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THE SECOND LANGUAGE PROCESSING OF NOMINAL COMPOUNDS: A MASKED PRIMING STUDY

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ABSTRACT

THE SECOND LANGUAGE PROCESSING OF NOMINAL COMPOUNDS:

A MASKED PRIMING STUDY

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The primary purpose of the present study was to understand the workings of the cognitive mechanisms underlying L2 morphological processing, and more particularly, to explore how noun-noun compounds in L2 English are processed by native speakers of Turkish in the earliest stages of word recognition. Furthermore, the study investigated the role of constituent morphemes in the processing of compound words and examined whether or not a compound word primes its first and second constituents equally. The final purpose was to examine whether L2 proficiency is a critical factor affecting the mechanisms used when processing morphologically complex words.

Four masked priming experiments were conducted to investigate compound processing in L2 English. Experiments 1a and 1b examined first constituent priming using the compound word as a prime and its first constituent as target (e.g., *bedroom – BED*) in both low proficiency and high proficiency learners of L2 English. Experiments 2a and 2b, on the other hand, examined second constituent priming (e.g., *bedroom – ROOM*) with low and high proficiency learners of L2 English, respectively.

The findings indicated that automatic morphological decomposition occurs at the earliest stages of visual word recognition, irrespective of semantic information and orthographic overlap and in the recognition of English noun-noun compounds by L2 learners, the lexical representations of the first constituent plays a significant role. Additionally, both high proficiency and low proficiency L2 learners employ similar processing mechanisms; however, less proficient L2 learners rely more on the declarative memory system during the processing of compound words in English.

Keywords: L2 morphological processing, compound words, masked priming, psycholinguistics

ÖZ

İKİNCİ DİLDE BİRLEŞİK ADLARIN İŞLEMLENMESİ: BİR MASKELENMİŞ HAZIRLAMA ÇALIŞMASI

Çelikkol Berk, Nurten

Yüksek Lisans, İngiliz Dili Öğretimi

Tez Yöneticisi: Doç. Dr. Bilal Kırkıcı

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Bu çalışmanın temel amacı ikinci dilde biçimbilimsel işlemleme sürecinin altında yatan bilişsel mekanizmaların çalışma prensipleri hakkında bilgi edinmek ve ikinci dil (D2) İngilizcede iki isimden oluşan birleşik sözcüklerin ana dili (D1) Türkçe olan kişilerce sözcük tanıma sürecinin erken aşamalarında nasıl işlemlendiğini ortaya çıkarmaktır. Buna ek olarak, birleşik sözcüklere erişim ve bu sözcüklerin zihinde temsil edilme şekillerinde bir birleşik sözcüğün birinci ve ikinci bileşeninin eşit bir rolü olup olmadığını keşfetmek amaçlanmıştır. Son olarak ikinci dildeki beceri düzeyinin biçimbilimsel açıdan karmaşık yapıların işlemlenmesindeki yeri ve önemi araştırılmıştır.

İkinci dilde birleşik sözcüklerin işlemlenme süreçlerini incelemek üzere dört adet maskelenmiş hazırlama deneyi uygulanmıştır. Deney 1a ve 1b'de birleşik sözcükler hazırlama sözcüğü olarak, birinci bileşenleri de hedef sözcük olarak kullanılmıştır (Örn: *bedroom* "yatak odası" – *BED* "yatak"). Deney 1a'nın katılımcılarını D2 İngilizce düzeyleri düşük olan, 1b'nin katılımcılarını ise D2 İngilizce düzeyi yüksek olan konuşucular oluşturmuştur. Öte yandan Deney 2a ve 2b birleşik sözcüklerin ikinci bileşenlerini hazırlamasını test etmiş olup, yine benzer şekilde D2 İngilizce düzeyleri düşük ve yüksek olan katılımcılara uygulanmıştır (Örn: *bedroom* “yatak odası” – *ROOM* “oda”).

Deneylerden elde edilen bulgular, erken sözcük tanıma süreçlerinde birleşik adların anadili Türkçe ve ikinci dili İngilizce olan konuşucular tarafından bileşenlerine ayrılarak işlemlendiğini, bu sürecin sözcüklerin ortografik özelliklerinden ve bileşenleri ile birleşik sözcük arasındaki anlam ilşkisinden bağımsız olduğunu göstermektedir. Ayrıca, birleşik sözcüklerin ilk bileşenlerinin sözcük tanıma sürecinde önemli bir rol oynadığı gözlemlenmiştir. Öte yandan, farklı düzeylerdeki konuşucuların birleşik isimlerin işlemlenmesi esnasında benzer bilişsel mekanizmalar kullandıkları belirlenmiş, ancak beceri düzeyi düşük olan konuşucularda bu sürecin bildirimsel belleğe daha çok dayandığı gözlemlenmiştir.

