.

Besides simple lexical decision tasks, there are also priming tasks. Priming experiments have also been extensively used in order to examine the role of morphology in processing multimorphemic words. Priming is the process that leads to the increase in speed and/or accuracy of response to a stimulus called "target" based on the occurrence of a prior exposure to another stimulus defined as "prime" (Tulving, Schacter and Stark, 1982). In other words, the term priming refers to the phenomenon in which prior exposure to a specific language form or meaning either facilitates or interferes with a speaker's subsequent language comprehension or production (Trofimovich and McDonough, 2011, p. 4). In priming experiments, participants are exposed to a prime word for a short duration (around 40-60 msec) which is subsequently followed by a target word. This is the difference between simple lexical decision tasks and priming tasks. The relation between the prime and target words can be morphological, phonological, orthographical or semantical. The analysis of the RTs demonstrates how target items are processed and represented in the mental lexicon, that is, whether they are decomposed into their constituent morphemes or accessed as whole words. In the priming paradigm, the RTs to a particular target word after an orthographically, semantically or morphologically related prime are compared to the RTs to the same target after an unrelated prime. If the RTs are shorter (i.e. if the target word is accessed faster) subsequent to an orthographically, semantically and morphologically related prime than the RTs obtained after an unrelated prime, this is taken to indicate an orthographic, semantic and morphologically priming, respectively. In priming paradigms, the prime and the target can be presented visually or aurally. There are also cross-modal priming paradigms where the prime is presented aurally while the target is a visual stimulus.

As discussed below in detail, priming studies involving compounds use either the compound word itself or one of its constituent roots as primes or targets. In both ways, priming tasks have been particularly revealing, first of all, for identifying the nature of the organization of the mental lexicon (i.e., how different words are associated with or linked with each other) and secondly, for determining the extent of morphological decomposition in accessing multimorphemic words.

Regarding the second issue, employing priming experiments has enabled researchers to explore whether compound words have a decomposed representation (i.e., as evidenced by the activation of one of the constituents) or a whole-word/full-listing representation (i.e., as reflected by the absence of activation of the constituent morphemes) in the mental lexicon (Isel, Gunter and Friederici, 2003). Linked with this main question, researchers have examined whether properties such as frequency, headedness, and semantic transparency make an impact on the processing pattern (decomposition versus full-listing).

The first type of priming experiment that has been used in investigating the processing of compounds is semantic priming. Semantic priming is used to identify the semantically-determined links among words as it reveals associative relations among representations in the mental lexicon (Sandra, 1990). One of the compound studies employing semantic priming paradigm was conducted in Dutch by Sandra (1990). He compared the processing of transparent and opaque compounds by using semantic associates of the constituents as primes and the compound words as targets. For example, the words *woman* and *bread* are used as primes for the target word *milkman* and *butterfly*, respectively. His findings showed that priming effect was evident for transparent compounds but not for opaque compounds. In other words, transparent compounds tended to be decomposed while opaque ones did not. In another semantic priming study, Zwitserlood (1994) compared the RTs for transparent, partially-opaque and opaque compounds in Dutch by using the compound words as the prime and the constituents as the target and found priming effect for both transparent and partially-opaque compounds.

Studies conducted subsequently to these early works pointed out some weaknesses in Sandra (1990). One of the main problems of the study was that the opaque compounds used in the study were actually semi-opaque (not completely opaque) as one of the constituents was transparent (e.g. *butterfly* and *Sunday*) (Zwitserlood, 1994; Libben, 1998; Libben, Gibson, Yoon and Sandra, 2003). Therefore, the results of the study were also taken with caution. For example, Lorenz, Heide and Burchert (2014, p. 89) stated that the semantic priming effect might have resulted from the stronger connections at the semantic level established between the transparent compounds and their constituents compared to opaque compounds. Shoolman and Andrews (2003, p. 249) also indicated that the semantic primes of transparent compounds were more strongly related in meaning to the compound target leading to faster responses for transparent compounds as the participants might have been biased to respond as "Yes" to targets preceded by a related prime. Finally, Koester, Gunter and Wagner (2007, p.73) explained that the lack of semantic priming for opaque compounds could simply reflect the unrelatedness between the meaning of the compound and its constituents rather than the absence of an attempt at combinatorial parsing.

There are also several factors that may lead to discrepancy in the results of these studies. To start with, both semantic priming studies differed in the stimuli they used. Sandra (1990) used semantic associates as primes; however, Zwitserlood (1994) used the compounds as primes. Another factor of discrepancy may be related to the latency between the presentation of prime and target. Zwitserlood (1994) used a constant stimulus-onset asynchrony (SOA) of

300 msec whereas Sandra (1990) used a response-to-stimulus (SRI) interval which was much longer (Zwitserlood, 1994, p. 363). According to Gagné (2011, p. 422), this longer latency might have allowed more time for the activation of constituents to decay and this decay might have reduced the possibility of the prime to activate the constituents in the target. These factors led researchers to employ another type of priming, namely morphological priming.

In the morphological priming paradigm, the constituents of the compounds are used as primes, which are immediately followed by the compound, which is presented as a target. This paradigm enhances the opportunity to explore what occurs in word recognition under the morpheme decomposition hypothesis because morphological priming paradigm enables the researchers to investigate whether prior activation of a compound's constituents facilitates the recognition of the whole word (Libben, Gibson, Yoon and Sandra, 2003, p. 59). It also provides insights about the extent to which constituents are activated when accessing a compound word (Vergara-Martinez, Duñabeitia, Laka and Carreiras, 2009). Libben, Gibson, Yoon and Sandra (2003) used morphological priming to explore the processing of compounds and obtained different results with this priming paradigm compared to Sandra (1990) and Zwitserlood (1994). They observed morphological priming for all types of compounds; however, the strongest facilitation was obtained for transparent compounds. They suggested that the discrepancy between their and Sandra's (1990) results was related to employing different experimental paradigms. Morphological priming targets the activation of constituents in word recognition process whereas semantic priming targets semantic association within the lexicon. While the prime word in morphological priming primes the actual form of a constituent as a unit of recognition, a semantic associate would not directly affect such a unit of recognition. For example, the prime *wash* is more likely to facilitate the activation of the target compound *hogwash* as it primes the actual form of a constituent as a unit of recognition. On the other hand, an associative prime of *wash* such as *soap* would not directly affect such a unit of recognition (Libben, Gibson, Yoon and Sandra, 2003, p. 63).

Overt morphological priming studies have been criticized for employing long prime exposures. For example, Libben, Gibson, Yoon and Sandra, (2003) and Jarema, Busson, Nikolova, Tsapkini and Libben (1999) employed prime exposures for 150 msec, which might affect the results since both prime and target words were consciously seen and processed (Duñabeitia, Laka, Perea and Carreiras, 2009, p. 7-8). In other word, this duration is long enough to make it possible for the parser to consciously perceive/recognize the prime (Arcara, 2009, p. 45-46).

Because of the weaknesses of semantic priming and the long priming duration of morphological priming, many researchers started to employ masked priming paradigm. The masked priming paradigm was first introduced by Forster and Davis (1984). This method is also referred as a "sandwich" technique because the prime is sandwiched between a forward pattern mask (#####) and the target stimulus. The mask is displayed for 500 msec followed immediately by the prime for 50 msec that is followed by the target stimulus for which the participant must make a lexical decision. Forster, Mohan and Hector (2003, p. 5) state that although the most preferred prime duration is 50 msec, it can vary from 20 to 67 msec. The prime is normally reflected as a string of lower case letters while the target appears in upper case letters. This is to ensure that the prime and the target look physically different.

The prime's virtual invisibility makes masked priming an ideal condition to explore lexical access as it eliminates any conscious appreciation of the relationship between prime and target stimulus (Marelli and Luzzatti, 2012, p. 645). As the information about the prime never reaches consciousness, the participants do not have the opportunity to implement prediction or expectancy strategies based on the prime. Masked priming paradigm provides an excellent tool to explore the effects of different primes. In compound processing, either or both of the two constituents of the compound can be used as primes and the compound can be used as the target. Potential facilitations (i.e., shorter RTs) in accessing the target compound after either of its constituents in comparison to an unrelated prime is normally taken as evidence for decomposition (Shoolman and Andrews, 2003, p. 250). In addition, by allowing the same target item to be presented in different conditions with different prime stimulus, this technique also avoids the possibility of employing guessing strategy for the stimulus items used (Shoolman and Andrews, 2003, p. 252).

In this paradigm, a faster response time to the target item in the experimental condition (i.e., when prime and target are morphologically or orthographically related) in comparison to the control condition (i.e., when prime and target are unrelated) indicates the effect of prime in recognizing the target (de Almeida and Libben, 2002, p. 110).

3. 2. Models of the Mental Lexicon

A variety of models have been proposed for the processing and representation of morphologically complex words in the mental lexicon and they try to answer one basic question: does the human parser decompose complex words into their constituent morphemes while processing them? The views on this question are generally grouped into four categories: full-listing, decomposition, hybrid models assuming the involvement of both full-listing and decomposition within a dual-process approach to processing, and finally the APPLE model. These models were originally proposed for the processing of derived and inflected words but their basic predictions hold for processing of compounds.

3. 2. 1. Full-listing

According to the full-listing model, complex words have their own representation in the mental lexicon and it assumes no morphological decomposition in word recognition (Butterworth, 1983). For example, the compound word *blueberry* is processed and represented as a whole in the mental lexicon and it is not associated with its constituents *blue* and *berry*. Computational efficiency is maximized by this model because there is no need to compute the meaning of a complex word from its constituent morphemes. In contrast, the storage efficiency is minimized as the memory load would increase due to storage of each complex word as a separate entry in the lexicon (Libben, 1998). According to this model, there should be no difference between the representation of monomorphemic words and complex words since complex words can simply be activated in the mental lexicon without any computational processes (Niswander, 2003; Ko, 2011). As Niswander (2003, p. 9) notes, this model predicts that the whole-word frequency (surface frequency) of a compound would affect its processing time, but the frequency and other aspects of its constituents (e.g., root frequency, constituent frequency, morphological family size) would be irrelevant.

3. 2. 2. Decomposition

The decomposition model, which was originally proposed by Taft and Forster (1975) for prefixed words, claims that the constituent morphemes rather than the whole word are listed in the mental lexicon. When applied to compounds, this model predicts that in accessing a compound, the meanings of the constituents are retrieved and analyzed. For instance, when processing *blueberry*, the constituents *blue* and *berry* rather than the whole word *blueberry* are represented in the lexicon. The meaning of the compound word *blueberry* is accessed by combining the meanings of its constituents *blue* and *berry*. Accordingly, encoding a compound requires composition of individual constituents, and decoding a compound requires decomposition of its constituents. In the decomposition model, the storage efficiency is maximized while the computational efficiency is minimized. The decomposition model proposed by Taft and Forster (1975) predicts compound words would be processed more slowly than monomorphemic words because morphological decomposition occurs prior to direct retrieval which is the searching and verification stage in compound word processing. For this reason, the processing of compound words is expected to be slower than the processing of monomorphemic words which involve full-listing.

3. 2. 3. Hybrid (Dual-route) Models

Supporters of hybrid or dual-route models suggest that both decomposition and whole-word access are equally relevant in complex word processing and various factors determine the extent of these processes. The decomposition route in this model is affected by the characteristics of the whole word and its constituents. Among these characteristics are the frequency of the whole word, the frequency of the constituent morphemes, the family size of the constituents and their semantic transparency which refers to the degree to which the constituent morphemes contribute to the meaning of the whole word (Wang, 2010, p. 119).

In line with these assumptions, Caramazza, Laudanna and Romani (1988) proposed the Augmented Address Morphology (AAM) model, which assumes that both whole-word representation and constituent morphemes can be activated simultaneously. This model posits that whole-word processing is activated for familiar words whereas decomposition takes place for novel words. The Morphological Race Model (MRM) presented by Schreuder and Baayen (1995) also argues that the whole-word route and the decomposition route are in competition. The difference between the models is that in the MRM, even familiar words can be accessed via decomposition route depending on the properties of the whole word such as semantic transparency and frequency. For example, the constituent morphemes are activated when a complex word is of low frequency and semantically transparent, but the whole-word form is activated for frequently used and semantically opaque forms.

An additional distinction within hybrid models has been pointed which focuses on the time course of activation of constituent and whole-word representations (Fiorentino, 2006; Mayila, 2010; Marchak, 2011). Some researchers suggest an early decomposition model, which posits that constituent morphemes are initially accessed via decomposition of the constituents followed by the access to the whole-word lexical representations. Other researchers suggest a late decomposition model, in which the constituents are accessed via their full-form lexical representations in the beginning. According to Giraudo and Grainger (2000; 2001), initial processing of a compound word proceeds via whole-word representation and access to morphological constituents can be followed afterward only when the relation among whole word and constituents is semantically transparent.

3. 2. 4. The APPLE model

Libben's (1994, 1998) Automatic Progressive Parsing and Lexical Excitation (APPLE) model is also relevant in this context as it relates to the processing of compound words. Libben (1998) assumes that the recognition of compounds can be described at three levels of representation: the stimulus level, the lexical level and the conceptual level.

According to Libben (1998, p. 35), a separate stimulus level is required for recognizing compound forms. Since compounds are composed of two roots, their processing is not as quick and easy as monomorphemic words. The APPLE model isolates the constituents of a compound through a left-to-right parsing procedure because this parsing procedure incorporates a check for the lexical and orthographic status of both constituents. The role of the APPLE parser at the stimulus level provides an account of two crucial aspects in compound recognition: How are the morphological constituent of a compound activated and why are not all lexical substrings of a compound activated?

At the lexical level, word forms are represented; therefore, compound words have their representations at this level. It seems necessary to postulate a purely morphological level of constituent structure rather than a semantic level. Thus, at the lexical level, the connections (i.e., facilitatory links) between the constituents and the compound word are represented (Libben, 1998, p. 36-37).

The notion of semantic transparency of a compound is represented at the conceptual level. It deals with the semantic relationship between the meaning of the constituent in the compound and the independent meaning of the same constituent. The model represents the constituent semantic transparency of compounds in terms of the links established (Libben, 1998, p. 38).

On this note Wang (2010, p. 120) proposes, for example, that *blueberry* is a fully transparent compound and both constituents *blue* and *berry* contribute to the meaning of the whole compound word *blueberry*. However, the compound word *strawberry* is partially-opaque (or partially-transparent) because the constituent *straw* does not contribute to the meaning of the whole compound while *berry* does. Both types of compounds are represented as a whole at the stimulus level, and then they are linked to the representation of both the constituent morphemes and the whole word at the lexical level. Therefore, at the stimulus and lexical level both transparent and partially-opaque compounds are decomposed and represented in the same way. The semantic transparency of the constituents determines whether constituent morphemes are linked to their representations at the conceptual level. As a result, only the meanings of the whole word and transparent constituents are activated.

The APPLE model assumes that the facilitative links between the compound word and its constituents which do not exist in monomorphemic words would result in a processing advantage for compounds relative to monomorphemic words. For this reason, the APPLE model predicts that it should be easier and faster to process compounds than monomorphemic words. In terms of semantic transparency, the model predicts slower RTs for transparent compounds when compared to opaque or partially-opaque compounds because only the semantic representations of transparent constituents and transparent whole compounds would be activated. Later in the study, these models will be relevant in the interpretation of the data obtained from the English and the Turkish studies.

CHAPTER 4

PROCESSING OF MULTIMORPHEMIC WORDS IN THE L1

Understanding how morphological processing is achieved is critical for identifying the representation and processing of words in the human mind. In the last 40 years, an increasing number of studies have examined the mental lexicon focusing on the representation and processing of multimorphemic words, namely the inflected, derived and compound words. The major motivation behind this line of psycholinguistic research relates to the question of whether morphologically complex words are fully listed in the mental lexicon or whether they are represented in a decomposed form.

Much work has been conducted on the processing of inflectional morphology. These studies, mostly conducted in English and German, have generally focused on potential differences between regular and irregular inflections in the nominal and verbal domain. Several studies in English found differing processing patterns for regularly and irregularly inflected words (Stanners, Neiser, Hernon and Hall, 1979; Münte, Say, Clahsen, Schiltz and Kutas, 1999). For example, Stanners, Neiser, Hernon and Hall (1979) found decomposition for the regularly inflected English past tense forms (e.g., *walk-WALKED*); however, they reported reduced priming effect (i.e., partial priming) for irregular verbs (e.g., *sing-SANG*). Münte, Say, Clahsen, Schiltz and Kutas (1999) observed the same processing pattern in an ERP study. In contrast, Morris and Stockall (2012) noted decomposition for both regular and irregular English past tense by employing ERP paradigm. Sonnenstuhl, Eisenbeiss and Clahsen (1999) investigated the processing of German past tense verb forms in a cross-modal priming experiment and obtained decomposition for regular participles (e.g., *gekauft-KAUFE* '*bought-BUY*') while irregular participles (e.g., *gelaufen-LAUFE* '*walked-WALK*') yielded no morphological parsing. The researchers concluded that regular participles were decomposed into their morphological constituents but irregular participles were not.

There are, however, studies that found full-listing for regularly inflected forms in English (e.g., Stemberger and MacWhinney, 1986; Katz, Rexer and Lukatela, 1991; Sereno and Jongman, 1997; Alegre and Gordon, 1999). The researchers stipulated that the frequency of the inflected word (whole-word frequency) is a significant factor in determining the parsing route.

Morphology processing studies involving inflected words have also been conducted in Turkish. By employing an unprimed (simple) lexical decision task to investigate nominal inflectional processing, Gürel (1999) suggested that not all multimorphemic words in Turkish were accessed through decomposition. A word could also be accessed via the direct route (i.e., full-listing) or the parsing route depending on the frequency of the suffix. In an unprimed lexical decision task based on Gürel's (1999) stimulus, Gürel and Uygun (2013) provided additional evidence that native Turkish speakers employed a direct access route. In another unprimed lexical decision task, Uygun and Gürel (2016) demonstrated that native Turkish speakers accessed morphologically complex words as fast as monomorphemic words, indicating no particular cost for processing inflected forms. In contrast, Kırkıcı and Clahsen (2013) employed a masked priming experiment to study the regular Aorist inflection (besides derived forms) and proposed that inflected words in Turkish were efficient primes for native speakers, proposing decomposition. Studies on the processing of inflection in another agglutinative language – Finnish – suggest that low-frequency inflected forms are decomposed by native speakers while high and even some medium frequency words are recognized via whole-word representation (e.g., Laine, Niemi, Koivuselkä-Sallinen, Ahlsén and Hyönä, 1994; Niemi, Laine and Tuominen, 1994; Laine, Vainio and Hyönä 1999; Lehtonen and Laine, 2003; Portin, Lehtonen and Laine, 2007; Vainio, Pajunen and Hyönä, 2014).

In addition to studies involving inflected forms, there are many studies that explored the processing patterns in derived forms including compounds. The section below will focus on these studies to highlight the findings of previous studies exploring the processing patterns observed in morphologically complex derivations in general and compounding in particular.

4. 1. Studies on Processing of Derived Words in the L1

While inflectional morphology is attached to root words to indicate tense, number, person, possession or comparison without altering the meaning, derivation is considered to be a process applying on the root words to derive new word forms with the possibility of changing the semantic (e.g., *depart-department*) and syntactic (e.g., *communicate-communication*) aspects of the root. Another notable distinction is related to the features of the morphemes added. For example, in English, inflectional morphemes consist of suffixes and are attached to the end of the roots; however, derivational morphemes include both prefixes (e.g., *un-happy*) and suffixes (e.g., *terror-ism*). These significant differences have led many researchers to conduct studies on derived words (Booij, 2005b, p. 110; Gomez, 2009, p. 5-6).

The motivation to study the processing of derivational forms goes back to Taft and Forster (1975). In their study, they investigate how English prefixed words were processed by native speakers in a lexical decision task. They found that nonwords which were stems of prefixed words (e.g., *juvenate* from *rejuvenate*) took longer to process than nonwords that were not stems (e.g., *pertoire - repertoire*) and the processing time for prefixed nonwords with a real stem (e.g., *dejuvenate*) took longer when compared with control items which did not have a real stem (e.g., *deportoire*) indicating morphological decomposition. This experiment paved the way for other studies focusing on the processing of derived words. By using the priming paradigm, many studies have been conducted to compare the effects of semantic transparency in processing derived words.

Several studies have found evidence to support decomposition in processing derived words regardless of semantic transparency (e.g., Feldman and Soltano, 1999; Feldman, 2000; Rastle, Davis, Marslen-Wilson and Tyler, 2000; Rastle and Davis, 2003; Rastle, Davis and New, 2004; Marslen-Wilson, Bozic and Randall, 2008; McCormick, Rastle and Davis, 2008; Rastle and Davis, 2008; Taft and Nguyen-Hoan, 2010 in English; Longtin, Segui and Hallé, 2003; Longtin and Meunier, 2005 in French). For example, Rastle, Davis, Marslen-Wilson and Tyler (2000) employed masked priming experiments and identified morphological relationships between masked multimorphemic words and targets made up of the primes' root lexemes. They found strong priming effects not only between transparent prime-target pairs (e.g., *quickly-QUICK*), which were genuinely morphologically related, but also between pairs (e.g., *hardly-HARD)*, which were not semantically related in modern English, and even for pseudoderived pairs (e.g., *corner-CORN*), which had no morphological interpretation as "*corn+er*". In addition to this study, Rastle, Davis and New (2004) examined the role of semantic information in derived word recognition. The prime target pairs included a semantically transparent morphological relationship (e.g., *cleaner-CLEAN*), a semantically opaque morphological relationship (e.g., *department-DEPART*) and a non-morphological form relationship (e.g., *brothel-BROTH*) via masked priming experiments. The results showed no statistical differences between the transparent and opaque conditions; however the priming effect in these conditions was remarkably stronger than the priming in the form condition in line with the visual priming results of Longtin, Segui and Hallé (2003) in French. These findings support the view that native speakers of English are not aware of the semantic relation between the prime-target pairs proposing morphological decomposition irrespective of semantic effects. In another study, Marslen-Wilson, Bozic and Randall (2008) selected morphologically complex primes that varied in the degree of semantic relatedness to their targets. The researchers designed six conditions to manipulate both morphological and semantic relatedness. The conditions included prime-target pairs which were (1) only orthographically related (e.g., *scandal-SCAN*), (2) only orthographically and morphologically related (e.g., *archer-ARCH*), (3) orthographically and morphologically related, and semantically related at an intermediate level of relatedness (e.g., *barely-BARE*), (4) only semantically related at an intermediate level of relatedness (e.g., *attach-GLUE*), (5) related in all three criteria (e.g., *bravely-BRAVE*) and (6) only highly semantically related (e.g., *accuse-BLAME*). The results of the masked priming experiment revealed that prime-target pairs with a morphological relationship (conditions 2, 3 and 5) yielded robust priming effect irrespective of the degree of their semantic relationship when compared with conditions that had no morphological relationship (conditions 1, 4 and 6). These results were interpreted as morphological decomposition for English derivational forms.

There are, however, studies that showed semantic transparency has a crucial role in determining the parsing route for derivations (e.g., Marslen-Wilson, Tyler, Waksler and Older, 1994; Feldman, O'Connor and Moscoso del Prado Martin, 2009; Diependaele, Duñabeitia, Morris and Keuleers, 2011 in English; Schreuder, Burani and Baayen, 2003; Diependaele, Sandra and Grainger, 2005 in Dutch; Meunier and Longtin, 2007 in French). For instance, by using a cross-modal priming experiment, Marslen-Wilson, Tyler, Waksler and Older (1994) investigated the lexical entry for morphologically complex English words and found a controversial pattern for derivational forms. They observed strong priming effects for semantically transparent derived forms (e.g., *punishment-PUNISH*), but not for semantically opaque pairs (e.g., *casualty-CASUAL*). They obtained clear evidence for morphological decomposition of semantically transparent forms, which was independent of phonological transparency. On the contrary, semantically opaque forms behaved like monomorphemic words. They concluded that semantic transparency had a critical role in determining the parsing route. In addition, Feldman, O'Connor and Moscoso del Prado Martin (2009) compared patterns of facilitation between semantically transparent (e.g., *coolant-COOL*) and opaque (e.g., *rampant-RAMP*) prime-target pairs. The authors retrieved robust facilitation for transparent but not for opaque items and concluded that semantically transparent items yielded significantly more facilitation when compared to opaque items.

Moreover, there are also studies that found a significant effect of frequency in processing English derivations. Vannest and Boland (1999) and Vannest, Bertram, Järvikivi and Niemi (2002) employed a lexical decision paradigm to examine the processing of English derived words. They used derived words with suffixes of *-hood, -ship, -less, -ness, -ian, -ity, -ous, -ory, -er* and *–ation*. For some suffixes they obtained the effect of root frequency, whereas there was no significant root frequency effect for the rest of the suffixes. In an unprimed lexical decision task, Bertram, Schreuder and Baayen (2000) investigated the processing of Dutch derivational suffixes *–er* (functioning as productive agent and comparative marker) and *–te* (a productive past tense but unproductive deadjectival abstract noun marker). The researchers also found the significant effect of frequency for Dutch derivations.

Finally, there are studies conducted in morphologically rich languages, namely Turkish and Finnish. Since evidence for the processing of Turkish derivations remains scarce, in this section, studies in Finnish are also included to have a better insight into accessing derivational morphology in agglutinative languages.

The two available studies on Turkish focus on the processing of derivational words. Kırkıcı and Clahsen (2013) aimed to examine the processing of deadjectival nominalization suffix *–lık* in native speakers and advanced learners of L2 Turkish by using masked priming experiments. The productive derivative suffix *–lık* is similar to *–ness* suffix in English and derives nouns from nouns, adjectives and adverbs (e.g., *temiz* 'clean', *temizlik* 'cleanness', *temizlikçi* 'cleaner', *temizlikçilik* 'the occupation of a cleaner') (Kırkıcı and Clahsen, 2013, p. 779). The stimuli involved a related condition (e.g., *yorgunluk-YORGUN* '*tiredness-TIRED*') and an unrelated condition (e.g., *basit-YORGUN* '*simple-TIRED*'). The results for the native speakers demonstrated significant priming effect for Turkish derived words and the researchers argued that these priming effects indicated morphological decomposition for visually presented Turkish derived words. In another study, Gacan (2014) tested the processing of transparent, frequent and highly productive derivational suffixes *–lı* (e.g., *zararlı* 'harmful') and *–sız* (e.g., *zararsız* 'harmless') via masked priming paradigm. The stimuli had a morphologically related (e.g., *zararlı-ZARAR 'harmful-HARM'* or *zararsız-ZARAR 'harmless-HARM'*), an identity condition (e.g., *zarar-ZARAR 'harm-HARM'*) and a morphologically unrelated condition (e.g., *çözüm-ZARAR 'solution-HARM'*). The results provided supporting evidence for decomposition in processing Turkish derivations because RTs for related condition were significantly shorter than those in the unrelated condition.

In Finnish, studies generally indicate full-listing for the processing of Finnish derivations. For example, Järvikivi, Bertram and Niemi (2006) investigated the processing of Finnish derivations in a series of unprimed lexical decision experiments. They employed two suffixes: the suffix *–Us* which attaches to verbs and forms nouns and the suffix *-(U)Us* which is a deadjectival suffix. The results revealed that both suffixes showed no facilitation effect leading the researchers to favor whole-word access for Finnish derivations. In another study, Bertram, Laine and Karvinen (1999) used a lexical decision task to investigate the morphological processing of Finnish complex words. They found the effect of storage for Finnish derived words when the suffix was either unproductive (*-lA*) or homonymic (*-jA*). Also, when the suffix is productive and unambiguous (*-stO*), derived Finnish words were responded faster than monomorphemic control items. Therefore, the authors proposed that derivational suffixes were processed via full-listing by Finnish native speakers. In another study, Vannest, Bertram, Järvikivi and Niemi (2002) examined the processing of Finnish derived words with the derivational suffixes *-kAs, -tOn* and *-isA* in a lexical decision task. The results implied that processing of words with *-kAs, -tOn* and *-isA* took place solely via full-listing. The researchers posited that there was no sign of evidence that the processing of derived Finnish words took place via morpheme-based representations.

In summary, the processing of derived words is still a hotly debated topic among researchers. While a group of researchers report evidence for decomposition by using masked priming paradigm, there are also studies that claim semantic transparency inhibits morphological computation in the same paradigm. The crucial effect of semantic transparency has also been observed in studies employing cross-modal priming. In addition, lexical decision studies have presented an additional factor – the effect of frequency – which prevents native speakers to rely on decomposition. These results have led the researchers to advocate dual-route in accessing derived forms. In agglutinative languages such as Finnish and Turkish, there are only a handful of studies and the results are inconclusive to confidently claim how derived words are processed. Further research in morphologically rich languages needs to be conducted to provide supporting evidence for which factors influence the processing pattern and which model is favored for derivational morphology.

4. 2. Studies on Processing of Compounds in the L1

There is relatively less work on compound processing compared to the studies on inflectional and derivational processing. As noted earlier, compounds consist of two constituents or open-class sets in a variety of syntactic categories with their position of occurrence unpredictable which enable the researchers to study the processing of multimorphemic words in detail as there are different options for parsing compounds and all these options appear to be attempted (Libben, 1994; Libben, Derwing and de Almeida, 1999). Compounds also allow the researchers to examine whether constituents, frequency and semantic transparency play a fundamental role in the processing of multimorphemic words (Foirentino, 2006). By exploring the activation of each constituent, researchers can explore whether compounds are stored as whole units or whether they are decomposed into their constituents.

Before investigating the compound studies in detail, it is important to mention that compound words have generally low frequency when compared to simple nouns. Andrews, Miller and Rayner (2004, p. 291) note that of the 315 compounds listed in the Standard Oxford Dictionary, 33% do not appear in CELEX, and that the average frequency of the remaining 191 words is 3.3 per million, with only 15 compounds having frequencies greater than 10 per million. Libben (2005, p. 269-270) also notes that compound words tend to be of low-frequency, and reports that over half of the 1437 noun–noun compounds in the CELEX database have a written frequency of less than one in a million and only 35 have a frequency of over 10 in a million (for comparison, the frequency of *dog* is 75 in a million and *cat* has a frequency of 25 in a million). There is ample evidence that low frequency words are recognized via morphological decomposition while high frequency words can be accessed as wholes. As for compounds, the whole-word frequency of a compound is generally lower than the frequencies of its constituents, a condition which makes compounds unique word forms to examine the effects of frequency interacting with other features such as transparency determining the extent of decompositional route in complex word recognition.

Since compounds are constructed by two lexemes, researchers have been interested in exploring if one of the constituents had a significant impact on the processing route by manipulating the frequency (i.e., low frequency vs. high frequency) or word category (i.e., word vs. nonword) of the constituents. The activation of either one or both constituents is interpreted as decomposition. Some researchers emphasize the importance of the first constituent (e.g., Taft and Forster, 1976; Lacruz, 2005; Juhasz, 2006; 2007; Ji, 2008; Drieghe, Pollatsek, Juhasz and Rayner, 2010; Juhasz and Berkowitz, 2011; Ji, Gagné and Spalding, 2011 in English; Jarema, Busson, Nikolova, Tsapkini and Libben, 1999 in French; Koester, Gunter, Wagner and Friederici, 2004; Holle, Gunter and Koester, 2010 in German; Kehayia, Jarema, Tsapkini, Perlak, Ralli and Kadzielawa, 1999 in Greek and Polish). For example, in one of the earliest studies in English, Taft and Forster (1976) ran a lexical decision experiment by employing false compounds formed by two existing words (e.g., *dustworth*), two nonwords (e.g., *mowdflisk*) and a word plus a nonword (e.g., *footmilge, thernlow*). They found that compound-looking nonwords (i.e., pseudocompounds) where the first constituent is a word (e.g., *footmilge*) took longer to reject as nonword in comparison to compound nonwords where the second constituent is a word (e.g., *thernlow*). In addition, they observed that false compounds were indicated more rapidly as nonexistent when a nonword (e.g., *thernlow, mowdflisk*) formed the first constituent. This showed that nonword classification time was affected by the lexical status of the first constituent. Also, compound words with a low frequency first constituent (e.g., *loincloth*) were classified significantly slower than compounds with a high frequency first constituent (e.g., *headstand*) revealing the facilitative role of first constituent frequency. In addition, Juhasz (2006) argued that compound words with a high frequency first constituent had shorter first fixation times (i.e., duration of the first fixation on the target word) and gaze durations (i.e., the total duration of all fixations on the target word) than did frequency and length matched simple words. In contrast, compounds with a low frequency first constituent did not differ from the simple words. Futhermore, Ji (2008) and Ji, Gagné and Spalding (2011) matched English compounds (e.g., *rosebud*) with monomorphemic (e.g., *giraffe*) words in terms of whole-word frequency and they found that high frequency of the first constituents facilitated the processing of compounds despite the similar whole-word frequency across the two types of words.

There are also studies that indicate the importance of the second constituent (e.g., Inhoff, Briihl and Schwartz, 1996; Juhasz, Starr, Inhoff and Placke, 2003; Libben, Gibson, Yoon and Sandra, 2003; Inhoff, Starr, Solomon and Placke, 2008; Juhasz, Pollatsek, Hyönä, Drieghe and Rayner, 2009 in English; Isel, Gunter and Friederici, 2003 in German; Duñabeitia, Perea and Carreiras, 2007 in Spanish and Basque). For instance, Juhasz, Starr, Inhoff and Placke (2003) found a facilitative effect of the second constituent in English compounds not only in lexical decision and naming task, but also in an eye movement experiment. They concluded that access to constituent heavily depended on the frequency of the second constituent. Moreover, Libben, Gibson, Yoon and Sandra (2003) also emphasized the importance of the second constituent because the RTs to compounds with an opaque second constituent (e.g., *staircase*) were slower than the RTs to compounds with a transparent second constituent (e.g., *strawberry*). Besides, by using a lexical decision task, Duñabeitia, Perea and Carreiras (2007) aimed to determine which constituent exerted greater influence in the recognition of Spanish and Basque compounds. Both languages have compounds that are right and left-headed. In the experiment, 80% of the Basque compounds were left-headed while almost 75% of the Spanish compounds were right-headed. They observed the effect of frequency for the second constituent for compounds both in Spanish and Basque in a language-independent manner. Low frequency compound words containing high frequency second lexemes were responded faster than compounds with low frequency second lexemes.

Finally, some studies found the effect of frequency for both constituents (e.g., Bien, Levelt and Baayen, 2005; Kuperman, Schreuder, Bertram and Baayen, 2009 in Dutch; Andrews, 1986; Andrews, Miller and Rayner, 2004; Janssen, Pajtas and Caramazza, 2014 in English). Andrews, Miller and Rayner (2004) monitored readers' eye movements as they read sentences in English containing compound words. In Experiment 1, the researchers manipulated the frequency of the first and second constituents of the compounds while holding the frequency of the whole compound constant. In Experiment 2, they used pairs of compound words with the same second constituent and different first constituents that were either high or low frequency (e.g., *raindrop/dewdrop*). The results showed reliable effects of frequency for both constituents. Janssen, Pajtas and Caramazza (2014) investigated the constituent effects in English compounds by using a lexical decision task and found that left and right constituent frequency together with compound's surface frequency and family size measures were the main factors that resulted in longer RTs.

Another major question in compound processing is whether the semantic transparency of constituents affects the parsing route. There is mounting evidence that semantic transparency has a crucial role in understanding how multimorphemic words are represented in the mental lexicon. Semantic transparency can play a more privileged role in compounds because compound words consist of root-root words rather than a root and an affix. Also, the transparency of each constituent can determine the pattern of compound processing. Therefore, many researchers focused on compound processing to examine the role of semantic transparency in processing multimorphemic words. In these studies, the compounds were usually divided into four groups according to the semantic transparency level of their constituents: transparent-transparent (TT) (e.g., *bedroom*), opaque-transparent (OT) (e.g., *nickname*), transparent-opaque (TO) (e.g., *shoehorn*) and opaque-opaque (OO) (e.g., *deadline*) (Libben, Gibson, Yoon and Sandra, 2003, p. 54). The RTs for each compound type were compared with each other to identify whether semantic transparency of the constituents influenced the processing pattern.

There are studies that revealed no effect of semantic transparency in processing compound words providing support for transparency-independent decomposition (e.g., Koester and Schiller, 2008; 2011 in Dutch; Libben, Gibson, Yoon and Sandra, 2003; Shoolman and Andrews, 2003; Dohmes, Zwitserlood and Bölte, 2004; Fiorentino, 2006; Fiorentino and Poeppel, 2007; Juhasz, 2007; Frisson, Niswander-Klement and Pollatsek, 2008; Fiorentino, Naito-Billen, Bost and Fund-Reznicek, 2014 in English; Jarema, Busson, Nikolova, Tsapkini and Libben, 1999 in French; Gumnior, 2008 in German). For instance, Shoolman and Andrews (2003) used a masked priming paradigm to explore the semantic influence of constituents in processing English compounds. In the study, participants were presented with transparent compounds (e.g., *bookshop*), partially-opaque compounds (e.g., *jaywalk*), pseudocompounds (e.g., *hammock*) and monomorphemic words (e.g., *fracture*). Their results showed that both first and second constituents primed compound targets regardless of semantic transparency. In addition, the priming effects observed for compound words were significantly greater than pseudocompounds and monomorphemic words. In a similar vein, Libben, Gibson, Yoon and Sandra (2003) observed that both constituents were activated in compound words and semantic transparency had no significant effect in parsing in a constituent priming experiment. However, they claimed that the transparency of the head was noteworthy since compounds with a transparent head (i.e., transparent-transparent and opaque-transparent) were processed more rapidly than compounds with an opaque head namely transparent-opaque and opaque-opaque compounds. This is because longer RTs were recorded for opaque-opaque compounds followed than transparent-opaque ones. In another study, Fiorentino, Naito-Billen, Bost and Fund-Reznicek (2014) investigated the processing of visually presented lexicalized and novel compounds by using both response time and electrophysiological measures. The experimental stimuli consisted of transparent compounds (e.g., *teacup*), opaque compounds (e.g., *eggplant*), long monomorphemic words (e.g., *throttle*), novel compounds (e.g., *tombnote*) and long nonmorphemic words (e.g., *blenyerp*). In this study, the primes were compounds and the targets were the first or second constituents of the primes. The results confirmed that transparent and opaque compounds primed the constituent targets and transparency had no facilitative effect. Finally, in French, Jarema, Busson, Nikolova, Tsapkini and Libben (1999) tested the role of semantic transparency in French via a constituent repetition priming paradigm. The prime-target pairs included transparent-transparent (e.g., *haricot vert* 'green bean'*)*, opaque-transparent (e.g., *garçon manqué* 'tomboy'), transparent-opaque (e.g., *argent liquid* 'cash') and opaque-opaque (e.g., *éléphant blanc* 'white elephant') compounds. They found that constituent activation occurred in all compound types.

However, some studies demonstrated that semantic transparency had a significant role in processing compounds presenting evidence for dual-route in compound recognition (e.g., Jarema, Busson, Nikolova, Tsapkini and Libben, 1999 in Bulgarian; Sandra, 1990; Zwitserlood, 1994 in Dutch; Wong and Rotello, 2010; Marchak, 2011; Brusnighan and Folk, 2012; El-Bialy, Gagné and Spalding, 2013; MacGregor and Shtyrov, 2013; Stathis, 2014 in English; Isel, Gunter and Friederici, 2003; Koester, Gunter and Wagner, 2007; Koester, Holle and Gunter, 2009 in German). To exemplify, Sandra (1990) investigated the effect of semantic transparency in Dutch speakers via a semantic priming paradigm. He used semantic associates of the first and second constituents of fully-transparent (e.g., *woman-MILKMAN*) and opaque (e.g., *bread-BUTTERFLY*) compounds. He observed no priming effect for opaque compounds; neither the first nor the second constituent was activated. In contrast, both constituents in transparent compounds were accessed. This suggests decomposition for transparent but full-listing for opaque compounds. In another study, Zwitserlood (1994) employed semantic priming with fully-transparent, partially-opaque and truly-opaque compounds and used compound words as prime and the constituents as target. She obtained priming effect for fully-transparent and partially-opaque compounds; however, no priming was reported for truly-opaque compound words. Jarema, Busson, Nikolova, Tsapkini and Libben, (1999) addressed the same issue by using masked priming experiment for Bulgarian compounds which are right-headed and they provided additional evidence for the critical role of semantic transparency because opaque-opaque compounds received no priming effect. For German compounds, Isel, Gunter and Friederici (2003) conducted an auditory priming experiment and concluded that compounds with a transparent head were decomposed, but compounds with an opaque head were stored as whole words. Finally, Stathis (2014) used transparent-transparent (e.g., *teacup*), transparent-opaque (e.g., *heatwave*), opaque-transparent (e.g., *peppermint*) and opaque-opaque (e.g., *hogwash*) compounds in a lexical decision task. The results revealed that transparency had a significant role and compounds were decomposed only when both constituents were transparent. No significant difference was found among transparent-opaque, opaque-transparent and opaque-opaque compounds.

Support for the dual-route model in compound processing was also obtained from studies identifying the lexical access of Italian compounds by manipulating the headedness of the compounds (e.g., El Yagoubi, Chiarelli, Mondini, Perrone, Danieli and Semenza, 2008; Marelli, Crepaldi and Luzzatti, 2008; 2009; Arcara, 2009; Marelli and Luzzatti, 2012; Arcara, Marelli, Buodo and Mondini, 2014). Italian has both right-headed (e.g., *astronave* 'spaceship') and left-headed (e.g., *capobanda* 'band leader') compounds. The results of Italian compound studies indicated that left-headed compounds were easily recognized compared to right-headed compounds and right-headed compounds showed a higher processing cost implying the effect of headedness.

In Turkish, there is only one study that investigates the representation of compound words by focusing on compound production. Özer (2010) investigated three types of compounds – bare juxtaposed compounds (e.g., *akbalık* 'dace'), indefinite compounds (e.g., *dil balığı* 'flounder') and definite compounds (e.g., *gölün balığı* 'fish of the lake') – in a morphological priming paradigm by means of a picture naming task. In the study, distractor words were Turkish nominal compounds. Picture names (e.g., *balık* 'fish') were morphologically related either to the first or second constituent or they were completely unrelated. Results of the study revealed morphological priming effect in all compound types; in other words, morphologically related compounds led to shorter naming latencies compared to unrelated distractors supporting the decompositional view of compound processing. Even though it was not statistically significant, she also obtained an RT advantage for the second constituent, namely the head of the compound. These results are line with compound production studies in different languages employing picture naming paradigm (e.g., Koester and Schiller, 2008; 2011 in Dutch; Dohmes, Zwitserlood and Bölte, 2004 in English; Zwitserlood, Bölte and Dohmes, 2000; 2002; Gumnior, 2008; Lüttmann, Zwitserlood, Böhl and Bölte, 2011 in German).

Owing to a paucity of studies on Turkish compounds, it is important to revise compound processing studies in other agglutinative languages such as Finnish and Basque. For example, Hyönä and Pollatsek (1998, p. 1612) state that compound words in Finnish are extremely common and compounding is a productive way of constructing novel words. Typically, two or more nouns are simply attached to each other to form a compound word (e.g., *lumi* 'snow', *lumipallo* 'snowball', *lumipallosota* 'snowball fight', *lumipallosotatantere* 'snowball fight field') which means that Finnish compounds can be longer than English compounds. Bertram and Hyönä (2003) report that over 50% of word types in Finnish are compounds and Finnish speakers encounter many compound words on daily basis. These features make Finnish an ideal language to study compound word recognition. Finnish studies usually employ the eye-tracking method as it has an advantage of high temporal sensitivity and thus can have an impact in understanding the role of morphological structure during lexical processing. In addition, it can record measurements during natural reading unlike lexical decision experiments (Fiorentino and Poeppel, 2007, p. 956). Finish compound studies have mainly focused on the influence of constituent frequency and compound length in compound processing.

Several studies indicate the importance of first constituent frequency (e.g., Hyönä and Pollatsek, 1998; 2000; Bertram and Hyönä, 2003; Bertram, Pollatsek and Hyönä, 2004; Pollatsek and Hyönä, 2005; Bertram and Hyöna, 2007; Kuperman, Bertram and Baayen, 2008; Pollatsek, Bertram and Hyönä, 2011). For example, Hyönä and Pollatsek (2000) reported the results of four experiments conducted on the identification of Finnish noun-noun compounds during reading. The researchers varied the frequency of the first and second constituents and the frequency of the whole word. They also varied the length of constituents while holding the word length and the frequency constant. The data showed that the frequency of the initial constituent influenced the duration of the first fixation (i.e., duration of the first fixation on the target word) as well as later processing. In addition, Kuperman, Bertram and Baayen (2008) explored the morphological processing of Finnish compounds via ERP experiments. They found the effect of left constituent frequency and family size in reading times, but the compound's right constituent was not a significant predictor of lexical processing. In another study, Pollatsek and Hyönä (2005) examined the effect of semantic transparency in reading long Finnish compounds. A set of 40 semantically transparent and 40 semantically opaque compounds were selected. All target words were noun-noun compounds with 12-15 characters. For both sets, the frequency of the first constituent was manipulated. The results of the data showed the facilitative effect of first constituent frequency but no effect of transparency on gaze durations (i.e., the total duration of all fixations on the target word) indicating that semantically transparent and opaque compounds were accessed in the same way. Pollatsek, Bertram and Hyönä (2011) also investigated the processing of novel and lexicalized Finnish compounds while measuring the eye movements. The results revealed that both the lexicality of the compound word and the frequency of the first constituent had significant effects on gaze durations.

However, in another study, the effect of second constituent frequency was found to be important. Pollatsek, Hyönä and Bertram (2000) investigated the effects of second constituent and whole-word frequency on eye movements during sentence reading. Both frequency manipulations significantly affected gaze durations. The fact that whole-word frequency influenced processing, at least, as much as the constituent frequency was taken as evidence for the parallel processing of morphological constituents and whole-word representations.

Because a Finnish compound can consist of more than two lexemes due to its productive nature, the researchers were also interested in exploring the effect of length in Finnish compounds. For instance, with the help of eye movement measures, Bertram and his colleagues (Bertram and Hyönä, 2003; Bertram, Pollatsek and Hyönä, 2004; Bertram and Hyöna, 2007) and Hyönä (2012) found significant differences in processing long (e.g., *joukkuehenki* 'team spirit') and short (e.g., *jäärata* 'ice ring') compounds in Finnish. The long compounds were on average 13 characters long and the short compounds were 7.5 characters long. They explained that when the compounds were long, compositional processes were involved, whereas for short compounds, the whole-word form dominated the processing. In addition, they showed that participants processed long compounds much faster when the first constituent was of high frequency than when it was of low frequency. In addition, Hyönä and Pollatsek (1998) used an eye-movement experiment to investigate the contribution of morphemic constituents on Finnish compound words. They compared the processing of long first constituent compounds (e.g., *mailman/sota* 'world war') with short first constituent compounds (e.g., *ydin/reaktori* 'nuclear reactor'). They found effects for both the length and the frequency of the initial morpheme on the pattern of eye movements. The length of the initial morpheme influenced the location of the second fixation on the word (i.e., the duration of the second fixation on the target word). Finally, Häikiö (2011) and Häikiö, Bertram and Hyönä (2011) measured Finnish second, fourth and sixth grade elementary school students' eye movements while reading Finnish short compounds. Their findings revealed whole-word representation in Finnish children's data.

Basque, another agglutinative language, is described as a language which provides an excellent opportunity for testing compound words since the lexicon contains a large number of compounds and compounding is a frequently employed morphological mechanism. Because of its agglutinative structure, Basque words are inflectionally and derivationally modified by adding morphemes and lexemes to the latter part of the stem. Also compounding is a highly productive process for novel word creation (e.g., *baso* 'forest', *basagizona* 'wild man', *basozaina* 'gamekeeper'). It is possible to find up to 50 compound words with the root *–bas* (Duñabeitia, Perea and Carreiras, 2007, p. 1172).

By using a lexical decision task, Duñabeitia, Perea and Carreiras (2007) aimed to determine which constituent exerted greater influence in the recognition of Basque compounds. Their findings provided compelling evidence for morphological decomposition in Basque. They also observed the effect of second constituent frequency in Basque compounds. Low frequency compound words containing high frequency second lexemes were responded faster than compounds with low frequency second lexemes. The same pattern was observed by Vergara-Martínez, Duñabeitia, Laka and Carreiras (2009) via ERP experiments.

In another study, Duñabeitia, Laka, Perea and Carreiras (2009) employed a constituent masked priming paradigm to examine the role of constituents in processing Basque compounds. They aimed to identify whether constituent priming effects could be obtained between compound words (e.g., will *postman* activate *MILKMAN* and will *postman* activate *MANKIND*?). Another aim was to discover whether priming effects could be modulated as a function of the position of the shared constituent (e.g., Will *postman* prime *MILKMAN* the same way as *milkshake* does?). They employed transparent compounds in the experiments. In the first experiment, participants were presented with compound words that shared either the initial constituent (e.g., *lanordu-LANPOSTU, lan* 'work', *ordu* 'hours', *postu* 'positions), or the final one (e.g., *bainugela-EGONGELA, bainu* 'bath', *gela* 'room', *egon* 'to be') or by a noncompound word with no shared units (e.g., *janari-LANPOSTU* '*food-WORKING HOURS*', *nabaritu-EGONGELA* '*to notice-LIVINGROOM*'). The results indicated that compound words that shared one of the constituents activated each other regardless of the position of the shared constituents. In the second experiment, participants were presented with compound words preceded by another compound word that shared one constituent but in the other location (e.g., *mendikate-SUMENDI, mendi* 'mountain', *kate* 'chain', *su* 'fire') and the researchers observed again a constituent priming effect. They concluded that two transparent compound words that share a constituent automatically activate each other providing overwhelming evidence for decomposition.

To conclude, a substantially high number of studies have provided evidence for decomposition in compound recognition. However, when researchers address the effect of semantic transparency, there are studies that find clear evidence for the dual-route model in processing compounds. Most studies agree that fully-transparent compounds are decomposed and the opacity of the head increases the processing cost. Dual-route has received some additional evidence from Italian compound studies because left-headed and right-headed compounds are accessed in different ways. Compound studies in Finnish confidently claim that the length and frequency of the first constituent play a prominent role in eye movement studies providing evidence for the dual-route model. Although the results of Basque and Turkish compound studies support decomposition, the limited number of studies in both languages makes it difficult to reach a definitive conclusion. Further research using different paradigms is needed in agglutinative languages to identify clearly the processing pattern in compounds.

CHAPTER 5

PROCESSING OF MULTIMORPHEMIC WORDS IN THE L2

Researchers have lately started to conduct an increasing number of studies on the processing of morphologically complex words with L2 learners using various online psycholinguistic methods. The main aim of this line of research is to identify how L2 learners retrieve multimorphemic words from the mental lexicon. Ultimately the aim of these L2 processing studies is to understand if L2 learners rely on the same mechanisms as L1 speakers. Although the number of studies conducted in L2 processing is relatively limited compared to L1 studies, available results do not seem to be conclusive as to late L2 learners differ from native speakers in terms of their processing patterns. In this context, two main competing views about L1-L2 processing differences have emerged.

The first view claims that L1 and L2 processing systems share many similarities, but L2 processing system can be more demanding when basic cognitive processes such as working memory and speed of processing are taken into consideration and it may also be influenced by the linguistic features of learner's L1. Thus, L2 processing can be slower and less automatized than L1 processing. Nevertheless, this view posits that L2 learners employ the same mechanisms for language processing as native speakers. The processing difference between native and nonnative speakers is only quantitative not qualitative. This view has been supported by several L2 English inflection studies employing oral production (Beck, 1997) and priming tasks (Basnight-Brown, Chen, Hua, Kostić and Feldman, 2007; Feldman, Kostić, Basnight-Brown, Filipović-Durdević and Pastizzo, 2010). For example, Beck (1997) conducted oral production experiments with native English speakers and high proficiency L2 learners from various L1 backgrounds and obtained no significant differences in the production latencies of high frequency and low frequency regularly inflected words both in L1 and L2 speakers. In addition, Basnight-Brown, Chen, Hua, Kostić and Feldman (2007) investigated the processing of regular and irregular English verb forms with L1 Chinese and L1 Serbian speakers in a cross-modal priming experiment and found native-like processing for regular forms. Finally, in two variants of primed lexical decision tasks, Feldman, Kostić, Basnight-Brown, Filipović-Durdević and Pastizzo (2010) explored L2 English regular-irregular past participles with L1 Serbian students with different proficiency levels and reported a significant priming effect for regularly and irregularly inflected primes in L2 students with high proficiency level.

The second view, however, argues that L2 processing differs from L1 processing in fundamental ways (Ullman, 2001; 2004; 2005). This view implements Ullman's declarative/procedural model to morphological processing. According to this model, there are two different memory systems for processing one's native language: a declarative system, which stores the explicitly learned words and phrases and a procedural system, which is involved in processing combinatorial rules of language. Ullman (2005) argued that L2 processing largely depends on the declarative memory system and reliance on the procedural system is much less compared to L1 processing. The overreliance on the declarative system in L2 processing is assumed to be related to maturational changes leading to attenuation of the procedural and enhancement of the declarative system. This means that, to process morphologically complex words, L2 learners rely more on full-form representations whereas morphological decomposition is underused or even absent in L2 processing. According to Clahsen, Felser, Neubauer, Sato and Silva (2010), current evidence based on L2 inflection studies revealed that L2 learners are not as sensitive to the morphological information as native speakers (e.g., Sakaguchi, 2006; Silva, 2008; Silva and Clahsen, 2008; Babcock, Stowe, Maloof, Brovetto and Ullman, 2012; Clahsen, Balkhair, Schutter and Cunnings, 2012 in English; Hahne, Mueller and Clahsen, 2006; Neubauer and Clahsen, 2009; Jacob, Fleischhauer and Clahsen, 2013 in German). For example, Silva and Clahsen (2008) investigated the processing of English past participles with L1 German and L1 Chinese students by using a masked priming experiment. They observed morphological priming effects for regular paste tense forms (e.g., *boiled-BOIL*) in native English speakers but not in L2 speakers. Their conclusion was that L2 learners do not decompose regular past tense forms like native speakers during processing. The same inflectional structure was examined by Clahsen, Balkhair, Schutter and Cunnings (2012) in a group of advanced Arabic-speaking learner of English through masked priming experiments. They found L1/L2 processing differences for regular inflections with no effect of morphological priming for the L2 learners. In another study, Neubauer and Clahsen (2009) tested German past participles with L1 Polish learners via masked priming paradigm with three prime-target pairs: identity condition (e.g., *melde-MELDE 'report-REPORT'*), test condition (e.g., *gemeldet-MELDE 'reported-REPORT'*) and unrelated condition (e.g., *wohne-MELDE 'live-REPORT'*). The researchers supported the claim that L2 processing diverged from native speakers. The results revealed full priming for native speakers but no priming in L2 learners for regular inflection. There are only a few studies examining the processing of inflected words in L2 Turkish. For example, by using a masked priming experiment, Kırkıcı and Clahsen (2013) examined the processing of the regular Aorist verb inflection with proficient L2 speakers coming from different L1 backgrounds and concluded that there were clear differences between L1 and L2 processing patterns. While the inflected form was an effective prime for native Turkish speakers, this was not the case for L2 Turkish speakers. In another study; Gürel and Uygun (2013) investigated the processing of monomorphemic and multimorphemic words via an unprimed lexical decision task. The participants were English native speakers with intermediate and advanced level Turkish proficiency. Unlike Kırkıcı and Clahsen, 2013), they found that advanced level L2 learners had a native-like processing pattern (i.e., full-listing) while intermediate level L2 learners were significantly slower than the native speakers and L2 advanced group. In a more recent study, based on an unprimed lexical decision task, Uygun and Gürel (2016) examined the processing of monomorphemic and multimorphemic words in English and Russian native speakers with intermediate and advanced level Turkish proficiency. Advanced level L1 English-L2 Turkish group processed the words in a similar pattern with native Turkish speakers (i.e., full-listing); however, advanced level L1 Russian-L2 Turkish group exhibited more processing cost. For the intermediate level L2 Turkish groups, the Russian speakers tend to decompose multimorphemic Turkish items more than English speakers. Thus, the results showed decompositional processing pattern in Russian speakers of Turkish in both proficiency groups. The findings also showed a decreasing reliance on decomposition on the basis of increasing proficiency in accessing multimorphemic words.