Anahtar Sözcükler: ikinci dilde biçimbilimsel işlemleme, birleşik sözcükler, maskelenmiş hazırlama, ruhdilbilim

To My Family

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LIST OF ABBREVIATIONS

AAM	The Augmented Addressed Morphology
AoA	Age of onset of acquisition
ANOVA	Analysis of variance
ERP	Event-related potentials
fMRI	Functional magnetic resonance imaging
L1	Native language
L2	Second language
M	Morphology
MRM	The Morphological Race Model
MS	Millisecond
N	Noun
NN	Noun-Noun
O	Orthographic
OPT	Oxford Placement Test
RT	Reaction time
S	Semantics
SD	Standard Deviation
SOA	The stimulus onset asynchrony

CHAPTER 1

INTRODUCTION

This chapter is made up of four sections. The first section introduces the theoretical background of the study. It focuses on the major theories of native (L1) and L2 (non-native) language processing. The second section discusses the aim and significance of the study. The third section outlines morphologically complex word forms and compounding phenomena that will be of specific motive to the present study. The final section of this chapter presents the research questions of the study and formulates the predictions characterized by the findings of earlier research.

1.1 Background to the Study

> When we study human language, we are approaching what some might call the "human essence," the distinctive qualities of mind that are, so far as we know, unique to man.
> Noam Chomsky, Language and Mind, 2006, p. 88

Language is the outset of humanity and so are words. Barely a moment in our lives goes by free from words. The use of language, even when compared to all the other miraculous abilities, is still the most distinguishable attribute unique to us humans. Attempts to understand the sophistication of the human brain, as well as the nature of human language, remain a burning issue. In spite of the ambition to settle the questions of how language is acquired, processed and stored in the brain, there is still much about the human mind that is unknown. As the cognitive mechanisms involved in the language processing system are not observable, a vast quantity of research on word recognition and lexical access has been conducted through various experimental techniques in order to shed some light on the organization of the mental lexicon. The mental lexicon, which is often referred to as the "backbone of human language processing" (Libben & Jarema, 2006, p.vi), "the cognitive system that constitutes the capacity for conscious and unconscious lexical activity" (Jarema & Libben, 2007, p.3) or as "the dictionary represented in the mind, which is used to comprehend and produce the language" (Shabani-Jadidi, 2015, p.137), is critical due to its potential to reveal the nature of the human capacity to create, store and activate both simple and complex representations.

The processing of morphologically complex words has long been the subject matter of psycholinguistic research as it not only gives way to understand the structure of the mental lexicon, but also offers a worthy resource to explore how words are stored in the mental lexicon and retrieved when needed. There is a long-standing debate whether the morpheme is the basic unit in lexical processing; i.e., whether morphologically complex words are decomposed into their constituent morphemes or processed as full forms. Taft and Forster (1975) initially proposed the *full decomposition hypothesis* which suggests that multimorphemic words are represented in the mental lexicon by their stems and affixes and they are decomposed during lexical access. This approach was later challenged by the view that no independent role of morphology exists in the mental lexicon. Butterworth (1983) proposed the *full listing hypothesis* suggesting no morphological decomposition is performed during lexical access; instead, all words, no matter if complex or monomorphemic, are stored and processed as whole words.

A more recent discussion has yielded different theories of complex word processing, which focus on whether a single mechanism or a series of mechanisms are employed during the processing of morphologically complex words. Single mechanism associative accounts (Rumelhart & McClelland, 1993) postulate that both simple and complex words are stored as full forms in the mental lexicon, whereas in single mechanism rule based accounts formal rules are applied to decompose words into their morphological constituents (Ling & Marinov, 1993). Finally, dual-route models propose that both whole-word and decompositional routes are available in morphological processing (Pinker, 1999).

Ullman (2005) proposes that word recognition relies on two separate memory subsystems, which are the declarative memory system and procedural memory system. The declarative memory is associated with the mechanism to store and retrieve whole word representations, whereas the procedural memory is employed to recognize and use grammatical rules. The declarative/procedural model also makes some specific predictions about nonnative processing, suggesting while native speakers make use of both the declarative and the procedural memory, L2 learners rely more on the declarative system. However, it is possible that highly proficient- native-like - L2 learners make more use of procedural memory, as well. Another view intending to understand L2 processing is called the ‘shared systems’ view (e.g. Perani, Paulesu, Galles, Dupoux, Dehaene, Bettinardi, Cappa, Fazio, & Mehler, 1998; Tatsuno & Sakai, 2005). This approach proposes that processing in an L2 follows a similar pattern with processing in an L1. However, processing in an L2 is less automatic and liable to transfer effects from the speaker’s native language.

1.2 Purpose and Significance of the Study

A substantial body of evidence has revealed that morphological structure plays a crucial role in the processing of morphologically complex words; however, the majority of the research in the field has focused on derivation and inflection, and the studies have primarily addressed monolingual speakers. Thus, the main purpose of the present study is to understand the workings of cognitive mechanisms underlying L2 morphological processing, and more particularly, to examine how noun-noun compounds in English are processed by native speakers of Turkish in the earliest stages of word recognition.

This study seeks to probe for the presence of morphological structure in the non-native lexicon and aims to find out whether semantic information and orthography play a role in the recognition of compound words by manipulating the morphological, orthographic and semantic relationships between prime-target pairs in a series of masked priming experiments. With the inclusion of “pseudocompounds” (monomorphemic words that contain a lexical unit as either their first or the second constituent, (i.e., *RESTaurant* or *beverAGE*) the study aims to test whether a possible priming effect is orthographic, but not morphological in nature. In addition, growing body of evidence supports the idea that semantic transparency plays an important role in the processing of compound words (Libben, 2006; Libben, Gibson, Yoon, & Sandra, 2003; Liu & Peng 1997; Peng, Lui, &

Wang, 1999; Zwitserlood, 1994), in that semantically transparent words are more likely to produce constituent activation as they are represented in the mental lexicon by their constituent morphemes and as whole words. However, there is also evidence that supports there is no fundamental difference between semantically transparent and opaque compounds (Fiorentino & Fund-Reznicek, 2009; Ji, Gagné, & Spalding, 2011; Shoolman & Andrews, 2003) as both conditions produced facilitative priming effects. Considering the discrepancy between these two views, the findings of the present study are important in that they may contribute to the literature by sorting out what information is used to segment compounds into their constituent morphemes and, in particular, whether morphological information plays a key role which is independent of the semantic and orthographic factors.

Another concern of this study is to investigate whether the position of the compound constituent plays a role in compound processing by testing if a noun-noun compound word primes its two constituents equally. If it does not, then the aim is to discover whether the initial or the final constituent produces a facilitative priming effect in nonnative compound word recognition, and thus attempts to disentangle the role of headedness in compound word processing.

Finally, what differences do or do not occur between L1 and L2 morphological processing and whether the potential differences might be related to the language proficiency of non-native speakers has always been a matter of curiosity. In this respect, the present study aims to clarify whether L2 learners' proficiency is a critical factor which affects the mechanisms they employ when processing morphologically complex words. Thus, the present study further contributes to the literature by examining potential similarities and/or differences between two different proficiency groups, and even more, offers an opportunity to figure out in what ways their structure of lexicon is similar to and/or different from the concepts in native speakers' mental lexicon.

1.3 Morphological Focus

The role of morphological complexity in the processing and representation of inflectionally and derivationally affixed words and compound words is a matter of debate with different claims on the nature of storage and computational processes. The basis of this study is the compounding phenomenon as compounds offer a venue for an in-depth analysis of the fundamental issues of language processing. In this study, the central issue of concern is how L1 Turkish speakers of L2 English process noun-noun compounds in English. Experiments 1a and 1b investigate whether noun-noun compound words prime their first constituents, and explore the processing of *transparent* compounds (e.g. *bedroom – BED*) and *opaque* compounds (e.g. *honeymoon – HONEY*), as well as *pseudocompound control* words (e.g. *restaurant – REST*) in order to seek further evidence about the locus of potential priming effects. On the other hand, Experiments 2a and 2b focus on whether noun-noun compounds prime their second constituents, again examining transparent compounds (e.g. *bedroom – ROOM*), opaque compounds (e.g. *honeymoon – MOON*) with matched pseudocompound controls (e.g. *candidate – DATE*). In order to avoid a possible contamination that may result from the participants' conscious awareness of the prime and/or of the relation between the prime and target that affect the plausibility of interpretations, Forster and Davis' (1984) masked priming paradigm was used in this study. In masked priming tasks, the likelihood of strategic effects are minimized through a very short display duration (e.g., 50) for the prime and the use a mask (e.g., a set of hash marks '#######') before the prime. When the prime is presented for a very short duration, and sandwiched between the mask and the target, the presence of the prime cannot usually be noticed or identified by the participants, and thus the observed priming effects through this procedure are more likely to represent automatic processing.