Processing data on L2 inflection is also available in Finnish - a highly inflected, agglutinative language like Turkish. In a lexical decision task, Lehtonen and Laine (2003) investigated the processing of morphologically complex Finnish nouns in three different frequency ranges in monolingual Finnish speakers and Finnish-Swedish bilinguals. They found that while the monolingual group processed low and medium frequency inflected nouns mostly through decomposition, they accessed high frequency inflected nouns via full-listing. In contrast, the bilingual group processed all inflectional nouns through decomposition regardless of their frequencies. In another study, Lehtonen, Hultén, Rodriguez-Fornells, Cunillera, Tuomainen and Laine (2012) examined the processing of Finnish nominal inflection based on three psycholinguistic factors – frequency, morphology and lexicality – in highly proficient Finnish-Swedish bilinguals and Finnish monolinguals via visual lexical decision task during ERP recordings. They observed that factors of frequency, morphology and lexicality were larger for bilinguals than monolinguals despite high L2 proficiency. The ERP results showed while bilinguals decomposed most inflected words into stem and affix, only monolinguals were able to develop full-form representations for high frequency inflected words. In sum, studies in Finnish have generally revealed different processing patterns for native speakers and L2 learners.

After this brief overview on processing L2 inflection, the following sections will present in detail the findings of L2 studies that examined the processing of derivation and compounding. The very same issue of native-nonnative differences has also been the main topic of investigation in this body of research.

5. 1. Studies on Processing of Derived Words in the L2

L2 processing studies on derivational morphology are relatively limited. Among the few studies, available is the study of Diependaele, Duñabeitia, Morris and Keuleers (2011) that compared the processing patterns of English native speakers with those of Spanish-English and Dutch-English bilinguals by using a masked priming task. The stimuli involved transparent suffixed primes (e.g., *viewer-VIEW*), pseudoderived primes (e.g., *corner-CORN*) and form control primes (e.g., *freeze-FREE*). The results indicated similar priming patterns in the native speakers and the two groups of bilinguals. The researchers found the largest priming pattern for transparent condition, the smallest priming patterns for form condition and intermediate priming for pseudoderived condition. These results support the hypothesis that bilinguals can achieve native-like processing patterns in the L2 (Lemhöfer, Dijkstra, Schriefers, Baayen, Grainger & Zwitserlood, 2008), a finding that opposes the hypothesis that bilinguals are not sensitive to the morphological properties in the L2 and rely more on whole-word processing (cf. Clahsen, Felser, Neubauer, Sato & Silva, 2010; Ullman, 2001; 2004; 2005).

Nevertheless, nonnative-like processing patterns in derivational morphology has been reported in a series of studies. For instance, Silva and Clahsen (2008) investigated the processing of deadjectival nominalizations with *–ness* and *–ity* via priming experiments by comparing native English speakers with advanced level L2 groups with Chinese or German as their L1. Although *–ness* and *–ity* are semantically similar, *–ity* is less productive and transparent than *–ness*. Despite these differences in productivity and transparency, both *–ness* and *–ity* are combinatorial word forms consisting of a stem and a suffix. The researchers manipulated the relationship between the word pairs to examine if the prime facilitated the recognition of the target. They compared morphologically related condition (e.g., *bitterness-BITTER, mobility-MOBILE*) with unrelated (e.g., *happy-BITTER, tired-MOBILE*) and identity (*bitter-BITTER, mobile-MOBILE*) conditions. The results for native speakers revealed a full stem-priming effect, that is, the same facilitation was obtained for morphologically related and identity conditions both of which were significantly faster than unrelated condition, a finding supporting decomposition in native speakers' data. In contrast, in both L2 groups, stem-priming effect was significantly reduced suggesting that L2 processing relies less on morphological decomposition when compared to L1 processing.

In addition, Clahsen and Neubauer (2010) examined the processing of German *–ung* nominalizations in native and L2 speakers of German. The *–ung* nominalization in German is a fully productive, phonologically highly transparent derivational process that forms a feminine noun out of a verbal stem (e.g., *gründen – Gründung* 'to found – foundation'). The researchers employed a masked priming experiment to investigate the priming effects of derivational word forms by using three prime-target pairs: morphologically related (e.g., *bezahlung-BEZAHLEN* '*to pay-PAYMENT*'), unrelated (e.g., *ernennung-BEZAHLEN* '*nomination-PAYMENT*'), and identity (e.g., *bezahlen-BEZAHLEN* '*to pay-TO PAY'*) conditions. The L2 group involved native Polish speakers with advanced level German proficiency. The results indicated that in the L1 group, morphologically related and identity conditions had similar RTs that were significantly shorter than unrelated condition indicating decomposition. However, for the L2 group, the morphologically related and unrelated conditions yielded similar RTs which were significantly longer than the identity condition resulting in full-listing. These results replicated the findings of Silva and Clahsen (2008) and the researchers concluded that L2 learners rely more on the declarative memory systems in processing morphologically complex words.

In another study, Rehak and Juffs (2011) replicated the study of Silva and Clahsen (2008) with two different groups of L2 learners with L1 Spanish and Mandarin Chinese. For the suffix *–ness*, both groups did not exhibit any priming effects adducing whole-word representation. However, the experiment testing the suffix *–ity* yielded different results. While the Mandarin Chinese group's responses yielded no morphological priming effect, the Spanish participants performed similar to native speakers indicating L1 transfer effect since Spanish has a similar suffix to the English suffix *–ity*.

Gacan (2014) tested the processing of English derivational suffixes *–ful* and *–less* with Turkish L2 learners of English via masked priming paradigm. The stimuli included a morphologically related (e.g., *fearful-FEAR* or *fearless-FEAR*), an identity condition (e.g., *fear-FEAR*), a morphologically unrelated condition (e.g., *exile-FEAR*) and orthographic control primes in the related (e.g., *harmony-HARM*) and unrelated (e.g., *insect-HARM*) conditions. The results revealed morphological priming effect for high proficiency L2 group for both suffixes whereas for low proficiency L2 group priming effects were observed only with the *–ful* suffix. In addition, the analysis of orthographic control conditions showed that the L2 processing of derivational morphology could be characterized by both the orthographic and morphological properties of the word proposing L2 learners process derived morphology markedly different from native speakers.

As an L2 Turkish study, so far only one study focusing on the processing of L2 Turkish derivational words has been conducted. Kırkıcı and Clahsen (2013) aimed to examine the processing of deadjectival nominalization suffix *–lık* in native speakers and L2 learners of Turkish by using masked priming experiment. The derivative suffix *–lık* is very productive and similar to *–ness* suffix in English. The L2 group was proficient in Turkish with different L1 backgrounds including Arabic, English, French, Georgian, Hausa, Kyrgyz, Mongolian, Oromo, Romanian, Russian, Swahili, and Urdu. The stimuli involved a morphologically related condition (e.g., *yorgunluk-YORGUN* '*tiredness-TIRED*') and an unrelated condition (e.g., *basit-YORGUN* '*simple-TIRED*'). The results for both the native speakers and the L2 learners indicated significant priming effect for Turkish derived words, that is, both L1 and L2 Turkish speakers employed the same processing pattern for the productive deadjectival nominalization suffix *–lık*. The researchers concluded that these priming effects indicated morphological decomposition for visually presented Turkish derived words both for native and non-native speakers.

In summary, the limited number of L2 derivational processing studies makes it difficult to reach a clear conclusion on whether or not L1 and L2 speakers employ the same processing systems. More research is needed in different languages in order to reach conclusive evidence and to understand L2 processing in detail. The processing of compound words provides an additional venue for testing the question whether the underlying mechanism for L2 processing of compounds is the same as or different from native speakers.

5. 2. Studies on Processing of Compounds in the L2

Despite the limited number of studies on L2 compound processing, the studies conducted aimed at exploring how L2 learners process compound words (e.g., Goral, Libben, Obler, Jarema and Ohayon, 2008; Mayila, 2010; Wang, 2010; Ko, 2011; Ko, Wang and Kim, 2011) and whether they diverge from native speakers while processing compounds in L2 (e.g., Borgwaldt and Lüttenberg, 2010; Lemhöfer, Koester and Schreuder, 2011; De Cat, Klepousniotou and Baayen, 2014; 2015; Li, Jiang and Gor, 2015).

Two studies provide evidence for full-listing in L2 compound processing. Goral, Libben, Obler, Jarema and Ohayon (2008) tested Hebrew-English bilinguals living in Israel to unveil the pattern of English compound word recognition in a primed lexical decision task. Three types of prime-target pairs were used: constituent 1 as prime (e.g., *wind-WINDMILL*), constituent 2 as prime (e.g., *mill-WINDMILL*) and an unrelated prime (e.g., *band-WINDMILL*). The Hebrew-English bilinguals living in Israel did not show significant constituent-priming effects in their RTs to compound words in English. These findings were taken to support the view that compound words in L2 are accessed via direct access route. In another study, Ko (2011) investigated what information was used to parse English compound words. In other words, Ko examined, via a masked priming experiment, whether morphological information played a role independent of the orthographic and semantic factors in English compound processing and what the relative contributions of the first and second constituents were in processing English compound words by Korean-English bilingual adults. The stimuli consisted of four types of prime-target pairs: morphologically decomposable, semantically transparent and orthographically overlapped (+M+S+O, e.g., *key-KEYHOLE; hole-KEYHOLE*), morphologically decomposable, semantically opaque and orthographically overlapped (+M-S+O, e.g., *dead-DEADLINE; line-DEADLINE*), only orthographically overlapped (-M-S+O, e.g., *pump-PUMPKIN; kin-PUMPKIN*) and only semantically related (-M+S-O, e.g., *frigid-COLD*). No significant priming effects were observed on RTs in any of the conditions. These results provide evidence for the claim that L2 learners do not rely on morphological decomposition in L2 compound processing.

There are also studies that support the decompositional process in L2 compound processing. On the basis of an unmasked lexical decision task, Ko, Wang and Kim (2011) aimed to explore whether compound words were decomposed into their constituent morphemes and whether cross-language activation occurred in processing compound words in Korean-English bilingual adults. To test the cross-language activation, the stimuli was designed in the following way: when the target language was English, the compound *honeybee* with two constituents *honey* and *bee* were translated into Korean and the combination of the translated constituents generated a translated compound word in Korean. In contrast, when the constituents of the English compound *bankbook* were translated into Korean, the combination of the translated constituents formed a translated nonword compound in Korean. According to this design, the stimuli involved four conditions: Real word-real word (e.g., *honeybee*), real word-nonword (e.g., *bankbook*), nonword-real word (e.g., *eyewater*) and nonword-nonword (e.g., *babydog*). Another goal of the study was to examine whether the frequency of the second constituent affected compound decomposition and cross-language activation. The stimuli consisted of high-frequency real words (e.g., *starlight*), high-frequency nonwords (e.g., *pocketbook*), low-frequency real words (e.g., *mousetrap*) and low-frequency nonwords (e.g., *sawdust*). The results revealed evidence for decomposition and cross-language activation. The researchers concluded that compound words were decomposed into their constituents because significant differences were obtained between high-frequency second constituents and low-frequency second constituents and there were significant differences in constituent activation between real words and nonwords. In addition, shorter RTs were observed when the second constituent's frequency was high. Further support for these results was provided by Wang (2010) that involved a lexical decision experiment with adult Chinese-English bilinguals. This study also observed cross-language activation and faster lexical decisions when the second constituent was a high-frequency word. These findings provide evidence for decomposition in bilingual compound processing because if compound words were not decomposed into their constituents, there should be no difference in the RTs of high-frequency and low-frequency second constituents. In another study, Goral, Libben, Obler, Jarema and Ohayon (2008) tested old and young Hebrew-English bilinguals living in the USA by employing unmasked priming paradigm in which compounds were used as targets and the constituents served as primes. The results displayed decomposition for both groups. In the older bilingual group, only the difference between constituent 2 and unrelated prime reached a significance level while both constituent primes were significantly different from the unrelated prime in younger bilinguals. Furthermore, the older bilingual group was neither slower nor less accurate than the younger bilinguals.

In contrast to these studies, there are also L2 compound studies providing support for the dual-route model. For example, Mayila (2010) investigated how adult Chinese-English bilinguals processed English noun-noun compound words via a masked priming experiment. Participants made visual lexical decisions to compound word targets preceded by masked primes, which were the second constituents of compounds sharing either a semantically transparent morphological relationship with the target (e.g., *bone-CHEEKBONE*) (this condition named as the transparent condition), an apparent morphological relationship but no semantic relationship with the target (e.g., *moon-HONEYMOON*) (the opaque condition), an orthographic relationship with the target (e.g., *plate-BIRTHPLACE*) (the orthographic condition), and a direct translation of Chinese of the second constituent of the target (e.g., *Chinese translation of the word 'paper'-NEWSPAPER*) (the Chinese condition). In line with Ko, Wang and Kim (2011) and Wang (2010), the study revealed cross-language activation in compound processing because the Chinese condition also produced significant priming effects indicating that when Chinese-English bilinguals process their L2, they also activate their L1. However, the results showed a significant effect of transparency in processing English compounds because the transparent condition produced significant priming effects but the opaque condition did not. Regarding the processing of English noun-noun compounds in L2, the study provided evidence that Chinese-English bilinguals used decomposition for transparent compounds but whole-word processing for the opaque condition.

In this body of research, some studies directly compared native and L2 speakers in compound processing (e.g., Borgwaldt and Lüttenberg, 2010; Lemhöfer, Koester and Schreuder, 2011; De Cat, Klepousniotou and Baayen, 2014; 2015; Li, Jiang and Gor, 2015). For example, in an offline rating task, Borgwaldt and Lüttenberg (2010) explored how L2 speakers of German with Russian as their L1 perceived the semantic transparency of German compounds compared to native speakers. The participants were asked to rate the semantic transparency for both the head (constituent 2) and the modifier (constituent 1) by indicating the strength of the relationship between the meaning of the compound and the meaning of its constituents. The results revealed a significant difference between the semantic transparency ratings for the compounds' heads. The L2 group perceived compounds' heads less transparent than German native speakers.

In another study, Lemhöfer, Koester and Schreuder (2011) investigated, via an unmasked lexical decision task, whether the decompositional process was influenced by orthotactic knowledge (i.e. knowledge of rules specifying the well-formedness of letter sequences) and whether compound parsing differed in native and nonnative speakers of Dutch. In compound processing, it can sometimes be difficult to identify the constituent boundary. In Dutch, the compound *fietspomp* 'bicycle pump' consists of two constituents which are *fiets* and *pomp*. This compound can also be parsed as *fiet* and *spomp*, which are two legal and pronounceable letter strings. In the compound *fietspomp*, the location of the boundary does not follow from orthotactic constraints, that is, from the rules of combining letter sequences to constitute well-formed units in a given language. On the other hand, in the compound *fietsbel* 'bicycle bell', the morpheme boundary is easier to detect since the bigram 'sb' cannot occur within Dutch morphemes. They found that both bilinguals and native speakers of Dutch benefitted from the presence of an orthotactic cue in compound recognition, which suggests they made use of sublexical information during compound processing, which aids the identification of constituents. This is taken to be evidence for decomposition. However, additional analysis by modulating the role of compound length indicated qualitative differences between native and nonnative speakers with respect to the cue effect. Native speakers used orthotactic cue for long compounds, but not for short compounds, indicating decomposition for long compounds and full-listing for short compounds. In contrast, the case was different for nonnative speakers because they decomposed all compounds irrespective of length and they used orthotactic cues for decomposition.

De Cat, Klepousniotou and Baayen (2014; 2015) examined the processing of noun-noun compounds by native speakers of English and advanced level German-English and Spanish-English L2 learners based on EEG recordings. The stimuli involved licit compounds (e.g., *coal dust*) and reversed compounds (e.g., *dust coal*). For licit compounds, the accuracy level of L2 groups was similar to native speakers. On the other hand, in reversed compounds, L2 learners were more likely to accept novel compounds as lexicalized compounds. English native speakers read licit compounds by using both whole-word and constituent information suggesting dual-route, yet both L2 groups relied more on a constituent-driven approach, namely decomposition. In contrast, for reversed compounds, all groups employed decomposition.

Finally, Li, Jiang and Gor (2015) explored the processing of English compound words in native English speakers and advanced level Chinese-English bilinguals in a masked priming experiment. The stimuli involved three conditions: transparent-transparent condition (e.g., *toothbrush*), opaque-opaque condition (e.g., *honeymoon*) and monomorphemic control condition (e.g., *restaurant*). Compound words were used as primes and the constituents were targets. The researchers obtained similar results for native speakers and L2 group. Both groups processed transparent and opaque compounds via decomposition indicating no effect of semantic transparency in compound recognition. In addition, not only constituent 1 but also constituent 2 were activated by both groups. Although native speakers were faster in terms of RTs, no difference in the processing pattern was observed in these groups indicating that native English speakers and Chinese-English bilinguals identify compound words by breaking a compound down into its morphological constituents.

In summary, however limited in number, available data from a number of L2 compound processing studies suggests that there is a tendency to decompose L2 compounds and this contradicts the hypothesis that L2 speakers rely more on whole-word lexical storage and less on decomposition than native speakers. However, it is also important to note that several linguistic factors such as constituent frequency and semantic transparency are found to have a determining role in choosing the parsing route.

CHAPTER 6

THE STUDY

The current investigation aims to examine the representation and processing of compounds in the mental lexicon of Turkish-English and English-Turkish sequential adult bilinguals in comparison to monolingual English and monolingual Turkish adults. Therefore the investigation includes two different but parallel studies on compound word processing, one in English and one in Turkish. This chapter details the methodology of each study.

6. 1. The English Study

6. 1. 1. Research Questions

The aim of the study is to find answers for the following questions:

1. How do native English speakers process compounds? More specifically,
    a. Does either constituent 1 or constituent 2 presented as primes lead to shorter reaction times (RTs) than unrelated primes in processing compounds and noncompounds?
    b. Is there a difference between transparent-transparent and partially-opaque compounds in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?
    c. Is there a difference between pseudocompound and monomorphemic words in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?
2. How do sequential Turkish-English bilinguals (i.e. late L2 English learners) process English compounds?

a. Does either constituent 1 or constituent 2 presented as primes lead to shorter reaction times (RTs) than unrelated primes in processing compounds and noncompounds?
b. Is there a difference between transparent-transparent and partially-opaque compounds in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?
c. Is there a difference between pseudocompound and monomorphemic words in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?
d. Does L2 English proficiency influence the way sequential bilinguals process the compounds in English?

3. Is there a difference between the English monolinguals and Turkish-English sequential bilinguals in processing compounds?
4. What pedagogical implications will these studies have in teaching L2 English compounds?

6. 1. 2. Predictions

In this study, the findings will reveal whether or not the constituents of English compounds are decomposed in online processing. It is expected that during the processing of English compound words, monolingual and Turkish-English sequential bilingual adults will employ dual-route patterns as the processing is predicted to be influenced by the semantic transparency of the compounds. If we find equivalent priming in all three conditions, namely first constituent, second constituent and unrelated conditions, this will suggest that priming results not from morphological decomposition but from low level orthographic processing (Shoolman and Andrews, 2003). However, if the processing pattern is based on access to the morphological structure, then we should see priming effects for compounds. Priming effects (i.e. decompositional access pattern) will be observed only in compound words but not in pseudocompounds or monomorphemic items. Within the compound words, effects that depend on semantic influences should reveal priming effects in the transparent conditions. More specifically, transparent-transparent items are expected to trigger stronger priming effects (i.e. decomposition) compared to partially-opaque items irrespective of which constituent (first or second) is used as a prime. Moreover, the first and second constituent primes are hypothesized to be stronger primes when compared to the unrelated primes. Crucially, the second constituent prime is also hypothesized to have a more facilitative role in compound processing because at the same time it functions as the head of the compounds.

Proficiency level of the participants is predicted to affect the processing of English compounds in such a way that while higher L2 proficiency participants are expected to show native-like performance, lower proficiency level participants are predicted to have slower responses across all conditions but not necessarily a non-native-like processing pattern in accessing compounds. In other words, L2 participants in two proficiency groups will be qualitatively similar to native English speakers, potential differences will only be quantitative, and be reflected in L2 participants with lower level L2 English proficiency.

6. 1. 3. Methodology

6. 1. 3. 1. Participants

63 monolingual English speakers (38 female and 25 male), 51 intermediate level (32 female and 19 male) and 51 advanced level (31 female and 20 male) Turkish-English sequential bilinguals participated in the experiment. The intermediate level sequential bilingual participants were students of the Preparatory school of Yeditepe University. The advanced level sequential bilingual participants were studying at the English Language Teaching,

English Language and Literature and Translation and Interpreting Studies departments of the same university. All participants were healthy adults with normal vision and they were never diagnosed with any learning or other behavioral disorders (see Table 2 for the characteristics of the participants).

Table 2.

Participants

Groups	Mean Age (range)	Age of first English exposure (range)	Length (years) of English exposure (range)
Monolingual English (N=63)	24.66 (20-53)	At birth	From birth
Turkish-English Intermediate Level Bilinguals (N=51)	19.56 (18-24)	9.41 (5-18)	10.49 (2-17)
Turkish-English Advanced Level Bilinguals (N=51)	21.13 (18-27)	8.88 (4-14)	12.19 (4-18)

6. 1. 3. 2. Tasks

The tasks of the English compound study include:

1. A background questionnaire: A language background questionnaire was prepared and delivered in order to collect demographic and linguistic information from the participants (see Appendix A for English monolinguals, Appendix B for Turkish-English sequential bilinguals).
2. Language Proficiency Test: To determine the English proficiency level of the bilinguals, Yeditepe University English Proficiency Test was conducted.
3. Masked priming task: This is the experimental task involving a masked priming lexical decision task administered via E-prime 2.0 (Schneider, Eschman & Zuccolotto, 2002).

6. 1. 3. 3. Materials

The English compound words were divided into two categories following the design of Shoolman & Andrews (2003): transparent-transparent in which the meaning of the two constituents was related to the meaning of the whole word (e.g., *headache*) and partially-opaque in which the meaning of one of the constituents was not related to the whole meaning (e.g., *grapefruit*).

A total of 20 compound words (10 for each compound type) were included in the experiment. All compounds were noun-noun compounds. In addition, 10 pseudocompounds (e.g. *mandate*) were used in the experiment. Pseudocompound words consist of two constituents that can potentially stand alone as free morphemes (i.e. *man* and *date*) but do not serve as a real compound. Finally, 60 monomorphemic words (e.g. *crocodile*) that cannot be decomposed were included in the study. Pseudocompound and monomorphemic items were employed as control items. Pseudocompound items were included to see to what extent meaningful constituents were activated. Monomorphemic items enabled us to make comparisons with compound items in terms of priming effects. The items were chosen after examining the coursebooks and interviewing the teachers of Turkish-English bilinguals. A complete list of compounds, pseudocompounds and monomorphemic items can be found in Appendix C, D and E. All compounds, pseudocompounds and monomorphemic items were selected from the SUBTLEX-US Corpus (Brysbaert & New, 2009). Based on the SUBTLEX-US Corpus, all items were matched on whole-word length, whole-word frequency, first constituent length, first constituent frequency, second constituent length and second constituent frequency as much as possible (see Table 3 for the properties of test items).

90 nonwords were added to the experiment. Nonwords included 60 monomorphemic nonwords (e.g., *felmigure*) and 30 compound nonwords that were formed by word-word (W-W, e.g., *boatnoon*), nonword-word (NW-W, e.g., *flurbpair*), word-nonword (W-NW, e.g., *cheekpeem*) and nonword-nonword (NW-NW, e.g., *bonchmip*) combinations. Compound nonword items were used to see whether the participants tend to analyze the constituent structure of the items irrespective of their compound status. These items also enabled us to investigate the contribution of the first and second constituents to the lexical decision performance. Nonwords were created by changing 2-3 letters without violating the phonotactic rules of English. The list of nonwords is given in Appendix F and G.

Table 3.

Examples from the English stimuli list

Condition	WW Frequency	WW Length	C1 Frequency	C1 Length	C2 Frequency	C2 Length
TT (*headache*)	5.37	8.7	143.47	4.4	82.31	4.3
PO (*grapefruit*)	5.86	8.8	139.08	4.4	65.78	4.4
PSC (*mandate*)	5.75	7.9	199.02	3.8	69.36	4.1
Monomorphemic (*crocodile*)	5.60	8.35	-	4.23	-	4.12
NW (Compound) (*boatnoon*)	-	8.43	-	4.27	-	4.16
NW (Mono) (*felmigure*)	-	8.4	-	4.2	-	4.2

WW: Whole Word; C1: Constituent 1; C2: Constituent 2; TT: Transparent-Transparent Compounds; PO: Partially-Opaque Compounds; PSC: Pseudocompounds; NW: Nonword

Compound, pseudocompound and monomorphemic items were compared in terms of frequency and length. No significant differences were found for the whole-word frequency (F=.013; p=.998), first constituent frequency (F=.079; p=.924) and second constituent frequency (*F*=.060; *p*=.942). In the comparison of length, no significant differences were obtained for the whole-word length (*F*=1.413; *p*=.244), first constituent length (*F*=976; *p*=.408) and second constituent length (*F*=441; *p*=.724).

In a further analysis, the real words (i.e., compound, pseudocompound and monomorphemic items) were compared in terms length with nonword items (i.e., monomorphemic nonword and compound nonword). No significant differences were found for the whole-word length (*t*=-.136, *p*=.892), first constituent length (*t*=.000, *p*=1) and second constituent length (*t*=-.174, *p*=.862).

The prime-target pairs were presented in three conditions: (i) Constituent 1 (*head–HEADACHE*), (ii) Constituent 2 (*ache–HEADACHE*) and (iii) Unrelated (*barn–HEADACHE*). There were three versions of the test so that no participant saw the same target more than once.

6. 1. 3. 4. Procedure

The study employed a masked priming paradigm, which enables researchers to compare the influence of constituents and unrelated primes and to compare their effects. In addition, this paradigm does not allow for any kind of explicit processing strategy that may arise from the conscious identification of the prime. Due to an extremely short priming period, this task is believed to tap the early stages of processing. Participants were tested individually. In this task, the participants were asked to respond to a set of words appearing on the computer screen by pressing either a "Yes" or "No" button on the keyboard as quickly and as accurately as possible. This experiment was conducted using E-prime 2.0 (Schneider, Eschman & Zuccolotto, 2002), which automatically records the RTs and accuracy of the participants. For each trial, first a forward mask (#####) was presented on the center of the screen for 500 msec; this was followed by the prime which was presented for 50 msec, followed immediately by the target. The target item remained on the screen until the participant pressed the “Yes” or “No” buttons. A practice of 10 stimuli was given prior to the actual test so that the participants would become familiar with the procedure.

6. 1. 3. 5. Data Analysis

Descriptive statistics and repeated measures ANOVA were conducted on the mean RTs of the items. Following Shoolman and Andrew’s (2003, p. 259) study, the average of the two sets of compound words (transparent and partially-opaque items) was compared with the average of noncompound words (pseudocompound and monomorphemic items) to determine the effect of morphological structure. Transparent compounds were compared with partially-opaque compounds to evaluate the semantic contributions. In addition, pseudocompound words were compared with monomorphemic words to assess the lexical status of constituents. Finally, to identify the overall priming effect, an average of the first and second constituent primes was compared to the unrelated prime and also the priming effects from the first and second constituent primes were compared with each other to identify any differential facilitation from the two constituents.

6. 2. The Turkish Study

6. 2. 1. Research Questions

The aim of the study is to find answers for the following questions:

1. How do native Turkish speakers process compounds? More specifically,
    a. Does either constituent 1 or constituent 2 presented as primes lead to shorter reaction times (RTs) than unrelated primes in processing compounds and noncompounds?
    b. Is there a difference between transparent-transparent and partially-opaque compounds in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?
    c. Is there a difference between pseudocompound and monomorphemic words in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?
2. How do sequential English-Turkish bilinguals (i.e. late L2 Turkish learners) process Turkish compounds?
    a. Does either constituent 1 or constituent 2 presented as primes lead to shorter reaction times (RTs) than unrelated primes in processing compounds and noncompounds?
    b. Is there a difference between transparent-transparent and partially-opaque compounds in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?
    c. Is there a difference between pseudocompound and monomorphemic words in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?
    d. Does L2 Turkish proficiency influence the way sequential bilinguals process the compounds in English?
3. Is there a difference between the Turkish monolinguals and English-Turkish sequential bilinguals in processing compounds?