In the present study compound words were selected as the subject of research rather than affixed words since compounds provide a clearer and more direct ground to test the contribution of constituents to whole-word identification. In addition, compared to the other morphologically complex word forms (i.e. derived, inflected), compounding addresses the issue of morphological processing in the best way because it is claimed to be the most universal process of composing complex words across all languages (Dressler, 2006). In addition, while inflected and derived words often include a relatively limited set of bound morphemes as an affix, the position of which is mostly predictable (e.g. the suffix –ed is always found at the end of an inflected word), compound words are composed of combinations of a wide range of grammatical forms and dimensions that can easily be manipulated to gain insights into the broader properties of the lexical retrieval process for multimorphemic words (Shoolman & Andrews, 2003). Therefore, eliminating the predictability factor of the constituent position (e.g., the morpheme *bed* is the first constituent in *bedroom*, but it is the second constituent in *seabed*), compounds allows for a better testing of morphologically complex words. What's more, the testing of compounds makes it possible to separate the effects of lexical, semantic and orthographic structures. As suggested by Shoolman et al. (2003, p. 136),

> the comparison of compound words with semantically transparent and opaque relationships between constituent and whole word meanings (e.g., *raindrop* versus *nightmare*) to words with a pseudocompound structure consisting of lexical or nonlexical constituents (e.g., *carpet* versus *pregnant*) provides a means of disentangling the effects of morphological structure per se from those owing to semantic associations and to lexical constituents.

Finally, noun-noun combinations were selected as the focus of current study as this is defined as the most productive compounding procedure (Libben, 2006) and ideal test-bed to compare alternative hypotheses.

1.4 General Research Questions

This study attempted to answer the following research questions:

1. Are compound words decomposed into constituent morphemes or processed as full-forms during the early stages of visual word recognition in L1 Turkish learners of L2 English?

2. Is L2 compound processing and recognition mediated by semantic transparency and/or orthographic overlap?

3. Do the observed processing patterns differ depending on whether the experimental targets are first or second constituents within noun-noun compounds?

4. Does the L2 processing of compound words differ as a function of L2 language proficiency?

In an attempt to shed light on whether native speakers of Turkish decompose noun-noun compounds in their L2 English, the following predictions were made. If L2 English learners process compound words by decomposing them into their constituent morphemes, a priming effect is predicted to occur in the experimental condition compared to the unrelated condition, which suggests shorter RTs for the target words in the related condition. Such a finding would lend support to the sublexical morpho-orthographic decomposition model of complex word processing (Rastle, Davis, & New, 2004; Taft & Forster, 1976; Taft, 1994). On the other hand, if no facilitative priming effect is obtained, it could be concluded that Turkish native speakers do not decompose compound words in L2 English into their components; instead, they store and retrieve noun-noun compounds (and possibly also other morphologically complex words) as full forms in their mental lexicon, which would be a result supportive of Single Mechanism Accounts.

In the light of the findings of previous studies on compound processing, it is expected that facilitative priming effects in both transparent and opaque conditions will be observed as both transparent (e.g., *bedroom*) and opaque (e.g., *deadline*) compounds can be decomposed into their constituents. However, the degree of priming is not predicted to be equivalent in transparent and opaque conditions. In transparent compounds, the priming effect is expected to be the result of morphological, semantic and orthographic overlap between the prime and target pairs; however, the lack of semantic overlap in the opaque prime and target pairs will lead to a smaller priming effect in the opaque condition. This finding would be in parallel with the Hybrid Account (Diependaele, Sandra & Grainger, 2005; 2009) which proposes that both sublexical morpho-orthographic and supralexical morpho-semantic processing function in a parallel way during early stages of visual word recognition, and this pattern of masked priming is potentially taken as evidence against an early stage of blind decomposition which is independent of semantic transparency. Moreover, in the orthographic overlap condition involving pseudocompounds (e.g. *hammock-ham*), negative (inhibited) priming or null priming effects are expected because the lexical representation of a pseudomorpheme (e.g.

ham in *hammock*) is not likely to be accessed if morphological decomposition occurs automatically or semantic factors are involved (Fiorentino & Fund-Reznicek, 2009).

In relation to the third question, it is predicted that both first and second constituents of transparent compounds will produce facilitative priming effects in processing as parallel with Sandra (1990) and Zwitserlood's (1994) findings. However, as opposed to Sanda (1990), who reports larger facilitation for the word initial constituent, it is expected that the word-initial position will yield smaller priming effects because in English, the second constituent, which functions as the semantic head, determines the meaning and the word category and thereby influences the processing of the compound words. Besides, no priming for the opaque and pseudocompound conditions are expected. If priming effects are obtained nevertheless in these conditions, this could be attributed to form priming rather than semantics.

As for the final question, L1 Turkish speakers of L2 English are predicted to follow different routes of processing depending on their level of L2 proficiency. Different priming effects are expected for low and high proficiency L2 speakers as it has been stated that L2 proficiency has an impact on the links between L1 and L2, and the concepts in the mental lexicon (Kroll & Stewart, 1994). If the proficiency of L2 learners is higher, then they are more likely to develop a connection to the L2 concept system rather than relying on their L1. As postulated by Ullman (2005), the proficiency level of L2 speakers influences the L2 processing pattern. Thus, higher proficiency in L2 leads to the usage of the procedural memory (i.e. rule- based processing), rather than the declarative memory (i.e., listing). Accordingly, the high proficiency L2 speakers in the current study are expected to rely on procedural memory which will generate stronger priming effects compared to their low proficiency level counterparts. On the other hand, low proficiency group is expected to rely on the declarative memory, and instead of following the decomposition route, they are expected to have whole-word representations of the words in their mental lexicon.

CHAPTER 2

REVIEW OF LITERATURE

This chapter includes four major sections. The first section provides an overview of the compounding phenomenon. The second section presents L1 morphological processing models under two broad headings: Single Mechanism Models and the Dual Mechanism Models, which is followed by L2 morphological processing theories. In the third section, approaches on compound representation and processing are discussed. The final section presents a review of previous research studies on compound processing in L1 and L2.

2.1 Compounding

2.1.1 Introduction

Words constitute the most important part of the linguistic knowledge and they are the irreplaceable components of the mental grammar. Thousands of words are kept in memory; however, comprehending or producing a word is an automatic and effortless process, which is only possible with a well-organized and structured mental system, called “mental lexicon”. Acting as a reservoir of words, the mental lexicon is not likely to be arbitrary in structure; instead it has an internal system of organization which enables a particular word to be selected quickly and accurately (Silva, 2009). In order to have a clearer insight into the organization of the mental lexicon, studying the morphological structures of words and investigating how morphologically complex words are processed may have a leading role. Morhologically complex words which are of great interest by psycholinguists in English traditionally involve three categories; inflection, derivation and compounding. In inflection, the forms of the words change by means of inflectional morphemes indicating properties such as tense, number and so forth. Inflectional morphemes do usually not change the grammatical category or the basic meaning of the stems they are attached to (e.g., *book – books, wait – waited*). On the other hand, derivation offers a powerful tool to create a new word based on an existing root or stem. The derived words may belong to the same grammatical class with the original word, but they may also be of a different category (e.g., *happy –unhappy, happiness*). Among these three types of morphologically complex forms, compounds constitute the most suitable word forms to address the issue of morphological processing. The significance of compounding was highlighted by Greenberg (1963, as cited in Scalise & Vogel, 2010, p.1):

> There are probably no languages without either compounding, affixing, or both. In other words, there are probably no purely isolating languages. There are a considerable number of languages without inflection, perhaps none without compounding and derivation.

In many languages, compounding, which is also called *composition* (Booij, 2007), is the most frequently adopted form of creating new words. It is not easy to give a precise and specific definition of compounding as it is highly flexible in nature and can emerge in different structures across languages. Dressler (2006, p. 24) states that a compound can be loosely described as "a grammatical combination of words, that is of lexical items or lexemes, to form new words." Crystal (2001, p. 66) defines a compound as "a linguistic unit composed of two or more elements, each of which could function independently in other circumstances." Molhova (1976, p. 136) explains that "composition is that means of forming new words which causes two or more roots to be merged into one, whose meaning might be the sum total of the meanings of the components or it might be idiomatic." Bauer (2001, p. 695) defines a compound as "a lexical unit made up of two or more elements, each of which can function as a lexeme independent of the other(s) in other contexts, and which shows some phonological and/or grammatical isolation from normal syntactic usage." The definitions provided above are essentially similar and share certain features. In summary, compounds consist of the combination of at least two lexical units which can also function both grammatically and semantically as individual forms or lexemes independently of the compound itself.

2.1.2 The Distinction Between Compounds and Phrases

Booij (2007) emphasizes the fact that compounds and phrases look pretty similar as “compound patterns often derive historically from phrasal word combinations" (p. 82). Although it is sometimes challenging to make a plain distinction between compounds and free phrases, some particular properties might be addressed in identifying compounds and distinguishing them from free phrases.