4. What pedagogical implications will these studies have in teaching L2 Turkish compounds?

6. 2. 2. Predictions

The results will reveal whether or not the constituents of Turkish compounds are decomposed in online processing. It is predicted that during the processing of Turkish compound words, monolingual and English-Turkish sequential bilingual adults will employ dual-routes as the processing pattern will be influenced by the semantic transparency of the compounds. If we find equivalent priming in all three conditions, namely first constituent, second constituent and unrelated conditions, this will suggest that priming results from low level orthographic representations (Shoolman and Andrews, 2003). However, if the effects result from morphological structure, then we should see priming effects for compounds. Priming effects (i.e. decompositional access pattern) will be observed only in compound words but not in pseudocompounds or monomorphemic items. Within the compound words, transparent-transparent items are expected to receive stronger priming effects compared to partially-opaque items irrespective of which constituent (first or second) is used as a prime. Moreover, the first and second constituent primes are hypothesized to be stronger primes compared to the unrelated primes and crucially the second constituent prime is also hypothesized to have a more facilitative role in compound processing because the second constituent is also the head of the compound. Proficiency level of the participants is predicted to affect the processing of Turkish compounds only quantitatively; while the participants with higher L2 Turkish proficiency level are expected to demonstrate native-like performance, the lower-proficiency group is hypothesized to have slower responses albeit similar processing patterns.

6. 2. 3. Methodology

6. 2. 3. 1. Participants

Twenty monolingual Turkish speakers took the pilot study. After the pilot study, 73 monolingual Turkish speakers (57 female and 16 male), 36 intermediate level (21 female and 15 male) and 35 advanced level (24 female and 11 male) English-Turkish sequential bilinguals participated in the main experiment. The L2 Turkish group consisted of participants working in Istanbul as English teachers in various schools and universities. All participants were healthy adults with normal vision and they were never diagnosed with any learning or other behavioral disorders (see Table 4 for the characteristics of the participants).

Table 4.

Participants

Groups	Mean Age (range)	Age of first Turkish exposure (range)	Length (years) of Turkish exposure (range)
Monolingual Turkish (N=73)	32.37 (18-46)	At birth	From birth
English-Turkish Intermediate Level Bilinguals (N=36)	40.30 (20-67)	31.13 (17-55)	9.08 (2-30)
English-Turkish Advanced Level Bilinguals (N=35)	42.60 (21-62)	25.14 (15-43)	17.42 (5-40)

6. 2. 3. 2. Tasks

The tasks of the Turkish compound study include:

1. A background questionnaire: A language background questionnaire was prepared and administered in order to collect demographic and linguistic information from the

participants (see Appendix H for Turkish monolinguals, Appendix I for English-Turkish sequential bilinguals).

2. Transparency Judgment Test: This test was prepared to obtain native Turkish speakers' judgments on the transparency level of a set of Turkish compound words (see section below for details of this test). The native Turkish speakers who took this transparency test were not included in the online compound study.
3. Language Placement Tests: To determine Turkish proficiency level of the bilinguals, Istanbul University Language Centre Turkish Placement Test was used.
4. Masked priming task: This is the experimental task involving a masked priming lexical decision task administered via E-prime 2.0 (Schneider, Eschman & Zuccolotto, 2002).

6. 2. 3. 3. Materials

To determine the first and second constituents' semantic contribution to the whole compound's meaning, a transparency judgment test for Turkish compounds was prepared on a 5-point scale (1: unrelated, 5: strongly related) and delivered to Turkish native speakers. By using the transparency judgment test ratings of 86 native speakers, the constituents with a mean score of 3.5 and over are classified as transparent and the Turkish compound words are divided into two categories following the design of Shoolman & Andrews (2003): transparent-transparent (TT), in which the meaning of the two constituents was related to the meaning of the whole word (e.g., *kuzeydoğu* 'northeast', *kuzey* 'north', *doğu* 'east') and partially-opaque (PO), in which the meaning of one of the constituents was not related to the whole meaning (e.g., *büyükelçi* 'ambassador', *büyük* 'big', *elçi* 'delegate') (see Appendix J for the complete list given in this transparency test and the judgement scores obtained by native Turkish speakers).

As for the experimental task, a total of 20 compound words (10 of each compound type) were included. Eleven of the compounds were noun-noun compounds and 9 of them were adjective-noun compounds. In addition, 10 pseudocompounds (e.g. *fesleğen* 'basil', *fes* 'fez', *leğen* 'bowl/pelvis') were used in the experiment. Pseudocompound words (PSC) consist of two constituents that can potentially stand alone as free morphemes but do not serve as a compound word. Finally, 60 monomorphemic words (e.g. *kağlumbağa* 'turtle') that are not decomposable were included in the study. The items were chosen after sending a questionnaire to 11 L2 Turkish participants from different L1 backgrounds. Pseudocompound and monomorphemic items were included in the test as control items. Pseudocompound items enabled us to see the extent to which meaningful constituents are activated. Similarly, the monomorphemic items enabled us to make comparisons with compound items in terms of priming effects (see Appendix K, L and M for the complete set of compounds, pseudocompounds and monomorphemic items). All compounds, pseudocompounds and monomorphemic items were selected from the METU Corpus (Say, Zeyrek, Oflazer & Özge, 2002). Based on the METU Corpus, all items were matched on whole-word frequency, whole-word length, first constituent frequency, first constituent length, second constituent frequency and second constituent length as much as possible (see Table 5 for the properties of test items).

90 nonwords were added to the experiment. Nonwords (NW) included 60 monomorphemic nonwords (e.g., *ülterzatif*) and 30 compound nonwords that were formed by word-word (W-W, e.g., *kumardalga, kumar* 'gambling', *dalga* 'wave'), nonword-word (NW-W, e.g., *bızakateş, ateş* 'fire'), word-nonword (W-NW, e.g., *meydanlaze, meydan* 'square') and nonword-nonword (NW-NW, e.g., *fatsihetre*) combinations. Compound nonword items were used to see whether the participants tend to analyze the constituent structure of the items irrespective of their compound status. These items also enabled to investigate the contribution of the first and second constituents to the lexical decision performance. Nonwords were created

by changing 2-3 letters without violating the phonotactic rules of Turkish (see Appendix N and O for the list of nonwords).

Table 5.

Examples from the stimuli list

Condition	WW Frequency	WW Length	C1 Frequency	C1 Length	C2 Frequency	C2 Length
TT (*kuzeydoğu*)	4.52	8.6	202.71	4.3	72.03	4.3
PO (*büyükelçi*)	4.35	9.1	230.01	4.7	43.52	4.4
PSC (*fesleğen*)	4.64	7.5	154.96	3.8	35.81	3.7
Monomorphemic (*kaplumbağa*)	4.59	8.18	-	4.12	-	4.07
NW (Compound) (*kumardalga*)	-	8.5	-	4.37	-	4.13
NW (Mono) (*ülterzatif*)	-	8.18	-	4.05	-	4.13

WW: Whole Word; C1: Constituent 1; C2: Constituent 2; TT: Transparent-Transparent Compounds; PO: Partially-Opaque Compounds; PSC: Pseudocompounds; NW: Nonword

Compound, pseudocompound and monomorphemic items were compared in terms of frequency and length. No significant differences were obtained for the whole-word frequency (F=.005; p=1), first constituent frequency (F=.115; p=.892) and second constituent frequency (F=.919; p=.411). In the comparison of length, no significant differences were obtained for the first constituent length (F=1.472; p=.228) and second constituent length (F=1.140; p=.338); however, a significant difference was obtained for the whole-word length (F=2.920; p=.039). The post-hoc analysis revealed a significant difference only between the partially-opaque and pseudocompound items (p=.038). The reason for the difference was that pseudocompound items were shorter in terms of length than the partially-opaque compound items and this was a case we could not control for.

The real words (i.e., compound, pseudocompound and monomorphemic items) were also compared in terms of length with nonword items (i.e., monomorphemic nonword and compound nonword). No significant differences were found for whole-word length (t=-.168, p=.866), first constituent length (t=.072, p=.942) and second constituent length (t=-.319, p=.750).

The prime-target pairs were presented in three conditions: (i) Constituent 1 (*kuzey*–*KUZEYDOĞU*), (ii) Constituent 2 (*doğu*–*KUZEYDOĞU*) and (iii) Unrelated (*çanta* 'bag'–*KUZEYDOĞU*). There were three versions of the test so that no participant saw the same target more than once.

6. 2. 3. 4. Procedure

The procedure was identical to the procedure in the English compound study.

6. 2. 3. 5. Data Analysis

Data analysis was identical to the data analysis in the English compound study.

Table 6.

Overview of Research Questions and Corresponding Procedure in the English Study

Research Question	Paricipants	Data Collection Instrument	Data Analysis
1. How do native English speakers process compounds? a. Does either constituent 1 or constituent 2 presented as primes lead to shorter reaction times (RTs) than unrelated primes in processing compounds and noncompounds? b. Is there a difference between transparent-transparent and partially-opaque compounds in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes? c. Is there a difference between pseudocompound and monomorphemic words in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?	Monolingual English speakers (N=63)	Masked priming experiment	Descriptive statistics and repeated measures ANOVA
2. How do sequential Turkish-English bilinguals (i.e. late L2 English learners) process English compounds? a. Does either constituent 1 or constituent 2 presented as primes lead to shorter reaction times (RTs) than unrelated primes in processing compounds and noncompounds? b. Is there a difference between transparent-transparent and partially-opaque compounds in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes? c. Is there a difference between pseudocompound and monomorphemic words in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?	Turkish-English Intermediate Level Bilinguals (N=51) Turkish-English Advanced Level Bilinguals (N=51)	Masked priming experiment	Descriptive statistics and repeated measures ANOVA

d. Does L2 English proficiency influence the way sequential bilinguals process the compounds in English?			
3. Is there a difference between the English monolinguals and Turkish-English sequential bilinguals in processing compounds?	Monolingual English speakers (N=63) Turkish-English Intermediate Level Bilinguals (N=51) Turkish-English Advanced Level Bilinguals (N=51)	Masked priming experiment	Descriptive statistics and repeated measures ANOVA
4. What pedagogical implications will these studies have in teaching L2 English compounds?	Turkish-English Intermediate Level Bilinguals (N=51) Turkish-English Advanced Level Bilinguals (N=51)	Masked priming experiment	Descriptive statistics and repeated measures ANOVA

Table 7.

Overview of Research Questions and Corresponding Procedure in the Turkish Study

Research Question	Paricipants	Data Collection Instrument	Data Analysis
1. How do native Turkish speakers process compounds? a. Does either constituent 1 or constituent 2 presented as primes lead to shorter reaction times (RTs) than unrelated primes in processing compounds and noncompounds? b. Is there a difference between transparent-transparent and partially-opaque compounds in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes? c. Is there a difference between pseudocompound and monomorphemic words in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes?	Monolingual Turkish speakers (N=73)	Masked priming experiment	Descriptive statistics and repeated measures ANOVA
2. How do sequential English-Turkish bilinguals (i.e. late L2 Turkish learners) process Turkish compounds? a. Does either constituent 1 or constituent 2 presented as primes lead to shorter reaction times (RTs) than unrelated primes in processing compounds and noncompounds? b. Is there a difference between transparent-transparent and partially-opaque compounds in terms of potential priming effects of constituent 1 or constituent 2 as compared to unrelated primes? c. Is there a difference between pseudocompound and monomorphemic words in terms of potential priming	English-Turkish Intermediate Level Bilinguals (N=36) English-Turkish Advanced Level Bilinguals (N=35)	Masked priming experiment	Descriptive statistics and repeated measures ANOVA

effects of constituent 1 or constituent 2 as compared to unrelated primes? d. Does L2 Turkish proficiency influence the way sequential bilinguals process the compounds in Turkish?			
3. Is there a difference between the Turkish monolinguals and English-Turkish sequential bilinguals in processing compounds?	Monolingual Turkish speakers (N=73) English-Turkish Intermediate Level Bilinguals (N=36) English-Turkish Advanced Level Bilinguals (N=35)	Masked priming experiment	Descriptive statistics and repeated measures ANOVA
4. What pedagogical implications will these studies have in teaching L2 Turkish compounds?	English-Turkish Intermediate Level Bilinguals (N=36) English-Turkish Advanced Level Bilinguals (N=35)	Masked priming experiment	Descriptive statistics and repeated measures ANOVA

CHAPTER 7

RESULTS

7. 1. The English Study

7. 1. 1. English Proficiency Test

As displayed in Table 8, the independent sample t-test revealed a significant difference between the English proficiency test scores ($t(100)=23.988$, $p=.000$). The Turkish-English advanced level bilinguals received significantly higher scores than the intermediate group.

Table 8.

English proficiency test scores

Groups	Scores (out of 100)	Range	Standard Deviation
Turkish-English Intermediate Level Bilinguals (N=51)	52.71	38-58	4.56
Turkish-English Advanced Level Bilinguals (N=51)	75.65	69-88	5.08

7. 1. 2. Masked Priming Test

All incorrect responses and outliers were excluded from the analysis. A "no" (i.e. nonword) response to a real word and a "yes" (i.e. real word) response to a nonword were labeled as an incorrect response. In addition, RTs exceeding three standard deviations above and below a participant's mean RT per word type were deemed outliers. Due to the low frequency of the tested items, the participants with an error rate exceeding 33.3% were excluded from the study. One Turkish-English intermediate level bilingual participant was excluded from the analysis because her error rate was 44.4%.

Table 9 presents the error rates across word categories. The highest error rates were found in monomorphemic words in all groups. A one-way ANOVA comparing the total error rates showed a significant difference among the groups (F=56.610; p=.000). According to the post-hoc test, the Turkish-English intermediate bilingual group had a significantly higher error rate than the other two groups (p=.000) and the Turkish-English advanced bilingual group made significantly more errors than the monolingual English group (p=.000).

Table 9.

Error rates (in percentages)

Groups	PO	TT	PSC	MONO	TOTAL
Monolingual English (N=63)	0.79	1.11	3.49	3.97	3.25
Turkish-English Intermediate Level Bilinguals (N=50)	7.60	5.80	17.00	17.36	14.95
Turkish-English Advanced Level Bilinguals (N=51)	3.33	2.74	9.80	12.41	10.04

PO: Partially-Opaque items; TT: Transparent-Transparent items; PSC: Pseudocompound items; MONO: Monomorphemic items

Table 10 demonstrates the outlier rates across word categories. The highest outlier rates were found in monomorphemic words in all groups. A one-way ANOVA comparing the total outlier rates exhibited no significant difference among the groups (F=.723; p=.487).

Table 10.

Outlier rates (in percentages)

Groups	PO	TT	PSC	MONO	TOTAL
Monolingual English (N=63)	0.00	0.00	0.00	1.85	1.23
Turkish-English Intermediate Level Bilinguals (N=50)	0.00	0.00	0.00	2.06	1.37
Turkish-English Advanced Level Bilinguals (N=51)	0.00	0.00	0.00	1.79	1.19

PO: Partially-Opaque items; TT: Transparent-Transparent items; PSC: Pseudocompound items; MONO: Monomorphemic items

The accuracy rates were 95.52%, 83.67% and 88.76% for the monolingual English, Turkish-English intermediate bilingual and Turkish-English advanced bilingual groups, respectively. A one-way ANOVA comparing the accuracy rates found a significant difference among the groups (F=56.844; p=.000). According to the post-hoc test, the monolingual English group had a significantly higher accuracy rate than the other two groups (p=.000) and the Turkish-English advanced bilingual group had significantly more correct responses than the Turkish-English intermediate bilingual group (p=.000).

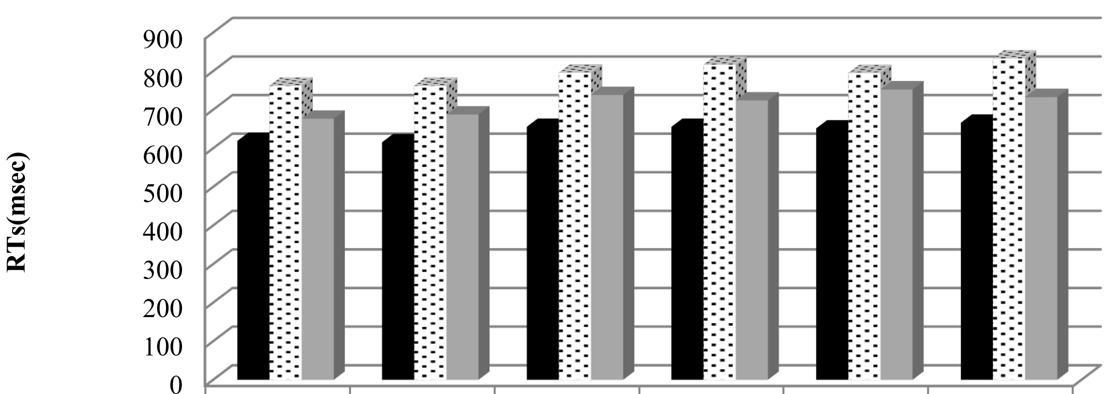
The first analysis investigated whether the compound words were processed differently from the noncompound words. For this analysis, the mean RTs to the two sets of compound words (transparent and partially-opaque items) was compared with the mean RTs to noncompund words (pseudocompound and monomorphemic items). A 2 (word types) x 3 (prime types) x 3 (groups) mixed-model ANOVA was conducted and the results indicated significant differences of word types (F=28.762; p=.000), prime types (F=10.831; p=.000), groups (F=18.999; p=.000) and the interaction between word types and prime types (F=3.484; p=.037).

As can be seen in Figure 1, in compound words, the Turkish-English intermediate level bilinguals were significantly slower than the monolingual English (p=.000) and Turkish-English advanced level bilingual groups (p=.015). Also, the advanced bilingual group was significantly slower than the English monolinguals (p=.011). For noncompound items, the intermediate group was significantly slower than the English monolingual (p=.000) and Turkish-English advanced level bilingual groups (p=.018) and the advanced group was significantly slower than the English monolinguals (p=.012). In addition, compound words were processed significantly faster than noncompound words (p=.000). Furthermore, significant differences were found between constituent 1 and unrelated primes (p=.000) and constituent 2 and unrelated primes (p=.000). The significant interaction of word types and prime types indicated significant differences between constituent 1 and unrelated primes (p=.000) and constituent 2 and unrelated primes (p=.000) in compound words, suggesting that compounds were accessed in a decomposed fashion. The size of priming effects in terms of Cohen's d was parallel for both constituent primes in compound words (constituent 1: d=3.5; constituent 2: d=3.627). Both primes showed a large effect size. However, no significant priming effect was obtained for noncompound words.

Within-group analysis for the English monolingual group illustrated a significant effect of word types (F=19.113; p=.000) and prime types (F=8.856; p=.000). Compound words were processed significantly faster than noncompound words (p=.000) and both constituent 1 (p=.002) and constituent 2 (p=.001) were significantly faster primes when compared to unrelated prime. Planned comparisons confirmed significant differences between constituent 1 and unrelated prime (p=.001) and constituent 2 and unrelated prime (p=.001) in compound words, indicating decomposition. The size of priming effects in terms of Cohen's d was parallel for both constituent primes in compound words (constituent 1: d=2.745; constituent 2: d=3.295). Both primes showed a large effect size. No priming effect was observed in noncompound words. These results suggest decomposition for compound words and full-listing for noncompound words.

Figure 1.

Mean RTs in three prime conditions for compounds and noncompounds



	C-C1	C-C2	C-UR	NC-C1	NC-C2	NC-UR
■ L1 ENG	619,069	615,462	655,47	655,554	651,354	665,947
∵ L2 ENG INT	761,745	761,487	795,428	816,465	794,608	832,638
■ L2 ENG ADV	676,645	687,281	738,087	723,752	752,246	732,315

C-C1: Compound Constituent 1; C-C2: Compound Constituent 2; C-UR: Compound Unrelated; NC-C1: Noncompound Constituent 1; NC-C2: Noncompound Constituent 2; NC-UR: Noncompound Unrelated

The results of the Turkish-English intermediate level bilinguals displayed a significant difference only between word types (*F*=7.939; *p*=.007), suggesting that compound words were processed significantly faster than noncompound words. Unlike the English monolingual group, no significant differences were found among the prime types, implying the absence of decomposition in both compound and noncompound words.

The results for the Turkish-English advanced level bilinguals reflected a significant difference of word types (*F*=7.721; *p*=.008), prime types (*F*=4.692; *p*=.012) and the interaction between word types and prime types (*F*=5.405; *p*=.007). Compound words were processed significantly faster than noncompound words (*p*=.008) and constituent 1 served as a significantly faster prime than the unrelated prime (*p*=.006). According to the results of planned comparisons, a significant difference was found both for constituent 1 (*p*=.001) and constituent 2 (*p*=.026) when compared to the unrelated prime in compound words, implying the presence of a decompositional process. The size of priming effects in terms of Cohen's *d* was parallel for both constituent primes in compound words (constituent 1: *d*=3.124; constituent 2: *d*=2.677). Both primes showed a large effect size. Nevertheless, no priming effect was observed in noncompound words.

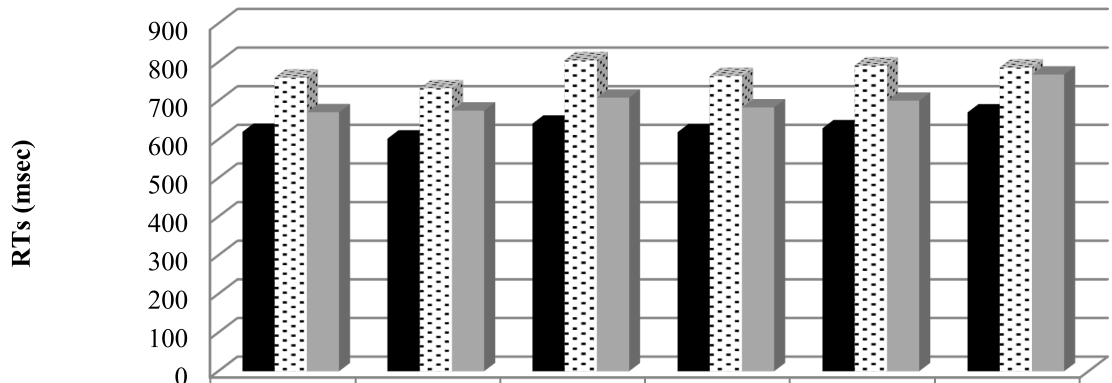
In sum, the results revealed that all groups processed English compound words significantly faster than noncompound words. The Turkish-English intermediate level bilinguals yielded no priming effects either for compounds or noncompounds. In contrast, the English monolinguals and the Turkish-English advanced level bilinguals were able to access both constituents and employed decomposition in accessing compound words.

The second analysis aimed to explore the effect of semantic transparency in compound processing. The RTs of transparent compounds were compared with partially-opaque compounds to evaluate the semantic contributions. A 2 (word types) x 3 (prime types) x 3 (groups) mixed-model ANOVA was conducted and the results revealed significant differences of word types (*F*=4.774; *p*=.03), prime types (*F*=10.390; *p*=.000) and groups (*F*=17.604; *p*=.000).

As Figure 2 demonstrates, in partially-opaque compounds, the Turkish-English intermediate level bilinguals were significantly slower than the monolingual English (*p*=.000) and Turkish-English advanced level bilingual groups (*p*=.022), yet the difference between advanced group and the monolingual English group did not reach a significant level (*p*=.078). In transparent-transparent compounds, the English monolingual group was significantly faster than both intermediate (*p*=.000) and advanced (*p*=.007) groups; however, the difference between two L2 groups missed the significance level slightly (p=.057). In addition, partially-opaque compound words were processed significantly faster than transparent compound words (p=.03). Also, significant differences were found between constituent 1 and unrelated primes (p=.000) and constituent 2 and unrelated primes (p=.000) revealing decomposition.

Figure 2

Mean RTs in three prime conditions for partially-opaque and transparent compound words



	PO-C1	PO-C2	PO-UR	TT-C1	TT-C2	TT-UR
■ L1 ENG	619,503	602,075	641,019	618,636	628,848	669,921
∴ L2 ENG INT	759,707	731,822	804,737	763,782	791,152	786,118
■ L2 ENG ADV	670,427	674,516	708,183	682,865	700,046	767,992

PO-C1: Partially-Opaque Constituent 1; PO-C2: Partially-Opaque Constituent 2; PO-UR: Partially-Opaque Unrelated; TT-C1: Transparent-Transparent Constituent 1; TT-C2: Transparent-Transparent Constituent 2; TT-UR: Transparent-Transparent Unrelated

Within-group analysis for the English monolingual group showed a significant effect of word types (F=4.656; p=.035) and prime types (F=9.869; p=.000). Partially-opaque compound words were processed significantly faster than transparent compound words (p=.035) and both constituent 1 (p=.001) and constituent 2 (p=.001) were significantly faster primes when compared to unrelated prime. Planned comparisons exhibited significant differences between constituent 1 and unrelated prime (p=.002) and constituent 2 and unrelated prime (p=.02) in transparent compound words, indicating decomposition. The size of priming effects in terms of Cohen's d was parallel for both constituent primes in transparent compounds (constituent 1: d=3.621; constituent 2: d=2.746). Both primes showed a large effect size. For partially-opaque compounds, a significance was obtained only between constituent 2 and unrelated prime (p=.018), suggesting headedness-based decomposition. These results suggest that the English monolingual group employs decomposition for both types of compounds (i.e. fully-transparent and partially-opaque compounds) but cannot access constituent 1 in partially-opaque compounds. In other words, constituent 1 facilitates the recognition of the target compound only when the compound is fully-transparent. This reveals that semantic transparency influences the activation of constituent morphemes in processing compounds.

The results of the Turkish-English intermediate level bilinguals displayed no significant difference between word types or prime types indicating full-listing for both compound types regardless of their semantic transparency.

The results for the Turkish-English advanced level bilinguals illustrated a significant difference of word types (F=6.239; p=.016) and prime types (F=7.010; p=.002). Partially-opaque compound words were processed significantly faster than transparent compound words (p=.016). Furthermore, constituent 1 (p=.001) and constituent 2 (p=.026) were significantly faster primes than the unrelated prime. According to the results of planned comparisons, a significant difference was found between constituent 1 and the unrelated prime only in transparent compound words (p=.011). However, no priming effect was found in partially-opaque compound words. This means that neither of the constituents serves as a prime in accessing the target compound if it is not fully-transparent, providing evidence for the effect of semantic transparency in processing compound words.

To sum up, the results revealed that the English monolinguals processed the compounds by employing decomposition. The semantic transparency affected the monolingual group since they could not activate constituent 1 in partially-opaque compounds. The Turkish-English advanced level bilinguals were also affected by the semantic transparency of the compound words since they employed decomposition for transparent compounds but reduced decomposition for partially-opaque compounds. This reported evidence for dual-route model in accessing compounds. In contrast, the Turkish-English intermediate level bilinguals yielded no priming effect for both compound types and were not affected by the semantic transparency of the compound, refuting our initial prediction that even lower proficiency L2 groups would reveal qualitatively similar processing.

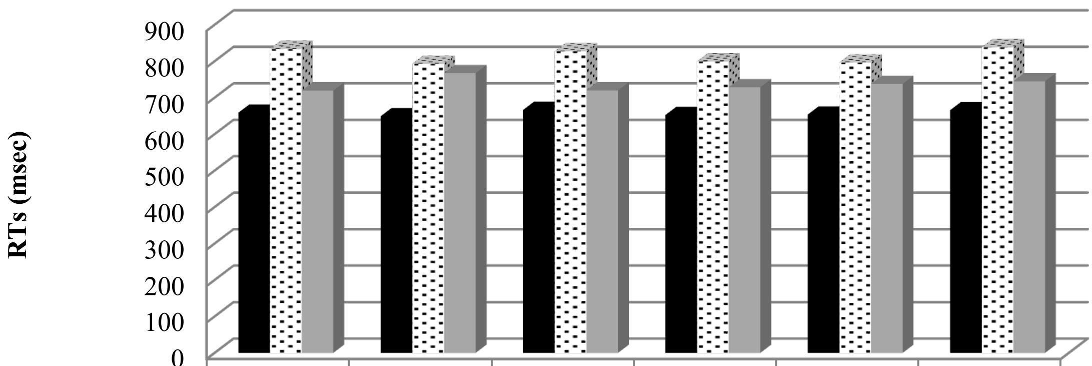
The final analysis focuses on the processing of pseudocompounds and monomorphemic items. In order to assess the lexical status of the constituents, the RTs of pseudocompounds were compared with monomorphemic words. A 2 (word types) x 3 (prime types) x 3 (groups) mixed-model ANOVA was conducted and the results revealed a significant difference only among groups (F=16.968; p=.000).

As presented in Figure 3, for pseudocompound items, the Turkish-English intermediate level bilinguals were significantly slower than the monolingual English (p=.000) and Turkish-English advanced level bilingual groups (p=.018); and the Turkish-English advanced level bilingual group was significantly slower than the monolingual English group (p=.022). In monomorphemic items, the Turkish-English intermediate level bilinguals were significantly slower than the monolingual English (p=.000) and Turkish-English advanced level bilingual groups (p=.032); and the Turkish-English advanced level bilingual group was significantly slower than the monolingual English group (p=.012).

Within-group analysis for all groups did not find any significant differences for word types and prime types, implying that both pseudocompound and monomorphemic words were processed via full-listing both by monolingual and bilingual participants.

Figure 3.

Mean RTs in three prime conditions for pseudocompound and monomorphemic words



	PSC-C1	PSC-C2	PSC-UR	MONO-C1	MONO-C2	MONO-UR
■ L1 ENG	658,728	649,071	666,251	652,38	653,636	665,643
L2 ENG INT	833,743	792,883	826,95	799,187	796,334	838,324
■ L2 ENG ADV	719,042	767,056	719,755	728,461	737,437	744,876

PSC-C1: Pseudocompound Constituent 1; PSC-C2: Pseudocompound Constituent 2; PSC-UR: Pseudocompound Unrelated; MONO-C1: Monomorphemic Constituent 1; MONO-C2: Monomorphemic Constituent 2; MONO-UR: Monomorphemic Unrelated

To reiterate the results of English compounds, all groups processed compound words significantly faster than noncompound words. The English monolingual group employed decomposition when accessing compound words in general. However, it was observed that semantic transparency influenced the processing route because in transparent compounds both constituents were activated whereas only constituent 2 was accessed in partially-opaque compounds. The Turkish-English advanced level bilinguals displayed priming effects in processing compounds in general and the processing route was affected by the semantic transparency of the compound word. They activated only constituent 1 (not constituent 2) in transparent compounds, but no priming effect was observed for partially-opaque compounds, supporting dual-route. In contrast, the Turkish-English intermediate bilingual group accessed compound words via full-listing since no priming effect was obtained and semantic transparency did not play a significant role in their compound processing. In addition, both monolingual and bilingual groups accessed noncompound words, namely pseudocompounds and monomorphemic items via full-listing since no priming effect was observed.

7. 2. The Turkish Study

7. 2. 1. Turkish Proficiency Test

As displayed in Table 11, the independent sample t-test revealed a significant difference between the Turkish proficiency test scores ($t(69)=21.447$, $p=.000$). The English- Turkish advanced level bilinguals received significantly higher scores than the intermediate group.

Table 11.

Turkish proficiency test scores

Groups	Scores (out of 100)	Range	Standard Deviation
English-Turkish Intermediate Level Bilinguals (N=36)	43.50	33-54	6.98
English-Turkish Advanced Level Bilinguals (N=35)	75.88	67.5-87	5.61

7. 2. 2. Masked Priming Test

All incorrect responses and outliers were excluded from the analysis. A “no” response to a real word and a “yes” response to a nonword were labeled as an incorrect response. In addition, RTs exceeding three standard deviations above and below a participant’s mean RT per word type were deemed outliers. Due to the low frequency of the tested items, the participants with an error rate exceeding 33.3% were excluded from the study. Six English-

Turkish intermediate level bilingual participants were excluded from the analysis because of their high error rates.

Table 12 presents the error rates across word categories. The highest error rates were found in monomorphemic words in all groups. A one-way ANOVA comparing the total error rates showed a significant difference among the groups (F=48.510; p=.000). According to the post-hoc test, the English-Turkish intermediate bilingual group had a significantly higher error rate than the other two groups (p=.000) and the English-Turkish advanced bilingual group made significantly more errors than the monolingual Turkish group (p=.001).

Table 12.

Error rates (in percentages)

Groups	PO	TT	PSC	MONO	TOTAL
Monolingual Turkish (N=73)	3.15	1.91	2.60	4.06	3.56
English-Turkish Intermediate Level Bilinguals (N=30)	15.33	14.33	8.00	18.56	16.56
English-Turkish Advanced Level Bilinguals (N=35)	8.29	6.29	3.71	9.05	8.06

PO: Partially-Opaque items; TT: Transparent-Transparent items; PSC: Pseudocompound items; MONO: Monomorphemic items

Table 13 demonstrates the outlier rates across word categories. The highest outlier rates were found in monomorphemic words in all groups. A one-way ANOVA comparing the total outlier rates exhibited a significant difference among the groups (F=3.123; p=.047). According to the post-hoc test, the English-Turkish advanced bilingual group had a significantly higher outlier rate than the Turkish monolingual group (p=.046).

Table 13.

Outlier rates (in percentages)

Groups	PO	TT	PSC	MONO	TOTAL
Monolingual Turkish (N=73)	0.00	0.00	0.00	1.68	1.12
English-Turkish Intermediate Level Bilinguals (N=30)	0.00	0.00	0.00	2.00	1.33
English-Turkish Advanced Level Bilinguals (N=35)	0.00	0.00	0.00	2.29	1.52

PO: Partially-Opaque items; TT: Transparent-Transparent items; PSC: Pseudocompound items; MONO: Monomorphemic items

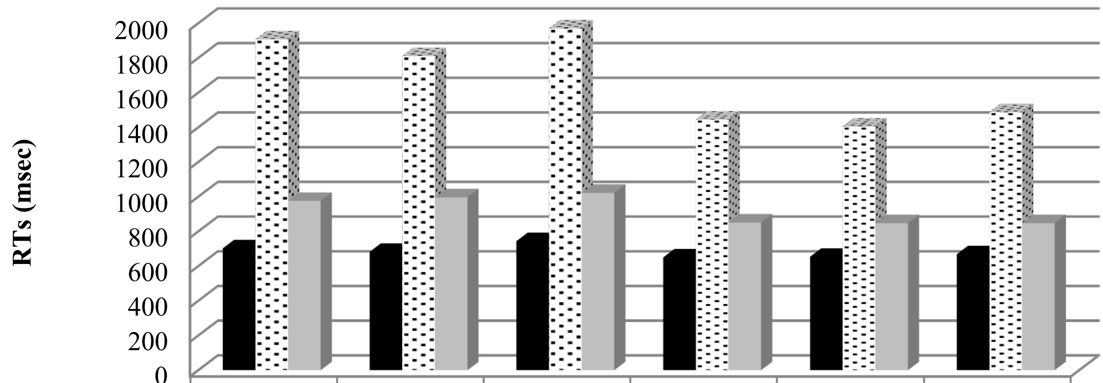
The accuracy rates were 95.32%, 82.11% and 90.41% for the monolingual Turkish, English-Turkish intermediate bilingual and English-Turkish advanced bilingual groups, respectively. A one-way ANOVA comparing the accuracy rates found a significant difference among the groups (F=52.360; p=.000). According to the post-hoc test, the monolingual Turkish group had a significantly higher accuracy rate than the other two groups (p=.000) and the English-Turkish advanced bilingual group had significantly more correct responses than the English-Turkish intermediate bilingual group (p=.000).

In the first analysis, the mean RTs to the two sets of compound words (transparent and partially-opaque items) were compared with the mean RTs to the noncompound words (pseudocompound and monomorphemic items) to investigate whether compound words were processed differently from noncompound words. A 2 (word types) x 3 (prime types) x 3 (groups) mixed-model ANOVA was conducted and the results indicated significant differences of word types (F=198.143; p=.000), prime types (F=5.276; p=.006), groups (F=184.691; p=.000) and the interaction between word types and groups (F=59.675; p=.000).

As can be seen in Figure 4, for compound and noncompound words, the Turkish monolingual group was significantly faster than both L2 groups (*p*=.000) and the English-Turkish advanced level bilinguals were significantly faster than the intermediate level bilinguals (*p*=.000). In addition, compound words were processed significantly slower than noncompound words (*p*=.000). Also, significant differences were found between constituent 2 and unrelated primes (*p*=.003) implying headedness-based decomposition.

Figure 4.

Mean RTs in three prime conditions for compounds and noncompounds



	C-C1	C-C2	C-UR	NC-C1	NC-C2	NC-UR
L1 TR	702,168	681,809	743,583	649,949	653,435	668,305
L2 TR INT	1906,85	1809,492	1969,394	1444,117	1403,338	1487,015
L2 TR ADV	975,921	996,106	1021,567	850,611	847,198	847,494

C-C1: Compound Constituent 1; C-C2: Compound Constituent 2; C-UR: Compound Unrelated; NC-C1: Noncompound Constituent 1; NC-C2: Noncompound Constituent 2; NC-UR: Noncompound Unrelated

Within-group analysis for the Turkish monolingual group illustrated a significant effect of word types (*F*=33.556; *p*=.000) and prime types (*F*=6.645; *p*=.002). Compound words were processed significantly more slowly than noncompound words (*p*=.000) and both constituent 1 (*p*=.009) and constituent 2 (*p*=.004) were significantly faster primes when compared to unrelated prime. Planned comparisons confirmed a significant difference between constituent 2 and unrelated prime (*p*=.002) and a suggestive trend towards significance between constituent

1 and unrelated prime (*p*=.066) only in compound words. The difference between both constituents in compounds was not significant. No priming effect was observed for noncompound words. These results indicate that native speakers tend to decompose compound words but not noncompound words in Turkish. These results also imply that native Turkish speakers' decomposition pattern is more prevalent when the head of the compound serves as a prime.

The results of the English-Turkish intermediate level bilinguals displayed a significant difference only between word types (*F*=61.601; *p*=.000) indicating that compound words were processed significantly more slowly than noncompound words. Unlike the Turkish monolingual group, no significant differences were found among the prime types, implying full-listing for both compound and noncompound words.

Similarly, the results of the English-Turkish advanced level bilinguals reflected a significant difference only between word types (*F*=49.156; *p*=.000). Compound words were processed significantly more slowly than noncompound words. Nevertheless, no significant differences were observed among the prime types, implying full-listing for both compound and noncompound words.

In sum, the results revealed that all groups processed Turkish compound words significantly slower than noncompound words. The bilingual groups yielded no priming effects for either compounds or noncompounds. Nevertheless, the Turkish monolinguals employed decomposition in accessing compound words and the head constituent plays a significant role.

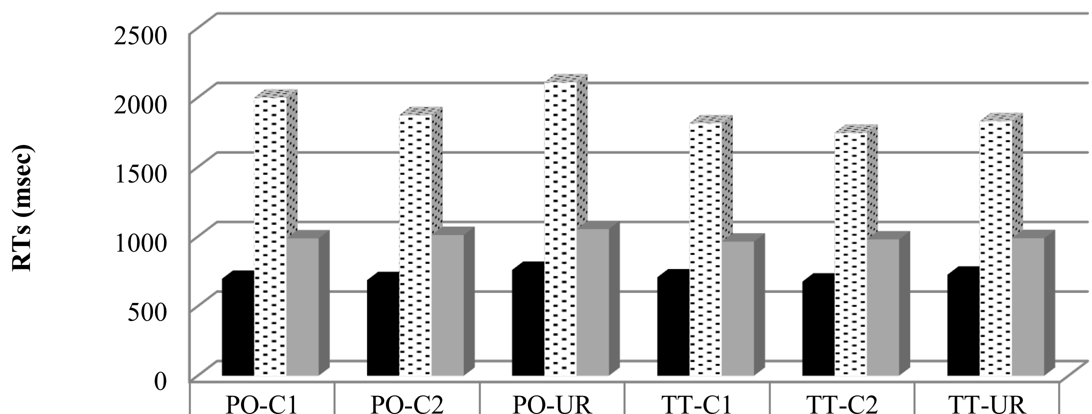
In the second analysis, the RTs of transparent compounds were compared with partially-opaque compounds to explore the effect of semantic transparency in compound processing. A 2 (word types) x 3 (prime types) x 3 (groups) mixed-model ANOVA was conducted and the results revealed significant differences of word types (*F*=10.545; *p*=.001), prime types (*F*=4.707; *p*=.01), groups (*F*=165.394; *p*=.000) and the interaction between word types and groups (*F*=4.844; *p*=.009).

As Figure 5 demonstrates, in partially-opaque compounds, the Turkish monolinguals were significantly faster than the intermediate level group (*p*=.000) and the advanced level bilinguals (*p*=.001). Furthermore, the English-Turkish advanced level bilinguals were significantly faster than the intermediate level bilinguals (*p*=.000). In transparent-transparent compounds, the Turkish monolingual group was significantly faster than both L2 groups (*p*=.000); and the English-Turkish advanced level bilinguals were significantly faster than the intermediate level bilinguals (*p*=.000). In addition, transparent compounds were processed significantly faster than partially-opaque compound words (*p*=.001). Also, significant differences were found between constituent 2 and unrelated primes (*p*=.006), implying an overall headedness-based decomposition.

Within group analysis for the Turkish monolingual group showed a significant effect of only prime types (*F*=5.476; *p*=.007). Constituent 2 was a significantly faster prime when compared to unrelated prime (*p*=.002) and a suggestive trend towards significance was retrieved between constituent 1 and unrelated prime (*p*=.066). Planned comparisons exhibited a significant difference between constituent 2 and unrelated prime (*p*=.023) in transparent compounds indicating headedness-based decomposition. Furthermore, significant differences between constituent 1 and unrelated prime (*p*=.011) and constituent 2 and unrelated prime (*p*=.006) were obtained for partially-opaque compounds. The size of priming effects in terms of Cohen's *d* was parallel for both constituent primes in partially-opaque compounds (constituent 1: *d*=2.503; constituent 2: *d*=2.766). Both primes showed a large effect size. These results suggest that overall the Turkish monolingual group employs decomposition for both types of compounds but cannot access constituent 1 (but only constituent 2) even in transparent-transparent compounds. In other words, for Turkish native speakers, constituent 2 (the head of the compound) is more readily accessed in processing fully-transparent compounds but in partially-opaque compounds, both constituent 1 and 2 are accessed. This suggests a more salient tendency for decomposition in partially-opaque compounds.

Figure 5.

Mean RTs in three prime conditions for partially-opaque and transparent compound words



	PO-C1	PO-C2	PO-UR	TT-C1	TT-C2	TT-UR
■ L1 TR	696,794	687,096	760,892	707,54	676,523	726,275
∵ L2 TR INT	1998,981	1872,8	2109,311	1814,719	1746,184	1829,478
■ L2 TR ADV	987,34	1011,576	1054,321	964,502	980,635	988,812

PO-C1: Partially-Opaque Constituent 1; PO-C2: Partially-Opaque Constituent 2; PO-UR: Partially-Opaque Unrelated; TT-C1: Transparent-Transparent Constituent 1; TT-C2: Transparent-Transparent Constituent 2; TT-UR: Transparent-Transparent Unrelated

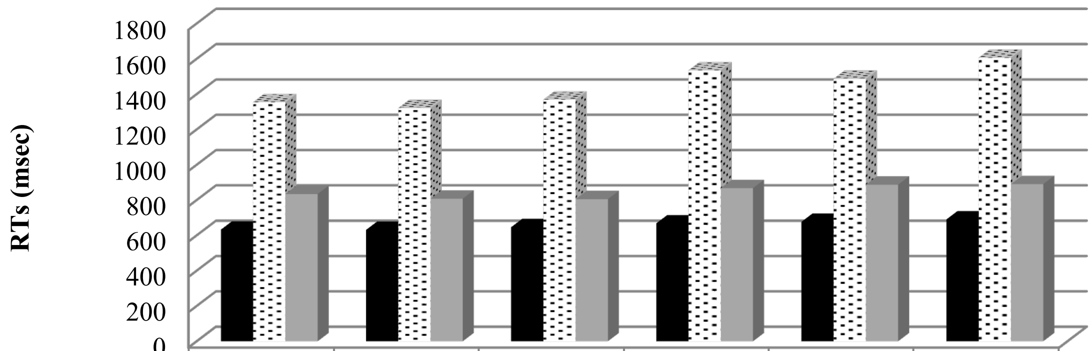
However, the results of both bilingual groups demonstrated no significant differences neither between word types nor among prime types, indicating full-listing for both compound types regardless of their semantic transparency.

To sum up, the results revealed that the Turkish monolinguals processed the compound words via decomposition and they were affected by the semantic transparency of the compound words. While only constituent 2 served as a significant prime for transparent compounds, both constituents were significantly faster primes than the unrelated prime in partially-opaque compounds. In contrast, the bilingual groups yielded no priming effects for either compound types and they were not affected by the semantic transparency of the compound.

The final analysis focuses on the processing of pseudocompounds and monomorphemic items. The RTs of pseudocompounds were compared with monomorphemic words to assess the lexical status of the constituents. A 2 (word types) x 3 (prime types) x 3 (groups) mixed-model ANOVA was conducted and the results indicated significant differences of word types (F=69.975; p=.000), groups (F=184.050; p=.000) and the interaction between word types and groups (F=14.684; p=.000).

Figure 6.

Mean RTs in three prime conditions for pseudocompound and monomorphemic words



	PSC-C1	PSC-C2	PSC-UR	MONO-C1	MONO-C2	MONO-UR
■ L1 TR	632,153	630,638	646,118	667,745	676,232	690,492
∵ L2 TR INT	1354,103	1320,414	1368,386	1534,131	1486,262	1605,643
■ L2 TR ADV	834,126	807,659	805,09	867,0964	886,738	889,899

PSC-C1: Pseudocompound Constituent 1; PSC-C2: Pseudocompound Constituent 2; PSC-UR: Pseudocompound Unrelated; MONO-C1: Monomorphemic Constituent 1; MONO-C2: Monomorphemic Constituent 2; MONO-UR: Monomorphemic Unrelated

As presented in Figure 6, not only for pseudocompounds but also for monomorphemic items, the Turkish monolingual group was significantly faster than both L2 groups (p=.000). Furthermore, the English-Turkish advanced level bilinguals were significantly faster than the intermediate level bilinguals (p=.000). In addition, pseudocompound words were processed significantly faster than monomorphemic words (p=.000).

Within-group analysis for all groups found a significant difference between word types. All groups processed pseudocompound words significantly faster than monomorphemic items (p=.000). However, no significant difference among the prime types was obtained proposing that both pseudocompound and monomorphemic words were processed via full-listing both by monolingual and bilingual groups.

To reiterate the results, all groups processed Turkish compound words significantly more slowly than noncompounds. The Turkish monolingual group employed decomposition when accessing compound words in general and the head constituent served as a significant prime. Semantic transparency was observed to influence the processing in the monolingual group because while only constituent 2 was activated in transparent compounds, both constituents were accessed in partially-opaque compounds. In contrast, both bilingual groups processed compounds via full-listing as no priming effects were obtained and the semantic transparency did not influence the parsing route of the bilinguals. In addition, both monolingual and bilingual groups accessed noncompound words, namely pseudocompounds and monomorphemic items via full-listing and they processed pseudocompounds significantly faster than monomorphemic items.

CHAPTER 8

DISCUSSION

The present study investigated the processing of compounds in English and Turkish with monolingual and sequential bilingual adults with intermediate and advanced level L2 proficiency. The main aim was to examine potential native-nonnative processing differences in the context of compounds.

The results of the English study showed that monolingual English speakers recognized compound words significantly faster than noncompound words. In other words, it took them less time to access compound words than noncompound words (i.e. monomorphemic items and pseudocompounds). Furthermore, they accessed compounds through constituent morpheme activation as evidenced by the fact that both roots of a compound word were activated in lexical access. As for the influence of semantic transparency of the compounds, English monolinguals demonstrated different lexical access patterns in two types of compounds; partially-opaque compounds were processed significantly faster than fully-transparent compounds. While both constituents (i.e. both roots) served as primes in transparent compounds, only the second constituents (i.e. head) served as a prime for the access of the whole word in partially-opaque compounds. This processing pattern can be explained by the Automatic Progressive Parsing and Lexical Excitation (APPLE) model of Libben (1994; 1998) which aims to describe how multimorphemic words, namely compounds can be decomposed. When English monolinguals encounter a fully-transparent (e.g., *headache*) and a partially-opaque (e.g., *grapefruit*) compound, they decompose both types of compounds into their constituent morphemes. This means that both types of compounds have similar representations at the lexical level; however, the notion of semantic transparency of compounds is represented at the next level which is the conceptual level. This level deals with the semantic relationship between the meaning of the constituent in the compound and the independent meaning of the same constituent. This means that both constituents of a fully-transparent compound (e.g., *head* and *ache*) are linked to its conceptual representation while in partially-opaque compounds only the transparent constituent (e.g., *fruit*) has the link to the conceptual representation. At this level, only the meanings of the whole word and transparent constituents are activated. This representational difference at the conceptual level results in slower RTs for fully-transparent compounds. In line with the assumption of the Apple model, English monolingual speakers activated both constituents (i.e. both roots) in transparent compounds whereas only the second constituents (i.e. head) was recognized for the access of partially-opaque compounds. That is, a headedness-based decompositional pattern was observed in partially-opaque items. This indicates a crucial role of semantic transparency in retrieving English compounds. As for the L2 learners of English, the Turkish-English intermediate-level sequential bilinguals processed compounds significantly faster than noncompounds; however, neither the activation of the constituents nor the effect of semantic transparency was detected in their data, suggesting no morphological parsing for English compound words. On the other hand, the advanced L2 group displayed a more native-like processing pattern; compounds were processed significantly faster than noncompound words; furthermore, compounds were parsed into their constituent morphemes as implied by the finding that both constituents of a compound were recognized during lexical access. Similar to English monolinguals, the advanced L2 group processed partially-opaque compounds significantly faster than transparent compounds and they were also affected by the semantic transparency of the compound. This suggests the presence of dual-routes in compound recognition, replicating the results of Mayila (2010). In contrast to English monolinguals, only constituent 1 yielded strong priming effects in transparent compounds while the head constituent did not. Also, no priming effects were obtained in the processing of partially-opaque compounds. In other words, L2 learners with advanced L2 proficiency did not seem to activate either of the constituent morphemes in partially-opaque compounds. As for pseudocompounds and monomorphemic items, all participating groups in the English study exhibited similar visual recognition pattern for these types of words, suggesting that they access these words as unanalyzed whole units.

In the Turkish study, the results revealed that unlike in the English study, overall, it took longer for the Turkish monolingual speakers to recognize compound words compared to noncompound items (i.e. pseudocompounds and monomorphemic items). Although transparent compounds were computed faster than partially-opaque compounds, the difference was not significant. In fully-transparent compounds, while the activation of constituent 1 did not reach the significance level (p=.066), constituent 2 served as an efficient prime. This suggests that transparent compounds were processed through headedness-based decomposition whereas both constituents were activated for partially-opaque compounds, implying the influence of semantic transparency in accessing the head in a decompositional computation. Thus, unlike native English speakers, native Turkish speakers only use constituent 2 (i.e. the head) in accessing fully-transparent compounds. When a compound is partially-transparent, native Turkish speakers attempt to access both constituent 1 and 2. With respect to the L2 learners of Turkish, both L2 Turkish groups performed significantly faster in accessing noncompound words compared to compounds; however, no priming effects were observed in compound recognition in line with the previous findings of Ko (2011) and Goral, Libben, Obler, Jarema and Ohayon (2008), suggesting that there is full-form representation for Turkish compounds in L2 learners. In addition, both groups processed transparent compounds faster than partially-opaque compounds yet the difference was not significant. Pseudocompound and monomorphemic items displayed a similar word recognition pattern in all participants; that is, pseudocompounds were accessed significantly faster than monomorphemic items; however, no priming effect were obtained in either types of words, suggesting direct access route.

These findings lead to the following questions in the context of the current investigation involving two studies: 1) Why are compounds processed faster than noncompounds in English but slower in Turkish?; 2) Why do English and Turkish monolinguals exhibit different processing patterns in compounds?; 3) Why do advanced L2 learners in both studies display dissimilar word recognition patterns? In other words, why is there a difference between the two studies in terms of the extent of native-like processing achieved by high-proficiency L2 learners of English and of Turkish; 4) Why do monolinguals and highly proficient L2 learners employ different mechanism in the Turkish study but not in the English study?; 5) What do the results of noncompound items imply as compared to compounds?; 6) What is the impact of L2 proficiency on the processing of compounds?; 7) What are the potential pedagogical implications of these results for L2 vocabulary in general and teaching compounds in particular?

The finding that compounds were processed significantly faster than noncompounds (i.e. pseudocompound and monomorphemic items) were also reported in many studies with native English speakers (e.g., Fiorentino and Poeppel, 2007; Ji, Gagné and Spalding, 2011; Fiorentino, Naito-Billen, Bost and Fund-Reznicek, 2014). This result suggests that English monolingual speakers decompose compound words by employing the APPLE model (Libben, 1994, 1998). Recall that this model aims to describe how multimorphemic words, namely compounds can be decomposed and assumes that there are facilitative links between a compound word and its constituents (its roots), which makes its recognition faster. For example, when testing the processing of a compound word (e.g., *headache*), the constituents (e.g., *head* and *ache*) were used as primes. As these primes were meaningful units of the whole-word and the constituents of the compound, they created facilitative links to recognize the compound word which served as the target. Nevertheless, these links do not exist in monomorphemic words hence the difference between the speed of processing of a compound and noncompound words. Although decomposition is expected to be costly, these facilitative links between the whole compound and its roots assist the word recognition process leading to shorter RTs for compounds than noncompounds, which do not have constituents to activate. This prediction was confirmed in the current study because facilitative links enabled the constituents of the compounds to serve as primes (e.g., *head-HEADACHE* and *ache-HEADACHE*) in fully-transparent and (e.g., *straw-STRAWBERRY* and *berry-STRAWBERRY*) partially-opaque compounds. The primes for monomorphemic items, however, (e.g., *croco-CROCODILE* and *dile-CROCODILE*) could not establish these facilitative links, leading to slower RTs for noncompound items.

In contrast, as the results of the Turkish study revealed, Turkish native speakers accessed Turkish compounds significantly more slowly than noncompound items. This finding is predicted within the decompositional model. In other words, the fact that compound words are processed more slowly than monomorphemic words implies the presence of morphological parsing occurring prior to direct retrieval, which is the searching and verification stage in compound word processing. Thus within this model, the processing of compound words is expected to be slower than the processing of monomorphemic words, which do not have any constituent morphemes. For instance, when processing a monomorphemic Turkish word, *kaplumbağa* 'turtle', Turkish monolingual speakers recognize it as a single unit, but when they encounter a compound word, they detect two root forms of the word, which can be decomposed. This process requires the involvement of cognitive resources in order to access both the constituents and the whole word leading to longer RTs in processing compounds.

What is also crucial is that, the priming paradigm is not so much interested in the comparisons between the overall RTs to compounds and noncompounds. What is revealing is the comparison among the three types of primes and potential differences among them in terms of the extent of their facilitation in accessing target words. It is important to note that in both the English and the Turkish studies, native speakers (and in the English study, the advanced group) processed the compound words faster when they were primed by either constituent 1 or 2 but not when they were presented with an unrelated prime. These suggest the presence of decomposition in both studies. The difference between the English and the Turkish studies is the differential role of transparency interacting with the headedness of the compound. This resulted in different patterns in two studies particularly for the native speaker groups: In the English study, native speakers accessed both constituent 1 and 2 but the advanced group accessed only the constituent 1 in processing transparent compounds. Neither of these priming effects was found in the intermediate group. As for the partially-opaque compounds in English, this type of compounds triggered the activation of the head (the constituent 2) in the native group only. Conversely, in the Turkish study, in processing transparent compounds, only the head (the constituent 2) was activated. However, in partially-opaque compounds, both constituents served as primes. Interestingly, this result was only observed in native speakers but not in L2 learners of Turkish. Learners of L2 Turkish did not seem to access the whole compound on the basis of its constituents either in the fully- or partially-transparent conditions. This particular finding suggests that unlike English native speakers, for Turkish native speakers, when a compound is not fully-transparent, there is more tendency to access the two roots, hence more salient decompositional pattern. For English native speakers, however, when a compound is not fully-transparent, there is more tendency to access the head of the compound only. These findings imply that semantic transparency of the compound affects the extent of decomposition differentially in English and in Turkish monolinguals. While two-root-based access to the compound is more prevalent in fully-transparent compounds in English; it is more clearly seen in partially-transparent compounds in Turkish. This also suggests that unlike native English speakers, Turkish native speakers resort to the activation of two roots when the compound is not fully-transparent.