One criterion is that compound words are inseparable. Even though each component of nominal phrases can be inflected by plural, not all the constituents of compounds are inflected. For example, *bottle* in *bottleneck* cannot be pluralized as *bottlesnecks* because the constituents of a compound cannot be inflected individually; rather, the whole compound itself must be inflected lexically as in *bottlenecks*. As another example, while it is possible to say *the blackest board* since it is a phrase, it is not possible to add a suffix to the first constituent of the compound *blackboard* (e.g., **blackestboard*). Another characteristic of compounds is that a compound is a single unit and its constituents cannot be modified separately (Ryder, 1994). The compound can be modified as a whole by other words, though. For example, it is not possible to say *a very blackbird*; however, we can say *very bad weather* since *bad weather* is a phrase, but *blackbird* is a compound. In the same way, as *high school* is a compound, it is only modified as *a big high school* instead of saying *a high big school*. However, this criterion is more likely to be applied to Adjective + Noun compounds because the first component has to be an adjective in order to be modified. Huddleson and Pullum (2002) further exemplified the case by using coordinate adjectives as modifiers, e.g., *new and used cars*, or trying to coordinate the heads e.g., *new cars and buses*, and as these are free phrases, both cases appear possible. However, it is obviously impossible with a compound such as *greenhouse* because it cannot be modified as free phrases can e.g., *white and green house.*

Spelling is also regarded as a possible criterion to differentiate compounds from phrases; however, in some cases because of the differences in the spelling of compounds, it may not act as an effective measure. While some compounds are spelled uniformly (*solid compounds*; e.g. *bedroom*, *deadline*, *motorcycle*, and *bookshop*), some are used with a hyphen (*hyphenated compounds*; e.g. *white-collar, fine-tune,* and *ice-cold*) and in some compounds there is simply a space between the components (*open compounds;* e.g. *fire alarm*, *pencil case*, and *chewing gum*) (Vogel, 2007). As there is no consensus regarding the spelling of compounds, there is not much consistency in the orthographic representation of compounds. For example, Bauer (1998) discusses the inconsistency in the spellings of *daisy wheel, daisy-wheel,* and *daisywheel*. However, it is stated that once a compound becomes lexicalized, it is more likely that the compound gains a solid spelling (Bauer, Lieber, & Plag, 2013). Similarly, according to Quirk and his colleagues, "the more established a compound is, the more likely it is that the compound is hyphenated or, as a fully established construction, written as a single orthographic unit" (Quirk, Greenbaum, Leech, & Svartvik, 1985, as cited in Schlechtweg, 2018, p. 86).

Stress is considered another useful criterion to distinguish compounds from phrases. As in the example of Booij (2012), *blackboard* is a compound, whereas *black board* is considered a phrase. If the stress falls on the first component as in /ˈblækˌbɔː(r)d/, then it means "a smooth, dark surface that is used for writing on with chalk in a classroom". Contrarily, if the stress falls on the final component as in /ˌblækˈbɔː(r)d/, then it refers to "a board which is painted black". Thus, it is concluded that the right-hand stress is a mark of phrases while the left-hand stress is a signal of compounds (Chomsky & Halle, 1968). However, there are also examples of double stress, which means both components of the compound are stressed as in *ice cream.* As stated by Bauer et al. (2013), why certain compounds show variation e.g., ice-cream, while others do not, e.g. ice-cap, remains a mystery.

In sum, it is not an easy task to state what a compound is and how to distinguish it from free phrases as no universal rule has been introduced yet. Obviously, it is possible to find well-established compounds in dictionaries, but still there are compounds which are not present in dictionaries even though they are frequently used in language. This is simply because compounding is a very productive tool used to produce new words every day.

2.1.3 Compound Words in English

In English, compound words may appear in all word classes although the majority of English compounds belong to nouns and adjectives. The following list presents examples of English compounds belonging to different word classes (Carter & McCarthy, 2006):

- nouns: *toothpaste, bus stop, greenhouse*;
- adjectives: *good-looking, homesick, open-minded;*
- verbs: *proofread, sky-dive, brainwash*;
- adverbs: *downstairs, nowadays, self-consciously*;
- pronouns: *someone, nobody, anybody;*
- numerals: *one fifth, sixty-eight, two-thirds*;
- prepositions: *into, upon, onto;*
- conjunctions: *even if, so that, whenever*;
- interjections: *jeepers creepers, super-duper, clever-clever*.

Compound words may consist of the combination of two constituents of the same word class (e.g. noun-noun "*toothpaste*", or verb-verb "*make-believe*"); however, the constituents do not have to share the same word class and may combine in different ways (e.g., noun-adjective "*sea-sick*", verb-noun "*pick-pocket*", adverb-adjective "*over-qualified*"). When both constituents of the compound are members of the same word class, then the resulting compound is expected to belong to the same word class, too. However, if the constituents are from different word classes, then the most important criterion to determine the compound word's class is the head constituent (the last element of the compound), which gives rise to large classes of nominal, adjectival and verbal compounds, based on whether the head constituent is a noun (e.g., *greenhouse*), an adjective (e.g., *homesick*) or a verb (e.g., *brainwash*). There are also cases where the compound class may be different from the word class of the head constituent, yet these are rare cases and do not yield productivity (Bauer, 1983). Among all the aforementioned types, nominal compounds are the most preferred types in the majority of languages, and noun-noun combinations make up the largest and most productive subclass (Dressler, 2006).