With respect to L2 learners' data, both studies showed slower RTs in the L2 groups, particularly in the intermediate groups. In terms of the pattern of processing, we found similarities between the advanced L2 groups and native speakers in the L2 English study. In the Turkish study, however, even the advanced group failed to show native-like patterns in processing compound words. Nonnative processing patterns were more salient in compound processing than the noncompound (i.e., monomorphemic and pseudocompound items) processing. This compound versus noncompound processing difference may not be due to the frequency and length of the whole word and constituents because these characteristics were matched in both types of words in each language. Therefore, the reason that leads to different word recognition patterns in compounds and noncompounds may be the participants' familiarity with the constituents and the compound word. For example, *strawberry* and *büyükelçi* ('ambassador', *büyük* 'big', *elçi* 'delegate') were two partially-opaque compounds used in the stimuli and the head constituents are *berry* and *elçi,* both of which have very low frequency count. However, when an L2 English learner sees the item *strawberry*, s/he may respond to this item faster than a frequency-matched monomorphemic word such as *pneumonia* since the constituent *berry* is a very frequent form existing in more than twenty compound words in English (e.g., *blackberry, blueberry, cranberry, elderberry, mulberry, raspberry* and *winterberry*). In addition, the familiarity of the compound word *strawberry* is also high for L2 learners of English because this word is included in the beginner/elementary level books.

When it comes to Turkish, L2 learners of Turkish might, overall, have less exposure and familiarity with these compound words in Turkish (despite their advanced proficiency) compared to L2 learners of English. Thus, for example, when an L2 learner of Turkish sees the compound *büyükelçi*, the RTs may be longer compared to the RTs to a monomorphemic item such as *imparator* 'emperor' since the constituent *elçi* exists only in one compound word in Turkish, which decreases the rate of familiarity of the constituent.

A variable that may have played an important role in the context of nonnative processing patterns in L2 learners is the mean age of L2 exposure. To examine potential effects of this variable, the mean age of first L2 exposure was compared in the two L2 groups. The results showed a significant difference between the groups (p=.000). While L1-Turkish-L2 English bilinguals were exposed to English at the mean age of 8.88, L1-English-L2 Turkish bilinguals' first exposure to Turkish has begun at the mean age of 25.14. As for the length of L2 exposure, in the current data, the mean length of exposure to L2 English was 12.19 years, while the mean length of exposure to L2 Turkish was 17.42 years. Thus, the L2 Turkish group had relatively longer length of exposure to Turkish even if their age of L2 onset was significantly higher than those of L2 English learners. Nevertheless, what is at stake here is not only the overall length of exposure to a particular L2 but also the exposure to and familiarity with a particular L2 word (a compound and its constituents). Although an L2 speaker may be exposed to a particular L2 for a fairly long period of time (as in the case of L2 Turkish learners), this may not guarantee that they would have been frequently exposed and become familiar with certain compounds in the L2. Thus, L2 learners of Turkish may know the meaning of the whole compound and the meaning of its constituents but they may still be showing a familiarity-based differential access rate/pattern compared to the learners of L2 English. It is important also to note that overall frequency of a particular compound and its constituents may not always guarantee that these forms are readily available to L2 learners of that language. The subjective frequencies may be low and this might influence the extent of root-based activation in compound processing in L2 learners (see also Gor, 2010 for similar arguments). Furthermore, unlike L2 English learners, who were all formal classroom learners, most L2 Turkish learners, were exposed only to naturalistic Turkish input as only six participants received formal education in Turkish for more than one year. Thus compared to L2 English learners, L2 Turkish learners might have obtained fewer opportunities to encounter and use the target compounds and individual constituents that they consist of.

In addition, the proficiency scores of the L2 English and L2 Turkish groups may not be directly comparable. These factors might have led to differential speed/pattern in L2 learners in the English and in the Turkish study. All of these variables may account for the processing differences between the intermediate and advanced L2 groups in the English and Turkish study. Naturally, relatively higher similarity between the L2 English learners (particularly the advanced group) and English native speakers compared to the similarity between the L2 Turkish learners (particularly the advanced group) and Turkish native speakers might stem from these learner variables (see Uygun & Gürel, 2016 for a similar discussion).

Given the above-mentioned differences between the L2 English and L2 Turkish learners, the findings obtained from the comparisons between the intermediate and the advanced groups in each study are not surprising. Unlike the English study, the Turkish study did not reveal any impacts of L2 proficiency in processing the tested items. The only significant difference between the intermediate and the advanced groups in the L2 Turkish study was the overall speed of accessing compounds; the advanced group was faster than the intermediate group but the pattern of word recognition was the same in the two groups. In contrast, in the English study, the influence was not only observed in RTs but also in the word recognition pattern. While Turkish-English intermediate-level bilinguals represented compounds through direct access route, the advanced-level bilinguals, like native English speakers, were able to decompose compounds in general although the priming effects were apparent only in transparent compounds. These suggest that L2 Turkish learners were less native like compared to L2 English learners in compound processing.

Another set of findings that is worth considering pertains to the RTs obtained from noncompound items (i.e., pseudocompound and monomorphemic words.). These items were included in the test to identify whether processing was influenced by orthographical properties. Li, Jiang and Gor (2015) found that L2 learners decompose English compounds but this process was not solely morphological because they obtained orthographic priming effects for control items in the word initial overlap position (e.g., *restaurant-REST*) but not in word final position (e.g., *tomorrow-ROW*). However, the present investigation indicated no orthographic priming effect for bilingual groups. In line with the monolingual groups, both sequential bilingual participants with intermediate and advanced level proficiency revealed no priming effect for the control items, indicating that these words were stored as unanalyzed wholes. Therefore, the decomposition process observed in monolinguals in both studies and the advanced group in the L2 English study is purely morphological and there is no effect of orthography either in native groups or in the L2 participants.

The final issue pertains to potential pedagogical implications in teaching compounds. It is known that vocabulary plays a significant role for L2 learners and they must learn a large number of words to become proficient. Harmer (1991, p. 153) states that if grammatical structures make up the skeleton of language, vocabulary provides the vital organs and the flesh. In addition, no matter how well L2 learners have learned the grammatical structures, in the absence of vocabulary competence, meaningful communication in the L2 cannot be achieved. Possibly because of their low whole-word frequency, compounds are usually neglected in L2 teaching curricula but certain types of compounds are very productive in certain languages, hence constitute a crucial part of the L2 lexicon. Therefore, compounds are an integral part of L2 vocabulary teaching. There are several reasons why compounds may require particular attention. First of all, compounding is a universal word formation process to create new words with new meanings. Secondly, they are multimorphemic forms consisting of two roots. Thirdly, compounds generally have a low whole-word frequency. Finally, the meaning of the compound word is not always the sum of the meanings of its constituents. All of these reasons can lead to possible processing problems for L2 learners. Indeed, the results of the current investigation provide evidence for such processing problems in L2 learners because only high-proficiency L2 English learners were able to demonstrate some effects of decomposition in compound processing. Crucially, this effect was observed in transparent compounds only. This suggests that only fully-transparent compounds are perceived easily. Partially-transparent ones need to be practiced more since the meaning of the constituents does not make up the meaning of the compound word. In other words, as opacity increases in compounds, it becomes more difficult for the students to identify and access the constituents. These findings clearly indicate that compound words should be taken into account when teaching an L2 (either English or Turkish).

One pedagogical suggestion to overcome processing problems is explicit teaching of compound words by drawing students' attention to its constituents. Schmitt (2008) suggests that rather than teaching a word individually, it is important to introduce the word families in order to maximize vocabulary learning. In other words, when introducing a new word, other members of its word family should also be mentioned. Thus in teaching compounds, not only the whole word but also its constituents and other semantically-linked words should be introduced because the meanings of words are learned explicitly which requires conscious processing at semantic and conceptual levels and attention to form-meaning connections (Ellis, 1994). For example, when L2 learners see partially-opaque compounds like *butterfly* and *buttercup*, they may have problems in understanding the meaning of the whole word because they will think of the original meaning of the constituent *butter* but cannot make the necessary connections to deduce the meaning of the compound. Therefore, it is important to enable L2 learners to perceive how and to what extent the constituent forms contribute to the meaning of the whole compound. Teaching compound words explicitly will ensure a systematic lexical development in the target language and it enables L2 learners to access the meanings of compounds effortlessly and immediately without having to devote too much time and effort to guess the meaning.

In addition, repeated exposure to and the use of a compound and its constituent forms are central to master compound words. Repeated exposure is very useful especially for compounds in which either one or both constituents are semantically opaque. This will make it easier for learners to process the individual roots of a compound. Fully-transparent compounds may be easier to learn because both constituents are semantically transparent and as long as the L2 learners know the meanings of the constituents, they can easily access the meaning of the compound. When opacity increases, it may be more difficult to infer the meaning because one or both constituents have lost their original meanings and L2 learners will struggle to access the whole-word meaning. Nevertheless, in both types of compounds, activities that would facilitate compound processing will be beneficial. Abundant visual and auditory input (texts for reading and listening) involving compounds are crucial in teaching compounds. Especially reading can be assumed as an ideal source for learning compound words because low frequency lexical items occur more frequently in written texts. Working on a written text not only provides multiple encounters with the compound but also the opportunity to make context-based inferencing which contributes to the knowledge of morphological rules and additional meanings (Pavičić Takač, 2008). Being exposed to compound words in written texts will enable L2 learners to identify the constituents in order to infer their meanings. If one or both constituents of the compound are opaque, L2 learners will be able to guess the meaning with the help of contextual clues. In addition, multiple encounters with the compound word will ensure and facilitate the learning of these low-frequency multimorphemic items.

Another pedagogical implication is teaching word formation processes in the L2, which will classify vocabulary both for teaching and learning (Tahaineh, 2012). Word formation is a universal feature of languages to create new words. When L2 learners know how words are formed, they will be more likely to attach meanings to words they have never encountered before as long as they can recognize the presence of familiar morphemes in the newly encountered word (McCarthy, 1990). In other words, learning the word formation rules in the L2 will enable L2 learners to decode and encode compound words. As long as L2 learners know the word formation rules and mechanisms in an L2, they will become autonomous and independent learners concerning vocabulary production, creativity and understanding. This will help L2 learners become not only independent and autonomous in their production but also more accurate and proficient in their realization and processing of compound words.

Explicit teaching/instruction that facilitates parsing of a compound and extensive exposure as well as production opportunities will affect the way the compounds are represented in the mental lexicon of L2 learners. Therefore, it is important to include compound words in the curriculum of the L2 as early as possible. This would give L2 learners more awareness of the constituents of a compound and consequently facilitate its processing both in language comprehension and production. In other words, the more and earlier L2 learners are exposed to compounds, the more automatized they may become in accessing them, which will, in return, result in more nativelike processing of compounds with increasing proficiency.

CHAPTER 9

CONCLUSION

This study reports the results of two studies investigating how compound words in English and Turkish are processed both by monolingual and bilingual speakers with intermediate and advanced proficiency levels and identify the potential differences between monolingual and bilingual speakers in recognizing compound words.

The results of the English study demonstrated that English monolinguals decomposed compound words. When semantic transparency of the compound was examined, the findings suggest that both constituents were activated in transparent compounds whereas only the second constituent was accessed in partially-opaque compounds, indicating the influence of semantic transparency on compound processing. No priming was observed for intermediate level sequential bilinguals, suggesting that they do not employ decomposition. Advanced level sequential bilinguals also employed decomposition for compounds, but semantic transparency played a crucial role because constituent 1 was accessed in transparent compounds, yet no priming effect was obtained for partially-opaque compounds, implying dual-route access for English compounds.

The Turkish study showed that monolingual Turkish participants recognized compound words on the basis of their constituents (i.e. via decomposition); however, the effect of semantic transparency was also observed in the group. Transparent compounds were accessed by recognizing the second constituent (i.e. the head of the compound) while both constituents were activated for partially-opaque compounds. In contrast, neither the advanced nor the intermediate-level sequential bilingual groups showed native-like processing except for the fact that all three groups processed noncompounds (pseudocompounds and monomorphemic words) faster than compounds.

For noncompound items, it appeared that the participants in both languages employed whole-word representation. This indicates that participants were not affected by the orthographic similarities in the prime-target pairs suggesting morphological priming effect when decomposition was employed.

To sum up, the overall results indicated that English monolinguals accessed compounds through decomposition in line with the assumptions of Libben's APPLE model (1994; 1998) whereas Turkish monolingual participants processed compounds via the decompositional route (Taft and Forster, 1975). Neither of the intermediate level sequential bilingual groups could activate the constituents of compounds in visual recognition. Advanced level sequential bilinguals differed in their processing patterns. Turkish-English sequential bilinguals recognized compounds through decomposition and employed dual-route access as revealed by the effect of semantic transparency on their processing pattern. In contrast, English-Turkish bilinguals showed no priming effects for compounds and semantic transparency was not relevant in the processing of compound words for them. The differences in the processing patterns of two advanced level sequential bilingual groups indicated the importance of early exposure to a second language together with formal education and crucially the importance of familiarity with complex and relatively low-frequency words such as compounds.

9. 1. Implications of the Study

The current study aimed to investigate the representation and processing of compounds in the mental lexicon of Turkish-English and English-Turkish sequential adult bilinguals in comparison to monolingual English and Turkish adults. This study expanded previous research on L1 English compounds and accumulated further support in how L2 learners recognize English compound words.

In addition, the study attempted to identify the processing routes of monolingual speakers of Turkish, a morphologically rich, agglutinative language. Besides monolingual Turkish data, the study also provided data from L2 learners of Turkish, contributing to the L2 processing literature in general and the L2 Turkish acquisition in particular. Furthermore, the study explored the similarities and differences between monolingual and bilingual adults in recognizing compounds. Thus, the findings contributed to our understanding of potential differences between native and nonnative language representation/processing in the context of compounds. Last but not least, the study proved the importance of early exposure to an L2 and formal education by comparing the processing patterns of two advanced level bilingual groups. The findings also had implications for classroom teachers in teaching multimorphemic words in general and compounds in particular.

9. 2. Limitations of the Study

The main limitation of this study pertains to the item selection. First of all, it was extremely difficult to obtain the whole-word frequencies of Turkish compounds from the available frequency counts of Turkish. In the current study, all items were selected from METU Corpus (Say, Zeyrek, Oflazer & Özge, 2002); however, the corpus was lacking a substantially high number of Turkish compound words. Due to this, only 20 compounds (10 transparent-transparent and 10 partially-opaque) were included in the test. Most of the compound studies have used at least 20 compound words for each transparency class and this has led the researchers to reach more generalizable results. Related with the item selection in Turkish, the second limitation was the inadequate number of partially-opaque compounds and the lack of opaque-opaque compounds. Partially-opaque compounds normally include both transparent-opaque and opaque-transparent compounds and when these compounds are analyzed separately, a better understanding of the semantic transparency of the head constituent can be obtained. However, in the current investigation, the partially-opaque compounds merged both transparent-opaque and opaque-transparent compounds. In addition, the lack of opaque-opaque compounds did not make it possible to investigate the processing of compounds with two opaque constituents.

Another limitation of the current study was designing two parallel studies. On account of the difficulties encountered in designing the Turkish study, the number of items used in the English study has also decreased in order to make both studies parallel in all aspects as much as possible.

9. 3. Recommendations for Further Research

This study has several recommendations for further research particularly in the context of L2 Turkish as a relatively understudied language as an L2 compared to English. First of all, the processing of Turkish compounds should be investigated by using different experimental techniques such as eye tracking, cross-modal priming or event-related brain potentials in order to provide more evidence to clarify how Turkish compounds are processed.

Furthermore, a test consisting of fully-transparent, partially-opaque and fully-opaque compounds will enable the researchers to explore the processing of Turkish compounds in detail and provide evidence for the representation of fully-opaque compounds.

Additionally, L2 Turkish participants from Romance languages such as Spanish, Italian and France should be included in these studies and the results should be compared with participants from Germanic languages such as German, English and Dutch to investigate if headedness influences the processing of compounds in L2 learners and observe the effect of L1 influence.

Finally, it is important to find participants who have been exposed to Turkish as an L2 in the classroom environment to test the influence of formal education in processing an L2.

REFERENCES

Alegre, M., & Gordon, P. (1999). Frequency effects and the representational status of regular inflections. *Journal of Memory and Language, 40*, 41-61.

Anderson, S. (1992). *A morphous morphology.* Cambridge: Cambridge University Press.

Andrews, S. (1986). Morphological influences on lexical access: Lexical or nonlexical effects? *Journal of Memory and Language, 25*, 726-740.

Andrews, S., Miller, B., & Rayner, K. (2004). Eye movements and morphological segmentation of compound words: There is a mouse in mousetrap. *European Journal of Cognitive Psychology, 16*, 285-311.

Arcara, G. (2009). *Neural correlates of morphological processing: The case of Italian noun-noun compounds.* Unpublished Ph.D. Dissertation. University of Padua.

Arcara, G., Marelli, M., Buodo, G., & Mondini, S. (2014). Compound headedness in the mental lexicon: An event-related potential study.

Aslan, E., & Altan, A. (2006). The role of (-s)ı in Turkish indefinite nominal compounds. *Dil Dergisi, 131*, 57-78.

Babcock, L., Stowe, J. C., Maloof, C. J., Brovetto, C., & Ullman, M. T. (2012). The storage and composition of inflected forms in adult-learned second language: A study of the influence of length of residence, age of arrival, sex and other factors. *Bilingualism: Language and Cognition, 15*(4), 820-840.

Banguoğlu, T. (1998). *Türkçe'nin grameri.* Ankara: Ankara Üniversitesi Basımevi.

Basnight-Brown, D. M., Chen, L., Hua, S., Kostić, A., & Feldman, L. B. (2007). Monolingual and bilingual recognition of regular and irregular English verbs: Sensitivity to form similarity varies with first language experience. *Journal of Memory and Language, 57*, 65-80.

Bauer, L. (1983). *English word formation.* Cambridge: Cambridge University Press.

Bauer, L. (2001). Compounding. In M. Haspelmath, E. König, W. Oesterreicher & W. Raible (Eds.), *Language typology and language universals* (pp. 695-707). New York: Walter de Gruyter.

Bauer, L. (2006). Compounds and minor word formation types. In B. Aarts & A. McMahon (Eds.), *The handbook of English linguistics* (pp. 483-506). Malden, MA: Blackwell Publishing.

Beck, M. L. (1997). Regular verbs, past tense and frequency: Tracking down a potential source of NS/NNS competence differences. *Second Language Research, 13*(2), 93-115.

Bertram, R., Laine, M., & Karvinen, K. (1999). The interplay of word formation type, affixal homonymy, and productivity in lexical processing: Evidence from a morphologically rich language. *Journal of Psycholinguistic Research*, *28*, 213-226.

Bertram, R., Schreuder, R., & Baayen, R. H. (2000). The balance of storage and computation in morphological processing: The role of word formation type, affixal homonymy and productivity. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*, 489-511.

Bertram, R., & Hyönä, J. (2003). The length of a complex word modifies the role of morphological structure: Evidence from eye movements when reading short and long Finnish compounds. *Journal of Memory and Language*, *48*, 615-634.

Bertram, R., Pollatsek, A., & Hyönä, J. (2004). Morphological parsing and the use of segmentation cues in reading Finnish compounds. *Journal of Memory and Language*, *51*, 325-345.

Bertram, R., & Hyönä, J. (2007). The interplay between parafoveal preview and morphological processing in reading. In R. G. van Gompel, M. H. Fischer, W. S. Murray, & R. L. Hill (Eds.), *Eye movements: A window on mind and brain* (pp. 391-407). Amsterdam: Elsevier.

Bien, H., Levelt, W. J. M., & Baayen, R. H. (2005). Frequency effects in compound production. *Proceedings of the National Academy of Sciences, 102*, 17876-17881.

Birtürk, A. A., & Fong, S. (2001). A modular approach to Turkish noun compounding: The integration of a finite-state model, 6th Natural Language Processing Pacific Rim Symposium, Tokyo, Japan, November 2001.

Bisetto, A., & Scalise, S. (2011). The classification of compounds. In R. Lieber & P. Štekauer (Eds.), *The Oxford handbook of compounding* (pp. 49-82). Oxford: Oxford University Press.

Booij, G. (2005a). *The grammar of words.* Oxford: Oxford University Press.

Booij, G. (2005b). Compounding and derivation: Evidence for construction morphology. In W. U. Dressler, D. Kastovsky, O. E. Pfeiffer & F. Rainer (Eds.), *Morphology and its demarcations* (pp. 109-132). Amsterdam: John Benjamins Publishing.

Booij, G. (2010). Compounding construction: Schemas or analogy. In S. Scalise & I. Vogel (Eds.), *Cross-disciplinary issues in compounding* (93-107). Amsterdam: John Benjamins Publishing.

Booij, G. (2011). Construction morphology and compounding. In R. Lieber & P. Štekauer (Eds.), *The Oxford handbook of compounding* (pp. 201-216). Oxford: Oxford University Press.

Borgwaldt, S., & Lüttenberg, D. (2010). *Semantic transparency of compound nouns in native and non-native speakers.* Poster presented at the 14th International Morphology Meeting, Budapest.

Brusnighan, S. M., & Folk, J. R. (2012). Combining contextual and morphemic cues is beneficial during incidental vocabulary acquisition: Semantic transparency in novel compound word processing. *Reading Research Quarterly, 47*(2), 172-190.

Brysbaert, M., & New, B. (2009). Moving beyond Kučera and Francis: A critical evaluation of current word frequency norms and the introduction of a new and improved word frequency measure for American English. *Behavior Research Methods, 41*, 977-990.

Butterworth, B. (1983). Lexical representation. In B. Butterworth (ed.), *Language production: Development, writing and other language processes* (pp. 257-294). London: Academic Press.

Caramazza, A., Laudanna, A., & Romani, C. (1988). Lexical access and inflectional - morphology. *Cognition, 28*, 287-332.

Carstairs-McCarthy, A. (2002). *An introduction to English morphology: Words and their structures*. Edinburgh: Edinburgh University Press.

Clahsen, H., & Neubauer, K. (2010). Morphology, frequency, and the processing of derived words in native and non-native speakers. *Lingua, 120*, 2627-2637.

Clahsen, H., Felser, C., Neubauer, K., Sato, M., & Silva, R. (2010). Morphological structure in native and non-native language processing. *Language Learning, 60*, 21-43.

Clahsen, H., Balkhair, L., Schutter, J. S., & Cunnings, I. (2012). The time course of morphological processing in a second language. *Second Language Research, 29*(1), 7-31.

Conti, S. (2006). *Compound adjectives in English.* Unpublished Ph.D. Dissertation. University of Pisa.

de Almeida, R. G., & Libben, G. (2002). Compound prelexical decomposition: Evidence from a masked priming paradigm. *Folia Linguistica, 36*, 97-115.

De Cat, C., Klepousniotou, E., & Baayen, R. H. (2014). Electrophysiological correlates of noun-noun compound processing by non-native speakers of English. *Proceedings of the First Workshop on Computational Approaches to Compound Analysis,* 41-52.

De Cat, C., Klepousniotou, E., & Baayen, R. H. (2015). Representational deficit or processing effect? An electrophysiological study of noun-noun compound processing by very advanced L2 speakers of English. *Frontiers in Psychology, 6*, Article 77.

Dede, M. A. (1978). *A syntactic and semantic analysis of Turkish nominal compounds.* Unpublished Ph.D. Dissertation. University of Michigan.

Delahunty, G. P., & Garvey, J. J. (2010). *The English language: From sound to sense.* Colorado, USA: The WAC Clearinghouse.

Diependaele, K., Sandra, D., & Grainger, J. (2005). Masked cross-modal morphological priming: Unravelling morpho-orthographic and morpho-semantic influences in early word recognition. *Language and Cognitive Processes, 20*(1-2), 75-114.

Diependaele, K., Duñabeitia, J. A., Morris, J., & Keuleers, E. (2011). Fast morphological effects in first and second language word recognition. *Journal of Memory and Language, 64*, 344-358.

Doğan, F. Ş. (2013). Comprehension of compound nouns by Turkish speaking pre-school children. *International Periodical for the Languages, Literature and History of Turkish or Turkic, 8/12,* 403-414.

Dohmes, P., Zwitserlood, P., & Bölte, J. (2004). The impact of semantic transparency of morphologically complex words on picture naming. *Brain and Language, 90*, 203-212.

Dressler, W. U. (2005). Word formation in natural morphology. In P. Štekauer & R. Lieber (Eds.), *Handbook of word-formation* (pp. 267-284). Dordrecht: Springer.

Dressler, W. U. (2006). Compound types. In G. Libben & G. Jarema (Eds.), *The representation and processing of compound word* (pp. 23-44). Oxford: Oxford University Press.

Drieghe, D., Pollatsek, A., Juhasz, B. J., & Rayner, K. (2010). Parafoveal processing during reading is reduced across a morphological boundry. *Cognition, 116*(1), 136-142.

Duñabeitia, J. A., Perea, M., & Carreiras, M. (2007). The role of the frequency of constituents in compound words: Evidence from Basque and Spanish. *Psychonomic Bulletin & Review, 14*(6), 1171-1176.

Duñabeitia, J. A., Laka, I., Perea, M., & Carreiras, M. (2009). Is *Milkman* a super-hero like *Batman*? Constituent morphological priming in compound words. *European Journal of Cognitive Psychology, 21*, 615-640.

El-Bialy, R., Gagné, C. L., & Spalding, T. L. (2013). Processing of English compounds is sensitive to the constituents' semantic transparency. *The Mental Lexicon, 8*(1), 75-95.

El Yagoubi, R., Chiarelli, V., Mondini, S., Perrone, G., Danieli, M., & Semenza, C. (2008). Neural correlates of Italian nominal compounds and potential impact of headedness effect: An ERP study. *Cognitive Neuropsychology, 25*, 559-581.

Ellis, N. (1994). *Implicit and explicit learning of languages.* London: Academic Press.

Fabb, N. (2001). Compounding. In A. Spencer & A. Zwicky (Eds.), *The handbook of morphology* (pp. 66-83). Oxford: Blackwell Publishers Ltd.

Feldman, L. B. (2000). Are morphological effects distinguishable from the effects of shared meaning and shared form. *Journal of Experimental Psychology: Learning, Memory and Cognition, 26*, 1431-1444.

Feldman, L. B., & Soltano, E. G. (1999). Morphological priming: The role of prime duration, semantic transparency and affix position. *Brain and Language*, *60*, 33-39.

Feldman, L. B., O'Connor, P. A., & Moscoso del Prado Martin, F. (2009). Early morphological processing is morphosemantic and not simply morpho-orthographic: A violation of form-then-meaning accounts of word recognition. *Psychonomic Bulletin & Review, 16*(4), 684-691.

Feldman, L. B., Kostić, A., Basnight-Brown, D. M., Filipović-Durdević, D., & Pastizzo, M. J. (2010). Morphological facilitation for regular and irregular verb formations in native and non-native speakers: Little evidence for two distinct mechanisms. *Bilingualism: Language and Cognition, 13*(2), 119-135.

Fiorentino, R. (2006). *Lexical structure and the nature of linguistic representations.* Unpublished Ph.D. Dissertation. University of Maryland.

Fiorentino, R., & Poeppel, D. (2007). Compound words and structure in the lexicon. *Language and Cognitive Processes, 22*(7), 953-1000.

Fiorentino, R., Naito-Billen, Y., Bost, J., & Fund-Reznicek, E. (2014). Electrophysiological evidence for the morpheme-based combinatoric processing of English compounds. *Cognitive Neuropsychology, 31*(1-2), 123-146.

Forster, K. I., & Davis, C. (1984). Repetition priming and frequency attenuation in lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10,* 680-698.

Forster, K. I., Mohan, K., & Hector, J. (2003). The mechanics of masked priming. In S. Kinoshita & S. J. Lupker (Eds.), *Masked priming: The state of the art* (pp. 241-278). NewYork: Psychology Press.