2.1.4 Headedness in English Compounds

As briefly mentioned above, the head constituent determines the basic properties, such as the syntactic category, of a compound. In English, it is generally the second constituent of a compound that is identified as the head (Libben & Jarema, 2006), which is in line with the Right Hand Head Rule proposed by Williams (1981). The head of the compound can give information about the syntactic category of the word while the other, non-head, constituent modifies it. For instance, a *houseboat* is a type of *boat*, yet *boathouse* describes a kind of *house*. However, there is also a small class of compounds which are not hyponyms of one of their constituents, and thus neither of their constituent functions as head. In this case, the central meaning of the compound is not conveyed by the head but is external to the compound (e.g. *honeymoon* is neither *honey* nor *moon*).

Compounds that have a head are called endocentric compounds, which means the (morphological or syntactic) category of the compound is identical to one of the constituents of the whole compound. For example, the compound *bookshop* is endocentric because it belongs to the same word-class as its second constituent, and it is also a kind of shop, which means it is semantically endocentric, as well. If the compound does not have a definite head, or if the head has to be inferred, then it is called an exocentric compound (Dressler, 2006). An example of semantically exocentric compounds is a *redcap* which does not refer to a *cap* that is *red*; instead, it refers to a person. Vogel (2007) claims that exocentric compounds may also belong to a word class different from their head or both of their constituents. For example, *overpower* is a compound word classified as a verb, but its components are made up of the adverb *over* and the noun *power.*

In another classification, Scalise and Bisetto (2005) define compounds depending on the semantic relationship between the components of a compound as *subordinative*, *attributive* and *coordinative compounds*, and suggest that the compounds which belong to these three classes can either be endocentric or exocentric. They propose that subordinative compounds are based on the 'complement' relation between their constituents. In a compound such as *goalkeeper*, *goal* is the complement of the head. Complement relations may sometimes be open to interpretations as in the case of the compound word *apron string*, which can have different interpretations such as *string* *of an apron*, *string on an apron*, or *string in an apron*. However, there is always a subordinative relation available between two constituents. Scalise and Bisetto further point out that even when there is no head, a subordination relation is still present, as in *turncoat.* Coordinate compounds are considered as the forms whose constituents are connected to each other by the conjunction ‘and’, as in the example *poet painter*, who is a *poet* and a *painter* at the same time, and therefore these compounds can be interpreted as having two heads which function independently (Scalise & Bisetto, 2005). In these compounds neither component dominates the other, a modifier-head relationship is not observed and they are therefore taken to be structurally and semantically independent (Ginzburg, Khidekel, Knyazeva, & Sankin, 1979). The last type is classified as attributive compounds, which can be formed by a noun and an adjective (e.g., *blue cheese*) with the adjective and the noun in a modifier-head relationship, or they may be formed by two nouns. In this case, the non-head is used in a metaphoric way that conveys an attribute of the head (e.g., *sword fish*, *snail mail*).

2.1.5 Nominal Compounds

Carstairs-McCarthy (2002, p. 61) states that “it is with nouns that compounding really comes into its own as a word forming process in English." Cultural and technical changes bring about new artefacts rather than new activities or properties, and this creates a need for new vocabulary which is more often satisfied by new nouns than by novel verbs or adjectives. Nominal compounds are often classified into four sub-categories depending on their constituents (Plag, 2002):

- Noun-Noun: *bedroom, door-handle, jigsaw puzzle*
- Verb-Noun: *playtime, drive-in, swear word*
- Adjective-Noun: *blackbird, double-page, single bed*
- Preposition-Noun: *overcoat, off-season, out tray*

Among the sub-classes presented above, the category which is composed of two nouns is generally the most productive type in English (Lieber, 1992); besides, the vast majority of them are endocentric as they have their semantic head within the compound (Bauer, 1983) and right-headed (e.g., *bedroom* is a kind of room, *door-handle* is handle of a door, *jigsaw puzzle* is a kind of puzzle).