Frisson, S., Niswander-Klement, E., & Pollatsek, A. (2008). The role of semantic transparency in the processing of English compound words. *British Journal of Psychology*. *99*, 87-107.

Gacan, P. (2014). *The morphological processing of derived words in L1 Turkish and L2 English.* Unpublished MA Thesis. Middle East Technical University.

Gagné, C. L. (2011). Psycholinguistic perspectives. In R. Lieber & P. Štekauer (Eds.), *The Oxford handbook of compounding* (pp. 407-430). Oxford: Oxford University Press.

Giraudo, H., & Grainger, J. (2000). Effects of prime word frequency and cumulative root frequency in masked morphological priming. *Language and Cognitive Processes, 15*(4/5), 421-444.

Giraudo, H., & Grainger, J. (2001). Priming complex words: Evidence for supralexical representation of morphology. *Psychonomic Bulletin & Review, 8*(1), 127-131.

Gomez, G. E. R. (2009). *The role of morphological awareness in bilingual children's first and second language vocabulary and reading.* Unpublished Ph.D. Dissertation. University of Toronto.

Gor, K. (2010). Introduction: Beyond the obvious: Do second language learners process inflectional morphology? *Language Learning, 60*(1), 1-20.

Goral, M., Libben, G., Obler, L. K., Jarema, G., & Ohayon, K. (2008). Lexical attrition in younger and older bilingual adults. *Clinical Linguistics and Phonetics, 22*(7), 509-522.

Göksel, A. (2009). Compounds in Turkish. *Lingue e Linguaggio, 2*, 213-236.

Göksel, A., & Kerslake, C. (2005). *Turkish: A comprehensive grammar.* New York: Routledge.

Göksel, A., & Haznedar, B. (2007). Remarks on compounding in Turkish. Retrieved from: http://componet.sslmit.unibo.it/download/remarks/TR.pdf

Gumnior, H. (2008). *The representation of morphologically complex words.* Unpublished Ph.D. Dissertation. University of Münster.

Gürel, A. (1999). Decomposition: To what extent? The case of Turkish. *Brain and Language, 68*, 218-224.

Gürel, A., & Uygun, S. (2013). Representation of multimorphemic words in the mental lexicon: Implications for second language acquisition of morphology. In S. Baiz, N. Goldman & R. Hawkes (Eds.), *Proceedings of the 37th annual conference on language development* (pp. 122-133). Somerville: Cascadilla Press.

Hahne, A., Mueller, J., & Clahsen, C. (2006). Morphological processing in a second language: Behavioural and event-related brain potential evidence for storage and decomposition. *Journal of Cognitive Neuroscience, 18*, 121-134.

Häikiö, T. (2011). *Reading development during elementary school years: Evidence from eye movements.* Unpublished Ph.D. Dissertation. University of Turku.

Häikiö, T., Bertram, R., & Hyönä, J. (2011). The development of whole-word representations in compound word processing: Evidence from eye fixation patterns of elementary school children. *Applied Psycholinguistics, 32*, 533-551.

Harmer, J. (1991). *The Practice of English Language Teaching*. New York: Longman.

Holle, H., Gunter, T. C., & Koester, D. (2010). The time course of lexical access in morphologically complex words. *NeuroReport, 21*(5), 319-323.

Hyönä, J. (2012). The role of visual acuity and segmentation cues in compound word identification. *Frontiers in Psychology*, *3*, 188.

Hyönä, J., & Pollatsek, A. (1998). Reading Finnish compound words: Eye fixations are affected by component morphemes. *Journal of Experimental Psychology: Human Perception and Performance, 24*(6), 1612-1627.

Hyönä, J., & Pollatsek, A. (2000). Processing of Finnish compound words in reading. In A. Kennedy, R. Radach, D. Heller, & J. Pynte (Eds.), *Reading as a perceptual process* (pp. 65–88). New York: Elsevier.

Inhoff, A. W., Briihl, D., & Schwartz, J. (1996). Compound word effects differ in reading, on-line naming, and delayed naming tasks. *Memory and Cognition, 24*(4), 466-476.

Inhoff, A. W., Starr, M. S., Solomon, M., & Placke, L. (2008). Eye movements during the reading of compound words and the influence of lexeme meaning. *Memory and Cognition, 36*(3), 675-687.

Isel, F., Gunter, T. C., & Friederici, A. D. (2003). Prosody-assisted head-driven access to spoken German compounds. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 29*, 277-288.

Jacob, G., Fleischhauer, E., & Clahsen, H. (2013). Allomorphy and affixation in morphological processing: A cross-modal priming study with late bilinguals. *Bilingualism: Language and Cognition, 16*(4), 924-933.

Janssen, N., Pajtas, P. E., & Caramazza, A. (2014). Task influences on the production and comprehension of compound words. *Memory and Cognition, 42*(5), 780-793.

Jarema, G. (2006). Compound representation and processing: A cross-language perspective. In G. Libben & G. Jarema (Eds.), *The representation and processing of compound words* (pp. 45-70). Oxford: Oxford University Press.

Jarema, G., Busson, C., Nikolova, R., Tsapkini, K., & Libben, G. (1999). Processing compounds: A cross-linguistic study. *Brain and Language*, *68*, 362-369.

Järvikivi, J., Bertram, R., & Niemi, R. (2006). Affixal salience and the processing of derivational morphology: The role of suffix allomorphy. *Language and Cognitive Processes, 21*, 394-431.

Ji, H. (2008). *The influence of morphological complexity on word processing.* Unpublished Ph.D. Dissertation. University of Alberta.

Ji, H., Gagné, C. L., & Spalding, T. L. (2011). Benefits and costs of lexical decomposition and semantic integration during the processing of transparent and opaque English compounds. *Journal of Memory and Language, 65*,406-430.

Juhasz, B. J. (2006). Effects of word length and sentence context on compound word recognition: An eye movement investigation. Dissertation Abstracts International, *67*(4-B), 2252B. (UMI No. 3215917).

Juhasz, B. J. (2007). The influence of semantic transparency on eye movements during English compound word recognition. In R. G. van Gompel, M. H. Fischer, W. S. Murray, & R. L. Hill (Eds.), *Eye movements: A window on mind and brain*, (pp. 373-389). Amsterdam: Elsevier.

Juhasz, B. J., Starr, M. S., Inhoff, A. W., & Placke, L. (2003). The effects of morphology on the processing of compound words: evidence from naming, lexical decisions and eye fixations. *British Journal of Psychology, 94*, 223-244.

Juhasz, B. J., & Berkowitz, R. N. (2011). Effects of morphological families on English compound word recognition: A multitask investigation. *Language and Cognitive Processes, 26*(4/5/6), 653-682.

Juhasz, B. J., Pollatsek, A., Hyönä, J., Drieghe, D., & Rayner, K. (2009). Parafoveal processing within and between words. *The Quarterly Journal of Experimental Psychology, 62*(7), 1356-1376.

Karacaoğlu, M. Ö. (2010). *Birleşik kelimelerin yazımı.* Unpublished Master's Thesis. Marmara University.

Katamba, F. (1994). *English words.* London: Routledge.

Katz, L., Rexer, K., & Lukatela, G. (1991). The processing of inflected words. *Psychological Research, 53*, 25-32.

Kehayia, E., Jarema, G., Tsapkini, K., Perlak, D., Ralli, A., & Kadzielawa, D. (1999). The role of morphological structure in the processing of compounds: The interface between linguistics and psycholinguistics. *Brain and Language*, *68*, 370-377.

Kırkıcı, B. (2007). The mental processing of L2 English lexical compounds: A developmental dual-mechanism account. *EUROSLA Yearbook 7*, 7-25.

Kırkıcı, B., & Clahsen, H. (2013). Inflection and derivation in native and non-native language processing: Masked priming experiments on Turkish. *Bilingualism: Language and Cognition, 16*, 776-791.

Ko, Y. (2011). *Processing of compound words by adult Korean-English bilinguals*. Unpublished Ph.D. Dissertation. University of Maryland.

Ko, Y., Wang, M., & Kim, S. Y. (2011). Bilingual reading of compound words. *Journal of Psycholinguistic Research, 40*, 49-73.

Koester, D., Gunter, T. C., Wagner, S., & Friederici, A. D. (2004). Morphosyntax, prosody and linking elements: The auditory processing of German nominal compounds. *Journal of Cognitive Neuroscience, 16*(9), 1647-1668.

Koester, D., Gunter, T. C., & Wagner, S. (2007). The morphosyntactic decomposition and semantic composition of German compound words investigated by ERPs. *Brain and Language, 102*, 64-79.

Koester, D., & Schiller, N. O. (2008). Morphological priming in overt language production: Electrophysiological evidence from Dutch. *NeuroImage, 42*, 1622-1630.

Koester, D., Holle, H., & Gunter, T. C. (2009). Electrophysiological evidence for incremental lexical-semantic integration in auditory compound comprehension. *Neuropsychologia, 47*, 1854-1864.

Koester, D., & Schiller, N. O. (2011). The functional neuroanatomy of morphology in language production. *NeuroImage, 55*, 732-741.

Kornfilt, J. (1997). *Turkish.* London: Routledge.

Kunduracı, A. (2013). *Turkish noun-noun compounds: A process-based paradigmatic account.*Unpublished Ph.D. Dissertation. University of Calgary.

Kuperman, V., Bertram, R., & Baayen, R. H. (2008). Morphological dynamics in compound processing. *Language and Cognitive Processes, 23*(7-8), 1089-1132.

Kuperman, V., Schreuder, R., Bertram, R., & Baayen, R. H. (2009). Reading polymorphemic Dutch compounds: Toward a multiple route model of lexical processing. *Journal of Experimental Psychology: Human Perception and Performance, 35*, 876-895.

Lacruz, I. (2005). *Morphology in visual word recognition.* Unpublished Ph.D. Dissertation. Kent State University.

Laine, M., Niemi, J., Koivuselkä-Sallinen, P., Ahlsén, E., & Hyönä, J. (1994). A neurolinguistic analysis of morphological deficits in a Finnish-Swedish bilingual aphasic. *Clinical Linguistics and Phonetics, 8*, 177-200.

Laine, M., Vainio, S., & Hyönä, J. (1999). Lexical access routes to nouns in a morphologically rich language. *Journal of Memory and Language, 40*, 109-135.

Lehtonen, M., & Laine, M. (2003). How word frequency affects morphological processing in monolinguals and bilinguals. *Bilingualism: Language and Cognition, 6*(3), 213-225.

Lehtonen, M., Hultén, A., Rodriguez-Fornells, A., Cunillera, T., Tuomainen, J., & Laine, M. (2012). Differences in word recognition between early bilinguals and monolinguals: Behavioral and ERP evidence. *Neuropsychologia, 50*, 1362-1371.

Lemhöfer, K., Dijkstra, T., Schriefers, H., Baayen, H. R., Grainger, J., & Zwitserlood, P. (2008). Native language influences on word recognition in a second language: A mega study. *Journal of Experimental Psychology: Learning, Memory and Cognition, 34*, 12-31.

Lemhöfer, K., Koester, D., & Schreuder, R. (2011). When bicycle pump is harder to read than bicycle bell: Effects of parsing cues in first and second language compound reading. *Psychonomic Bulletin & Review, 18*, 364-370.

Lewis, G. L. (1967). *Turkish grammar.* Oxford: Oxford University Press.

Li, M., Jiang, N., & Gor, K. (2015). L1 and L2 processing of compound words: Evidence from masked priming experiments in English. *Bilingualism: Language and Cognition,* Available on CJO 2015 doi:10.1017/S1366728915000681

Libben, G. (1994). How is morphological decomposition achieved? *Language and Cognitive Processes, 9*, 369-391.

Libben, G. (1998). Semantic transparency in the processing of compounds: Consequence for representation, processing and impairment. *Brain and Language, 61*, 30-44.

Libben, G. (2005). Everything is psycholinguistics: Material and methodological considerations in the study of compound processing. *Canadian Journal of Linguistics*, *50*(1/2/3/4), 267-283.

Libben, G. (2006). Why study compound processing? An overview of the issues. In G. Libben & G. Jarema (Eds.), *The representation and processing of compound words* (pp. 1-22). Oxford: Oxford University Press.

Libben, G., Derwing, B., & de Almeida, R. G. (1999). Ambiguous novel compounds and models of morphological parsing. *Brain and Language, 68*, 378-386.

Libben, G., Gibson, M., Yoon, Y. B., & Sandra, D. (2003). Compound fracture: The role of semantic transparency and morphological headedness. *Brain and Language, 84*, 50-64.

Longtin, C. M., Segui, J., & Hallé, P. A. (2003). Morphological priming without morphological relationship. *Language and Cognitive Processes, 18*(3), 313-334.

Longtin, C., & Meunier, F. (2005). Morphological decomposition in early visual word processing. *Journal of Memory and Language*, *53*, 26–41.

Lorenz, A., Heide, J., & Burchert, F. (2014). Compound naming in aphasia: Effects of complexity, part of speech, and semantic transparency. *Language, Cognition and Neuroscience, 29*(1), 88-106.

Lüttmann, H., Zwitserlood, P., Böhl, A., & Bölte, J. (2011). Evidence for morphological composition at the form level in speech production. *Journal of Cognitive Psychology, 23*(7), 818-836.

MacGregor, L. J., & Shtyrov, Y. (2013). Multiple routes for compound word processing in the brain: Evidence from EEG. *Brain and Language, 126*, 217-229.

Marchak, K. A. (2011). *Availability of constituents' semantic representations during the processing of opaque and transparent compound words.* Unpublished MA Thesis. University of Alberta.

Marelli, M., Crepaldi, D., & Luzzatti, C. (2008). The processing of compound words in Italian: Evidence for an access to morphological constituents and a headedness effect. Retrieved from: http://boa.unimib.it/bitstream/10281/38740/1/poster_bressanone.pdf

Marelli, M., Crepaldi, D., & Luzzatti, C. (2009). Head position and the mental representation of Italian nominal compounds. *The Mental Lexicon, 4*(3), 430-455.

Marelli, M., & Luzzatti, C. (2012). Frequency effects in the processing of Italian nominal compounds: Modulation of headedness and semantic transparency. *Journal of Memory and Language, 66*, 644-664.

Marslen-Wilson, W. D., Tyler, L. K., Waksler, R., & Older, L. (1994). Morphology and meaning in the English mental lexicon. *Psychological Review*, *101*(1), 3-33.

Marslen-Wilson, W., Bozic, M., & Randall, B. (2008). Early decomposition in visual word recognition: Dissociating morphology, form and meaning. *Language and Cognitive Processes, 23*(3), 394-421.

Mayila, Y. (2010). *English compound word processing: Evidence from Mandarin Chinese-English bilinguals.* Unpublished MA Dissertation. University of Kansas.

McCarthy, M. (1990). *Vocabulary*. Oxford: Oxford University Press.

McCormick, S. F., Rastle, K., & Davis, M. H. (2008). Is there a "fete" in "fetish"? Effects of orthographic opacity on morpho-orthographic segmentation in visual word recognition. *Journal of Memory and Language, 58*(2), 307-326.

Meunier, F., & Longtin, C. M. (2007). Morphological decomposition and semantic integration in word processing. *Journal of Memory and Language, 56*(4), 457-471.

Morris, J., & Stockall, L. (2012). Early, equivalent ERP masked priming effects for regular and irregular morphology. *Brain and Language, 123*(2), 81-93.

Münte, T. F., Say, T., Clahsen, H., Schiltz, K., & Kutas, M. (1999). Decomposition of morphologically complex words in English: Evidence from event-related brain potentials. *Cognitive Brain Research, 7*, 241-253.

Neubauer, K., & Clahsen, H. (2009). Decomposition of inflected words in a second language: An experimental study of German participles. *Studies in Second Language Acquisition, 31*(3), 403-435.

Niemi, J., Laine, M., & Tuominen, J. (1994). Cognitive morphology in Finnish: Foundations of a new model. *Language and Cognitive Processes, 3*, 423-446.

Niswander, E. (2003). *The processing of English affixed words during reading: Frequency, word length and affixal homonymy.* Unpublished Ph.D. Dissertation. University of Massachusetts Amherst.

Özer, S. (2010). *Morphological priming in Turkish nominal compound processing.* Unpublished MA Thesis. Middle East Technical University.

Pavičić Takač, V. (2008). *Vocabulary learning strategies and foreign language acquisition.* Clevedon: Multilingual Matters Ltd.

Plag, I. (2003). *Word formation in English.* London: Cambridge University Press.

Pollatsek, A., Hyönä, J., & Bertram, R. (2000). The role of morphological constituents in reading Finnish compound words. *Journal of Experimental Psychology: Human Perception and Performance, 26,* 820-833.

Pollatsek, A., & Hyönä, J. (2005). The role of semantic transparency in the processing of Finnish compound words. *Language and Cognitive Process, 20*(1-2), 261-290.

Pollatsek, A., Bertram, R., & Hyönä, J. (2011). Processing novel and lexicalized Finnish compound words. *Journal of Cognitive Psychology, 23*(7), 795-810.

Portin, M., Lehtonen, M., & Laine, M. (2007). Processing of inflected nouns in late bilinguals. *Applied Psycholinguistics, 28*, 135-156.

Rastle, K., Davis, M. H., Marslen-Wilson, W. D., & Tyler, L. K. (2000). Morphological and semantic effects in visual word recognition: A time-course study. *Language and Cognitive Processes*, *15*(4-5), 507-537.

Rastle, K., & Davis, M. H. (2003). Reading morphologically complex words. In S. Kinoshita & S. J. Lupker (Eds.), *Masked priming: The state of the art* (pp. 279-301). New York: Psychology Press.

Rastle, K., Davis, M. H., & New, B. (2004). The broth in my brother's brothel: morpho-orthographic segmentation in visual word recognition. *Psychonomic Bulletin & Review, 11*(6), 1090-1098.

Rastle, K., & Davis, M. H. (2008). Morphological decomposition based on the analysis of orthography. *Language and Cognitive Processes, 23*(7-8), 942-971.

Rehak, K. M., & Juffs, A. (2011). Native and nonnative processing of morphologically complex English words: Testing the influence of derivational prefixes. In xxxx (Eds.), *Selected Proceedings of the 2010 Second Language Research Forum* (pp. 125-142). Somerville, MA: Cascadilla Proceedings Project.

Sakaguchi, K. (2006). *Morphological processing of inflection in native speakers and second language learners of English: A masked priming study.* Unpublished MA Thesis. University of Essex.

Sandra, D. (1990). On the representation and processing of compound words: Automatic access to constituent morphemes does not occur. *Quarterly Journal of Experimental Psychology, 42A*(3)*,* 529-567.

Say, B., Zeyrek, D.,Oflazer, K., & Özge, U. (2002). Development of a corpus and a treebank for present-day written Turkish. In K. İmer & G. Doğan (Eds.), *Current research in Turkish linguistics. Proceedings of the 11th international conference on Turkish linguistics* (pp. 183-192). Northern Cyprus: Eastern Mediterranean University.

Scalise, S., & Fábregas, A. (2010). The head in compounding. In S. Scalise & I. Vogel (Eds.), *Cross-disciplinary issues in compounding* (109-126). Amsterdam: John Benjamins Publishing.

Scalise, S., & Vogel, I. (2010). Why compounding? In S. Scalise & I. Vogel (Eds.), *Cross-disciplinary issues in compounding* (1-18). Amsterdam: John Benjamins Publishing.

Schmitt, N. (2008). Teaching Vocabulary. Longman Teacher Guidelines Series.

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). *E-Prime. Reference Guide.* Psychology Software Tools, Inc., Pittsburgh.

Schreuder, R., & Baayen, R. H. (1995). Modeling morphological processing. In L. B. Feldman (Ed.), *Morphological aspects of language processing* (pp. 131-154). Hillsdale, NJ: Erlbaum.

Schreuder, R., Burani, C., & Baayen, R. H. (2003). Parsing and semantic opacity. In E. Assink & D. Sandra (Eds.), *Reading complex words: Neuropsychology and cognition* (pp. 159-190). The Netherlands, Amsterdam: Kluwer.

Sepp, M. (2006). *Phonological constraints and free variation in compounding: A corpus study of English and Estonian noun compounds*. Unpublished Ph.D. Dissertation. The City University of New York.

Sereno, J.A., & Jongman, A. (1997). Processing of English inflectional morphology. *Memory and Cognition, 25*, 425-437.

Shoolman, N., & Andrews, S. (2003). Racehorses, reindeer, and sparrows: using masked priming to investigate morphological influences on compound word identification. In S. Kinoshita & S. J. Lupker (Eds.), *Masked priming: The state of the art* (pp. 241-278). NewYork: Psychology Press.

Silva, R. (2008). *Morphological processing in a second language: Evidence from psycholinguistic experiments.* Unpublished Ph.D. Dissertation. University of Essex.

Silva, R., & Clahsen, H. (2008). Morphologically complex words in L1 and L2 processing: Evidence from masked priming experiments in English. *Bilingualism: Language and Cognition, 11*, 245-260.

Sonnenstuhl, I., Eisenbeiss, S., & Clahsen, H. (1999). Morphological priming in the German mental lexicon. *Cognition, 72*, 203-236.

Stanners, R., Neiser, J., Hernon, W., & Hall, R. (1979). Memory representation for morphologically related words. *Journal of Verbal Learning and Verbal Behavior, 18*, 399-412.

Stathis, A. (2014). *How partial transparency influences the processing of compound words?* Unpublished MA Thesis. University of Windsor.

Stemberger, J.P., & MacWhinney, B. (1986). Frequency and the lexical storage of regularly inflected forms. *Memory and Cognition, 14*(1), 17-26.

Şenel, M. (2009). Kes-kopyala-yapıştır; Yeni kelime türet. *Belleten, 2009-1,* 99-109.

Taft, M. (1994). Interactive activation as a framework for understanding morphological processing. *Language and Cognitive Processing, 9*(1), 271-294.

Taft, M., & Forster, K. I. (1975). Lexical storage and retrieval of prefixed words. *Journal of Verbal Learning and Verbal Behaviour, 14*, 638-647.

Taft, M., & Forster, K. I. (1976). Lexical storage and retrieval of polymorphemic and polysyllabic words. *Journal of Verbal Learning and Verbal Behaviour, 15*, 607-620.

Taft, M., & Nguyen-Hoan, M. (2010). A sticky stick? The locus of morphological representation in the lexicon. *Language and Cognitive Processes*, *25*(2), 277-296.

Tahanien, Y. (2012). The awareness of the English word-formation mechanisms is a necessity to make an autonomous L2 learner in EFL context. *Journal of Language Teaching and Research, 3*(6), 1105-1113.

Tat, D. (2013). *Word syntax of nominal compounds: Internal and aphasiological evidence from Turkish.* Unpublished Ph.D. Dissertation. University of Arizona.

Trias, S. P. (2010). *Complex word formation and the morphology-syntax interface.* Unpublished Ph.D. Dissertation. Universitat Autonoma de Barcelona.

Trofimovich, P., & McDonough, K. (2011). Using priming methods to study L2 learning and teaching. In P. Trofimovich & K. McDonough (Eds.), *Applying priming methods to L2 learning, teaching and research: Insights from psycholinguistics* (pp. 3-21). Amsterdam: John Benjamins Publishing.

Tulving, E., Schacter, D. L., & Stark, H. A. (1982). Priming effects in word-fragment completion are independent of recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 8*, 336-342.

Ullman, M. T. (2001). The neural basis of lexicon and grammar in first and second language: The declarative/procedural model. *Bilingualism: Language and Cognition, 4*, 105-122.

Ullman, M. T. (2004). Contributions of memory circuits to language: The declarative/procedural model. *Cognition, 92*, 231-270.

Ullman, M. T. (2005). A cognitive neuroscience perspective on second language acquisition: The declarative/procedural model. In C. Sanz (ed.), *Mind and context in adult second language acquisition: Methods, theory and practice* (pp. 141-178). Washington DC: Georgetown University Press.

Uygun, S., & Gürel, A. (2016). Processing morphology in L2 Turkish: The effects of morphological richness in the L1. In A. Gürel (ed.), *Second Language Acquisition of Turkish* (pp. 249-277). Amsterdam: John Benjamins Publishing.

Vainio, S., Pajunen, A., & Hyönä, J. (2014). L1 and L2 word recognition in Finnish: Examining L1 effects on L2 processing of morphological complexity and morphophonological transparency. *Studies in Second Language Acquisition, 36*, 133-162.

Vannest, J., & Boland, J. E. (1999). Lexical morphology and lexical access. *Brain and Language, 68*, 324-332.

Vannest, J., Bertram, R., Järvikivi, J., & Niemi, J. (2002). Counterintuitive cross-linguistic differences: More morphological computation in English than in Finnish. *Journal of Psycholinguistic Research, 31*(2), 83-106.

Vergara-Martínez, M., Duñabeitia, J. A., Laka, I., & Carreiras, M. (2009). ERP correlates of inhibitory and facilitative effects of constituent frequency in compound word reading. *Brain Research, 1257*, 53-64.

Wang, M. (2010). Bilingual compound processing: The effects of constituent frequency and semantic transparency. *Writing Systems Research, 2*(2), 117-137.

Wong, M., & Rotello, C. M. (2010). Conjunction errors and semantic transparency. *Memory and Cognition, 38*(1), 47-56.

Yükseker, H. (1987). Turkish nominal compounds. *Toronto Working Papers on Linguistics, 7*, 83-102.

Zwitserlood, P. (1994). The role of semantic transparency in the processing and representation of Dutch compounds. *Language and Cognitive Processes, 9*(3), 341-368.

Zwitserlood, P., Bölte, J., & Dohmes, P. (2000). Morphological effects on speech production: Evidence from picture naming. *Language and Cognitive Processes, 15*(4-5), 563-591.

Zwitserlood, P., Bölte, J., & Dohmes, P. (2002). Where and how morphologically complex words interplay with naming pictures. *Brain and Language, 81*, 358-367.

APPENDICES

APPENDIX A

BACKGROUND QUESTIONNAIRE FOR ENGLISH MONOLINGUALS

Date: _______________

I agree to participate in the 10-minute long test of Prof. Dr. Ayşe Gürel's research project which is funded by the Scientific and Technological Research Council of Turkey (TÜBİTAK 1001, Research Grant No: 112K183).

Name-Surname :

Date of Birth :

Signature :

APPENDIX B

BACKGROUND QUESTIONNAIRE FOR TURKISH-ENGLISH SEQUENTIAL BILINGUALS

I. PERSONAL INFORMATION (Will Remain Confidential)

Name-Surname:____

Sex: Female: Male:

Date of Birth:_______________**Place of Birth:** City/Country:______________________

II. THE TURKISH LANGUAGE

Please provide the required information about your experience in learning Turkish as a foreign/second language.

Age of first exposure	
Place of first exposure	
How long have you taken/been taking Turkish lessons?	
Proficiency level of the Turkish class you last attended/presently attend	

III. TURKISH LANGUAGE PROFICIENCY

Have you ever taken any Turkish Proficiency Test? If so,

Where did you take it? _____________________________________

When did you take it? _____________________________________

What was your score? _____________________________________

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

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

APPENDIX C

PRIMES-TARGET COMPOUNDS IN ENGLISH TEST

PARTIALLY OPAQUE COMPOUNDS			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Compound**
grape	fruit	chess	GRAPEFRUIT
sun	flower	coal	SUNFLOWER
egg	plant	bone	EGGPLANT
rest	room	tail	RESTROOM
straw	berry	court	STRAWBERRY
butter	fly	coast	BUTTERFLY
brain	storm	flash	BRAINSTORM
night	mare	sand	NIGHTMARE
rain	bow	rose	RAINBOW
neck	lace	pill	NECKLACE
TRANSPARENT-TRANSPARENT COMPOUNDS			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Compound**
heart	beat	yard	HEARTBEAT
post	card	bull	POSTCARD
head	ache	barn	HEADACHE
moon	light	guard	MOONLIGHT
snow	ball	skin	SNOWBALL
hand	bag	milk	HANDBAG
tooth	paste	fight	TOOTHPASTE
horse	power	house	HORSEPOWER
wheel	chair	board	WHEELCHAIR
door	bell	line	DOORBELL

APPENDIX D

PRIMES-TARGET PSEUDOCOMPOUNDS IN ENGLISH TEST

Prime (Constituent 1)	Prime (Constituent 2)	Unrelated Prime	Target Pseudocompound
contest	ant	sheep	CONTESTANT
ward	robe	face	WARDROBE
sum	mary	dog	SUMMARY
vine	gar	time	VINEGAR
fore	cast	life	FORECAST
nap	kin	bug	NAPKIN
man	date	box	MANDATE
cock	roach	town	COCKROACH
con	sequence	ladder	CONSEQUENCE
sea	son	pan	SEASON

APPENDIX E

PRIMES-TARGET MONOMORPHEMIC ITEMS IN ENGLISH TEST

Prime (Constituent 1)	Prime (Constituent 2)	Unrelated Prime	Target Monomorphemic
horos	cope	bush	HOROSCOPE
gir	affe	shop	GIRAFFE
parti	ciple	blood	PARTICIPLE
enve	lope	wood	ENVELOPE
bach	elor	pole	BACHELOR
port	rait	wall	PORTRAIT
ambas	sador	wagon	AMBASSADOR
let	tuce	bean	LETTUCE
squ	irrel	cook	SQUIRREL
graf	fiti	case	GRAFFITI
cardi	gan	cage	CARDIGAN
cuc	umber	camp	CUCUMBER
cont	ent	soup	CONTENT
plas	ter	gun	PLASTER
bliz	zard	bath	BLIZZARD
appe	tite	water	APPETITE
bill	iard	dust	BILLIARD
arthri	tis	king	ARTHRITIS
vocab	ulary	grass	VOCABULARY
intel	lect	sauce	INTELLECT
curri	culum	knife	CURRICULUM
inst	inct	farm	INSTINCT
appren	tice	earth	APPRENTICE
furni	ture	bowl	FURNITURE
zuc	chini	mind	ZUCCHINI
petit	ion	hole	PETITION
holo	caust	trip	HOLOCAUST
peppe	roni	band	PEPPERONI
prov	ince	corn	PROVINCE
tat	too	cat	TATTOO
neigh	bour	mail	NEIGHBOUR
trea	sure	step	TREASURE
dil	emma	air	DILEMMA
cand	idate	song	CANDIDATE
umb	rella	desk	UMBRELLA
archi	tect	side	ARCHITECT
hurri	cane	sight	HURRICANE
princi	ple	apple	PRINCIPLE
collea	gue	mouse	COLLEAGUE
elep	hant	salt	ELEPHANT
scor	pion	luck	SCORPION
sen	tence	rope	SENTENCE
foun	tain	rank	FOUNTAIN

frag	rance	suit	FRAGRANCE
temp	late	mark	TEMPLATE
for	est	cow	FOREST
pamp	hlet	stone	PAMPHLET
cal	ender	foot	CALENDER
alli	gator	paper	ALLIGATOR
temper	ature	shell	TEMPERATURE
ratio	nale	flood	RATIONALE
lob	ster	gum	LOBSTER
croco	dile	year	CROCODILE
pneu	monia	style	PNEUMONIA
nurt	ure	lock	NURTURE
sche	dule	work	SCHEDULE
cli	mate	pin	CLIMATE
prost	itute	bread	PROSTITUTE
diar	rhea	worm	DIARRHEA
sopho	more	snake	SOPHOMORE

APPENDIX F

PRIMES-TARGET NONWORD COMPOUND ITEMS IN ENGLISH TEST

NONWORD-NONWORD			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Nonword Compound**
bea	zike	bee	BEAZIKE
baip	gech	form	BAIPGECH
belf	bew	beer	BELFBEW
rog	chy	gas	ROGCHY
bamp	teck	glue	BAMPTECK
arh	kig	fee	ARHKIG
cul	hews	gap	CULHEWS
bonch	mip	pear	BONCHMIP
NONWORD-WORD			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Nonword Compound**
yipmunk	oil	train	YIPMUNKOIL
flurb	pair	bear	FLURBPAIR
vight	break	trust	VIGHTBREAK
gurm	day	cash	GURMDAY
lis	candle	flat	LISCANDLE
bix	mountain	cheese	BIXMOUNTAIN
stel	stop	exam	STELSTOP
WORD-NONWORD			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Nonword Compound**
store	feard	staff	STOREFEARD
cheek	peem	stair	CHEEKPEEM
tree	pold	leaf	TREEPOLD
pot	hount	dock	POTHOUNT
chef	pite	lion	CHEFPITE
carrot	kif	toast	CARROTKIF
frame	blaul	tribe	FRAMEBLAUL
WORD-WORD			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Nonword Compound**
mouth	bird	mess	MOUTHBIRD
pipe	meal	page	PIPEMEAL
boat	noon	gang	BOATNOON
cloud	candy	piano	CLOUDCANDY
firm	aid	surf	FIRMAID
wire	wife	part	WIREWIFE
floor	cover	judge	FLOORCOVER

price	trash	spoon	PRICETRASH

APPENDIX G

PRIMES-TARGET NONWORD MONOMORPHEMIC ITEMS IN ENGLISH TEST

Prime (Constituent 1)	Prime (Constituent 2)	Unrelated Prime	Target Nonword Monomorphemic
cair	pell	rage	CAIRPELL
slem	ish	lime	SLEMISH
impec	ulafe	stick	IMPECULAFE
cag	ijex	lord	CAGIJEX
inslua	jas	mint	INSLUAJAS
conp	rote	rock	CONPROTE
horg	vield	dove	HORGVIELD
sruck	wail	sport	SRUCKWAIL
skon	dahe	mile	SKONDAHE
emist	idity	sword	EMISTIDITY
bex	zand	drum	BEXZAND
fup	elirm	club	FUPELIRM
enfel	lorm	iron	ENFELLORM
gomen	tine	dress	GOMENTINE
woas	tilk	name	WOASTILK
accom	flect	trade	ACCOMFLECT
saugh	zer	knee	SAUGHZER
plor	tlew	flag	PLORTLEW
tize	nol	ear	TIZENOL
bock	taif	base	BOCKTAIF
estail	ect	plate	ESTAILECT
ausp	ontra	path	AUSPONTRA
reno	gale	love	RENOGALE
stube	bect	lift	STUBABECT
drat	sical	tape	DRATSICAL
deni	siment	force	DENISIMENT
calli	bagy	hall	CALLIBAGY
emas	tron	shoe	EMASTRON
felmi	gure	field	FELMIGURE
den	gribut	fish	DENGRIBUT
als	ave	war	ALSAVE
eru	sant	rug	ERUSANT
slab	bage	pine	SLABBAGE
confri	dunt	craft	CONFRIDUNT
tosse	raxe	fire	TOSSERAXE
cazdel	tif	clock	CAZDELTIF
lench	marz	fork	LENCHMARZ
dest	rime	gate	DESTRIME
eiv	erlin	root	EIVERLIN
slock	ade	pony	SLOCKADE
chen	tixe	note	CHENTIXE
parch	wlord	arrow	PARCHWLORD
pon	frand	wind	PONFRAND

ril	laze	key	RILLAZE
chu	sio	rat	CHUSIO
inc	rodune	point	INCRODUNE
plair	tirl	crow	PLAIRTIRL
stawp	attis	honey	STAWPATTIS
agin	shett	sugar	AGINSHETT
gloin	vose	child	GLOINVOSE
vart	glise	sweat	VARTGLISE
glur	shet	ship	GLURSHET
preci	reve	table	PRECIREVE
silp	onth	nose	SILPONTH
rego	prife	jail	REGOPRIFE
chom	bore	bomb	CHOMBORE
flen	din	lady	FLENDIN
ath	orate	buck	ATHORATE
cop	plene	view	COPPLENE
are	lesh	ham	ARELESH

APPENDIX H

BACKGROUND QUESTIONNAIRE FOR TURKISH MONOLINGUALS

Tarih: ______________

Prof. Dr. Ayşe Gürel'in proje yürütücüsü olduğu TÜBİTAK 1001'in 112K183 numaralı projesi için 10 dakika sürecek olan teste katılmayı kabul ediyorum.

İsim-Soyisim :

Doğum Tarihi :

İmza :

APPENDIX I

BACKGROUND QUESTIONNAIRE FOR ENGLISH-TURKISH SEQUENTIAL BILINGUALS

I. PERSONAL INFORMATION (Will Remain Confidential)

Name-Surname:____

Sex: Female: Male:

Date of Birth:_______________**Place of Birth:** City/Country:______________________

II. THE ENGLISH LANGUAGE

Please provide the required information about your experience in learning English as a foreign/second language.

Age of first exposure	
Place of first exposure	
How long have you taken/been taking English lessons?	
Proficiency level of the English class you last attended/presently attend	

III. ENGLISH LANGUAGE PROFICIENCY

Have you ever taken any English Proficiency Test? If so,

Where did you take it? ______________________________________

When did you take it? ______________________________________

What was your score? ______________________________________

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

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

APPENDIX J

TURKISH TRANSPARENCY JUDGMENT TEST AND SCORES

			5: Çok İlgili 4: İlgili 3: Orta 2: Az İlgili 1: İlgisi Yok		5: Çok İlgili 4: İlgili 3: Orta 2: Az İlgili 1: İlgisi Yok
	Bileşik Sözcük	**Sözcük 1**	**Anlama Katkısı**	**Sözcük 2**	**Anlama Katkısı**
1	ağabey	ağa	3.12	bey	3.05
2	alabalık	ala	2.50	balık	4.52
3	altyapı	alt	4.23	yapı	4.19
4	altınbaş	altın	2.45	baş	2.25
5	altıntop	altın	2.45	top	2.35
6	anaokulu	ana	3.70	okul	4.53
7	anapara	ana	3.71	para	4.34
8	arapsaçı	arap	2.07	saç	2.73
9	astsubay	ast	3.75	subay	4.37
10	aşçıbaşı	aşçı	4.67	baş	4.26
11	atabey	ata	3.48	bey	3.57
12	atasözü	ata	4.44	söz	4.55
13	ayakkabı	ayak	4.69	kap	4.19
14	ayaktakımı	ayak	2.75	takım	3.21
15	ayakucu	ayak	4.35	uç	4.30
16	babaanne	baba	4.51	anne	4.55
17	babayiğit	baba	2.78	yiğit	3.67
18	başkent	baş	4.40	kent	4.40
19	başörtü	baş	4.60	örtü	4.51
20	başparmak	baş	4.35	parmak	4.63
21	başrol	baş	4.31	rol	4.64
22	başsağlığı	baş	2.87	sağlık	3.70
23	başucu	baş	4.03	uç	3.80
24	başüstü	baş	3.75	üst	3.44
25	baykuş	bay	1.62	kuş	4.02
26	beyefendi	bey	3.78	efendi	3.82
27	bilinçaltı	bilinç	4.49	alt	3.78
28	binbaşı	bin	3.44	baş	3.41
29	birahane	bira	4.50	hane	4.20
30	bozayı	boz	3.53	ayı	4.52
31	bozkurt	boz	3.41	kurt	4.46
32	bölükbaşı	bölük	3.95	baş	3.79

33	buzdolabı	buz	4.05	dolap	4.35
34	bülbülyuvası	bülbül	3.21	yuva	3.29
35	büyükanne	büyük	4.38	anne	4.46
36	büyükbaba	büyük	4.36	baba	4.54
37	büyükbaş	büyük	3.66	baş	3.20
38	büyükelçi	büyük	3.15	elçi	4.17
39	büyükşehir	büyük	4.30	şehir	4.34
40	camgöbeği	cam	2.04	göbek	1.88
41	camgöz	cam	2.27	göz	2.51
42	canevi	can	2.91	ev	2.61
43	cephane	cep	2.24	hane	2.91
44	cezaevi	ceza	4.50	ev	4.09
45	çayhane	çay	4.45	hane	4.24
46	çerkeztavuğu	çerkez	3.31	tavuk	4.10
47	dağbaşı	dağ	4.23	baş	3.56
48	darağacı	dar	1.99	ağaç	2.84
49	demirbaş	demir	2.13	baş	2.51
50	denizaltı	deniz	4.40	alt	4.12
51	denizkızı	deniz	4.33	kız	3.95
52	derebeylik	dere	2.33	beylik	3.35
53	dereotu	dere	2.42	ot	3.67
54	dershane	ders	4.58	hane	4.21
55	devetabanı	deve	2.27	taban	2.15
56	dikdörtgen	dik	4.08	dörtgen	4.30
57	dişbudak	diş	2.24	budak	2.07
58	dizüstü	diz	3.95	üst	3.94
59	doğumevi	doğum	4.50	ev	4.30
60	düztaban	düz	4.03	taban	4.00
61	fildişi	fil	3.36	diş	3.36
62	fotosentez	foto	3.10	sentez	3.87
63	genelkurmay	genel	3.73	kurmay	4.00
64	gensoru	gen	2.16	soru	3.16
65	gerçeküstü	gerçek	3.55	üst	3.07
66	gökkuşağı	gök	4.22	kuşak	3.55
67	gökyüzü	gök	4.41	yüz	3.05
68	gözaltı	göz	4.05	alt	3.73
69	gözdağı	göz	2.76	dağ	2.21
70	gözlemevi	gözlem	4.44	ev	4.07
71	gözyaşı	göz	4.56	yaş	4.47
72	güneybatı	güney	4.49	batı	4.48
73	güneydoğu	güney	4.51	doğu	4.40
74	güvenoyu	güven	3.94	oy	4.05

75	hahambaşı	haham	3.49	baş	3.34
76	halkevi	halk	4.17	ev	4.06
77	hanımefendi	hanım	4.30	efendi	3.23
78	hanımeli	hanım	2.53	el	2.23
79	hapishane	hapis	4.36	hane	4.30
80	harmandalı	harman	2.54	dal	2.27
81	hastahane	hasta	4.57	hane	4.36
82	havaalanı	hava	4.00	alan	4.14
83	havalimanı	hava	4.10	liman	3.58
84	heykeltıraş	heykel	4.26	tıraş	3.56
85	hücumbot	hücum	3.59	bot	3.18
86	ilkbahar	ilk	4.00	bahar	4.38
87	ilkokul	ilk	4.24	okul	4.48
88	ilköğrenim	ilk	4.36	öğrenim	4.40
89	ilköğretim	ilk	4.22	öğretim	4.48
90	imalathane	imalat	4.51	hane	4.31
91	insanoğlu	insan	4.38	oğul	3.60
92	kabadayı	kaba	3.67	dayı	2.64
93	kafatası	kafa	4.19	tas	3.09
94	kahvehane	kahve	4.37	hane	4.16
95	kahverengi	kahve	4.29	renk	4.47
96	kalemtıraş	kalem	4.47	tıraş	3.99
97	kamuoyu	kamu	4.27	oy	4.10
98	kapıkule	kapı	2.79	kule	2.91
99	karabacak	kara	2.69	bacak	2.72
100	karabaş	kara	2.90	baş	2.56
101	karabiber	kara	4.05	biber	4.02
102	karaciğer	kara	3.85	ciğer	4.28
103	karakaş	kara	4.02	kaş	4.05
104	karakol	kara	1.91	kol	1.78
105	karasinek	kara	4.29	sinek	4.45
106	karekök	kare	3.15	kök	2.94
107	kartopu	kar	4.36	top	4.16
108	katsayı	kat	3.43	sayı	4.03
109	kavuniçi	kavun	3.58	iç	3.49
110	kayıkhane	kayık	4.16	hane	4.05
111	kayınvalide	kayın	3.12	valide	4.10
112	kazasker	kaz	2.07	asker	3.99
113	kervansaray	kervan	3.92	saray	3.12
114	kızılağaç	kızıl	2.99	ağaç	3.50
115	kocabaş	koca	3.00	baş	3.11
116	kocakarı	koca	2.93	karı	3.49

117	konukevi	konuk	4.25	ev	4.25
118	koramiral	kor	2.50	amiral	3.86
119	korgeneral	kor	2.37	general	3.88
120	köroğlu	kör	2.69	oğul	3.20
121	köşebaşı	köşe	4.07	baş	3.61
122	kumarhane	kumar	4.35	hane	4.15
123	kuşburnu	kuş	2.00	burun	1.93
124	kuzeybatı	kuzey	4.28	batı	4.31
125	kuzeydoğu	kuzey	4.36	doğu	4.42
126	küçükbaş	küçük	3.82	baş	3.22
127	marangozhane	marangoz	4.26	hane	4.19
128	meyhane	mey	3.73	hane	4.12
129	mikrodalga	mikro	3.53	dalga	3.40
130	miralay	mir	2.48	alay	2.84
131	ocakbaşı	ocak	3.78	baş	3.56
132	ortaokul	orta	4.07	okul	4.42
133	ortaöğretim	orta	3.99	öğretim	4.41
134	sağduyu	sağ	2.19	duyu	3.01
135	sarıbalık	sarı	3.03	balık	3.77
136	semizotu	semiz	2.44	ot	4.16
137	sığırkuyruğu	sığır	2.69	kuyruk	2.84
138	sıkıyönetim	sıkı	3.92	yönetim	4.17
139	sivrisinek	sivri	2.96	sinek	4.22
140	sonbahar	son	4.02	bahar	4.34
141	soyadı	soy	4.51	ad	4.48
142	suçüstü	suç	4.28	üst	3.37
143	şaheser	şah	3.22	eser	4.26
144	şaraphane	şarap	4.34	hane	4.21
145	şekerpare	şeker	3.81	pare	2.39
146	tımarhane	tımar	2.96	hane	3.90
147	tozpembe	toz	2.51	pembe	3.77
148	tümgeneral	tüm	3.12	general	4.13
149	vezirparmağı	vezir	2.01	parmak	2.04
150	vişneçürüğü	vişne	3.59	çürük	3.16
151	yarımada	yarım	3.86	ada	4.44
152	yarıyıl	yarı	4.18	yıl	4.28
153	yatakhane	yatak	4.55	hane	4.23
154	yayınevi	yayın	4.53	ev	4.28
155	yemekhane	yemek	4.61	hane	4.40
156	yeniçeri	yeni	2.45	çeri	2.60
157	yerküre	yer	3.73	küre	3.53
158	yeryüzü	yer	3.94	yüz	3.44

159	yılbaşı	yıl	4.42	baş	4.07
160	yüksekokul	yüksek	3.98	okul	4.32
161	yükseköğrenim	yüksek	3.91	öğrenim	4.28
162	yükseköğretim	yüksek	3.92	öğretim	4.34
163	yüzbaşı	yüz	3.38	baş	3.55
164	yüzyıl	yüz	4.35	yıl	4.47

APPENDIX K

PRIMES-TARGET COMPOUNDS IN TURKISH TEST

PARTIALLY OPAQUE COMPOUNDS			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Compound**
sivri	sinek	hafta	SİVRİSİNEK
bay	kuş	dua	BAYKUŞ
kayın	valide	çevre	KAYINVALİDE
tımar	hane	yalı	TIMARHANE
şah	eser	vade	ŞAHESER
büyük	elçi	çivi	BÜYÜKELÇİ
şeker	pare	çamur	ŞEKERPARE
hanım	efendi	minder	HANIMEFENDİ
küçük	baş	vali	KÜÇÜKBAŞ
kervan	saray	tırnak	KERVANSARAY
TRANSPARENT-TRANSPARENT COMPOUNDS			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Compound**
güney	batı	iklim	GÜNEYBATI
alt	yapı	tül	ALTYAPI
kuzey	doğu	makas	KUZEYDOĞU
yüksek	okul	sofra	YÜKSEKOKUL
son	bahar	tapu	SONBAHAR
baba	anne	iğne	BABAANNE
kalem	tıraş	görev	KALEMTIRAŞ
düz	taban	leke	DÜZTABAN
kara	ciğer	soba	KARACİĞER
yarım	ada	müze	YARIMADA

APPENDIX L

PRIMES-TARGET PSEUDOCOMPOUNDS IN TURKISH TEST

Prime (Constituent 1)	Prime (Constituent 2)	Unrelated Prime	Target Pseudocompound
fes	leğen	boğa	FESLEĞEN
kan	dil	ova	KANDİL
kur	abiye	ağaç	KURABİYE
kar	ton	bez	KARTON
limon	ata	konu	LİMONATA
gün	dem	bel	GÜNDEM
sihir	baz	yöre	SİHİRBAZ
belge	sel	küme	BELGESEL
kart	postal	vapur	KARTPOSTAL
kaba	hat	dere	KABAHAT

APPENDIX M

PRIMES-TARGET MONOMORPHEMIC ITEMS IN TURKISH TEST

Prime (Constituent 1)	Prime (Constituent 2)	Unrelated Prime	Target Monomorphemic
lez	zet	çöp	LEZZET
sad	razam	esir	SADRAZAM
muhal	lebi	bilek	MUHALLEBİ
kert	enkele	çocuk	KERTENKELE
müc	evher	kule	MÜCEVHER
salın	cak	aile	SALINCAK
por	takal	uğur	PORTAKAL
mayd	anoz	ilaç	MAYDANOZ
kırta	siye	kitap	KIRTASİYE
kil	ise	çağ	KİLİSE
kalor	ifer	özür	KALORİFER
lav	abo	but	LAVABO
şarkü	teri	havuz	ŞARKÜTERİ
tentür	diyot	tarla	TENTÜRDİYOT
bakli	yat	maaş	BAKLİYAT
int	ikam	oya	İNTİKAM
kırl	angıç	eşek	KIRLANGIÇ
helik	opter	balık	HELİKOPTER
dir	sek	fal	DİRSEK
torn	avida	maşa	TORNAVİDA
barb	unya	saat	BARBUNYA
münas	ebet	emir	MÜNASEBET
müna	kaşa	büst	MÜNAKAŞA
pask	alya	vadi	PASKALYA
zen	cefil	deri	ZENCEFİL
muka	yese	kasa	MUKAYESE
hıris	tiyan	kumaş	HIRİSTİYAN
yor	gan	his	YORGAN
pan	suman	arsa	PANSUMAN
böğürt	len	darbe	BÖĞÜRTLEN
manda	lina	avuç	MANDALİNA
lah	macun	file	LAHMACUN
pişman	iye	kömür	PİŞMANİYE
bombar	dıman	çömlek	BOMBARDIMAN
pat	ates	ülke	PATATES
eşof	man	kıl	EŞOFMAN
maran	goz	depo	MARANGOZ
isti	rahat	kaşık	İSTİRAHAT
eldi	ven	büyü	ELDİVEN
sar	ımsak	ocak	SARIMSAK
mıkna	tıs	usul	MIKNATIS
şef	tali	din	ŞEFTALİ
ceh	ennem	kuyu	CEHENNEM

batta	niye	harf	BATTANİYE
iskam	bil	puan	İSKAMBİL
kons	olos	rica	KONSOLOS
ant	renman	şüphe	ANTRENMAN
bahçı	van	şans	BAHÇIVAN
kaplum	bağa	dünya	KAPLUMBAĞA
yıl	dız	cep	YILDIZ
sak	lambaç	ulus	SAKLAMBAÇ
istik	amet	arzu	İSTİKAMET
bal	ina	diş	BALİNA
cet	vel	acı	CETVEL
veter	iner	hayat	VETERİNER
direk	siyon	kablo	DİREKSİYON
gar	dırop	boya	GARDIROP
kad	ayıf	izin	KADAYIF
salta	nat	uçak	SALTANAT
kont	enjan	kira	KONTENJAN

APPENDIX N

PRIMES-TARGET NONWORD COMPOUND ITEMS IN TURKISH TEST

NONWORD-NONWORD			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Nonword Compound**
kam	döz	düş	KAMDÖZ
olak	vaşı	felç	OLAKVAŞI
baf	zol	çil	BAFZOL
ipa	yaf	köy	İPAYAF
hözlem	ebi	fırça	HÖZLEMEBİ
hasman	dazı	göbek	HASMANDAZI
fatsi	hetre	engel	FATSİHETRE
foz	lurt	dut	FOZLURT
NONWORD-WORD			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Nonword Compound**
fazı	masa	çene	FAZIMASA
bızak	ateş	nehir	BIZAKATEŞ
fağ	çilek	alçı	FAĞÇİLEK
hafış	ders	burs	HAFIŞDERS
vigit	altın	kavga	VİGİTALTIN
çalza	çay	halk	ÇALZAÇAY
biğ	yasa	mayo	BİĞYASA
WORD-NONWORD			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Nonword Compound**
meydan	laze	yüzük	MEYDANLAZE
çavuş	zartak	kuvvet	ÇAVUŞZARTAK
göz	faç	don	GÖZFAÇ
akşam	tüzhar	karar	AKŞAMTÜZHAR
yemek	hıl	bina	YEMEKHIL
kahve	zolu	cilt	KAHVEZOLU
fındık	kuvay	kaynak	FINDIKKUVAY
WORD-WORD			
Prime (Constituent 1)	**Prime (Constituent 2)**	**Unrelated Prime**	**Target Nonword Compound**
arı	ceza	diz	ARICEZA
kayık	kedi	köpük	KAYIKKEDİ
şarap	köşk	düğün	ŞARAPKÖŞK
suç	vişne	araç	SUÇVİŞNE
kumar	dalga	güneş	KUMARDALGA
ayak	köşe	keçe	AYAKKÖŞE
para	burun	bere	PARABURUN

cam	deniz	kare	CAMDENİZ

APPENDIX O

PRIMES-TARGET NONWORD MONOMORPHEMIC ITEMS IN TURKISH TEST

Prime (Constituent 1)	Prime (Constituent 2)	Unrelated Prime	Target Nonword Monomorphemic
udren	ajin	ödev	UDRENAJİN
zay	çum	tuz	ZAYÇUM
eha	nez	örf	EHANEZ
omor	tasmin	damar	OMORTASMİN
afa	semi	haç	AFASEMİ
çeka	zinma	ayna	ÇEKAZİNMA
may	makak	saha	MAYMAKAK
zal	ike	köz	ZALİKE
zibe	yire	vinç	ZİBEYİRE
zermi	cek	sene	ZERMİCEK
rakik	azür	melek	RAKİKAZÜR
hiter	arfi	nane	HİTERARFİ
dap	tomat	semt	DAPTOMAT
nek	çisyev	kadeh	NEKÇİSYEV
zarni	gon	harç	ZARNİGON
zuc	ime	soy	ZUCİME
züv	erhin	hala	ZÜVERHİN
enpik	lofedi	mantar	ENPİKLOFEDİ
seak	rizon	fayda	SEAKRİZON
zanti	lafır	levha	ZANTİLAFÖR
zepo	dito	elma	ZEPODİTO
çihvan	dor	dost	ÇİHVANDOR
izra	kiye	şart	İZRAKİYE
inah	taz	göç	İNAHTAZ
muzal	eğet	paça	MUZALEĞET
tuv	vek	tüy	TUVVEK
ühüm	mizet	örnek	ÜHÜMMİZET
tanfis	çanya	mektup	TANFİSÇANYA
jom	pokto	umut	JOMPOKTO
rın	gıçak	büfe	RINGIÇAK
ran	ziyö	çark	RANZİYÖ
ezfer	fiz	yurt	EZFERFİZ
von	serke	kuzu	VONSERKE
ezeb	itay	sırt	EZEBİTAY
mand	ajma	halı	MANDAJMA
zomat	irma	borç	ZOMATİRMA
vır	dazat	tasa	VIRDAZAT
ülter	zatif	duman	ÜLTERZATİF
goma	les	kum	GOMALES
ürifme	tij	pamuk	ÜRİFMETİJ
vütem	elki	tane	VÜTEMELKİ
azek	iyat	turp	AZEKİYAT
tal	çangov	karo	TALÇANGOV

zemo	krati	pike	ZEMOKRATİ
çokom	ozif	tütün	ÇOKOMOZİF
züger	hag	gemi	ZÜGERHAG
çerdi	jen	dizi	ÇERDİJEN
zuv	alçız	renk	ZUVALÇIZ
zıl	dırbın	kalp	ZILDIRBIN
mar	naf	üye	MARNAF
jamdo	min	taht	JAMDOMİN
vap	şis	hız	VAPŞİS
liç	ignir	dert	LİÇİGNİR
gos	şes	nal	GOSŞES
vepzem	rede	pilav	VEPZEMREDE
dez	elke	cins	DEZELKE
fimen	şider	serçe	FİMENŞİDER
ekrar	seş	kutu	EKRARSEŞ
fez	eten	üzüm	FEZETEN
büsok	rari	mezar	BÜSOKRARİ

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THE PROCESSING OF COMPOUNDS IN ADULT SECOND LANGUAGE LEARNERS OF ENGLISH AND TURKISH

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ARTSÜREM