The present study focuses on Noun-Noun compounds consisting of two free morphemes; more specifically, both constituent of the compound words tested as part of the present study are mono-morphemic units. The reason for choosing Noun-Noun compounds as the linguistic focus is the fact that they are frequently encountered cross-linguistically and they provide an efficient testing ground for the relationship between the storage and computation in the mental lexicon. Besides, the vast majority of noun-noun compounds are right-headed, therefore these compounds lend themselves easily to an analysis with respect to headedness. In addition, diverse levels of morphosemantic transparency (which is discussed in the following section) they have provides a more direct ground to test the role of semantic transparency in the processing of morphologically complex words.

2.1.6 Transparency

The process of compounding gives rise to the formation of a new lexeme that represents a completely novel form with a particular meaning. For example, an *armchair* does not directly refer to an *arm* or a *chair*, but instead it represents another object. This is called 'integration' and is described as the single meaning of the components within a compound being integrated into a novel meaning which refers to a new object. However, the meaning of the compound may still be deducible from the meanings of its components, which depends on the degree of the compound's *transparency*. A compound is considered semantically transparent as long as the meanings of its components provide sufficient information to predict or interpret the meaning of the compound (e.g., *sailboat, cheekbone*). On the other hand, the compound words with the lowest degree of transparency are termed *opaque* as the constituent meanings do not provide an effective guidance to the meaning of the whole compound (e.g., *blackmail*, *deadline*).

English compound words are known to demonstrate diverse levels of morphosemantic transparency, ranging from fully transparent cases to fully opaque compounds (Libben, 2006). Libben argues that the transparency of the head is presumed to be more important compared to the non-head according to the scale presented below:

- (TT) Both members of the compound are transparent, e.g., *doorbell*;
- (OT) The head constituent of the compound is transparent, while the non-head constituent is opaque, e.g., *strawberry*
- (TO) The non-head constituent of the compound is transparent, while the head constituent is opaque, e.g., *jailbird*
- (OO) Both members of the compound are opaque, e.g., *honeymoon*

The semantic transparency of a morphologically complex word is assumed to have an influence on both the processing of the word and its representation in the mental lexicon (Marslen-Wilson, Tyler, Waksler, & Older, 1994). In the present study, the role of semantic transparency in the representation and processing of the English compound words is explored since compounds pave the way for a more illuminating investigation on the role of transparency in the organization of the mental lexicon. The semantic transparency of the compound words in the present study was examined under two categories, namely, transparent and opaque compounds, which were defined as follows:

- *Transparent Compounds*: Both constituents contribute to the meaning of the compound word to a certain extent; e.g., *doorbell* (a doorbell is a bell placed near a door, which can be rung by the visitors to signal their arrival)
- *Opaque Compounds*: The meaning of the compound is not understood from the meanings of the constituents members; e.g., *honeymoon* (honeymoon means neither honey nor moon but refers to a vacation or trip taken by a newly married couple)

2.1.7 The Significance of Compounding in Language Processing

Compounding is an extremely wide-spread word formation process and perhaps it is the easiest way to create novel cognitive / linguistic representations. Jackendoff (2009, p.113) emphasizes the role of compounds in terms of providing an understanding into the earliest forms language proposes:

> This view of modern language as 'laid over' a protolinguistic substrate leads to the intriguing possibility that the coverage is not complete: that there exist pockets of modern language that are relics of earlier stages of the language capacity. Such relics would be areas where there is only rudimentary grammatical structure, and in which such grammatical structure as there is does not do much to shape semantic interpretation. Rather, we would expect semantic interpretation to be highly dependent on the pragmatics of the words being combined and on the contextual specifics of use. I suggest that compounding fills the bill completely.

In the same vein, Dressler (2006, p. 23) also emphasizes the importance of compounding by claiming that "if a language has inflection, it also has derivation and compounding, and if a language has derivation, it also has compounding, but not vice-versa". Hence, studying compounds offers an opportunity to explore the fundamental aspects of morphology as well as the basic principles of morphological processing and representation.

Compounds are a particularly intriguing linguistic construction because they are words, but at the same time they hold an internal syntax. As noted by Libben (2006, p. 3), "compound words are structures at the crossroads between words and sentences reflecting both the properties of linguistic representation in the mind and grammatical processing" and thus, they set ground for a better understanding the interaction between storage and computation in the mind.

The compositionality of compounds is another advantage of testing them in processing studies as they address the constituency effects in a more direct and proper manner. Affixed words have a relatively limited set of bound morphemes whose position is mostly predictable, and thus this allows affix-stripping processes. Compound words, on the other hand, compose of a wide range of combinations, and thus serve the purpose more competently and offer insights into the broader properties of the lexical retrieval processes of multimorphemic words (Shoolman & Andrews, 2003). In this case, what makes compounding a matter of curiosity for psycholinguistic researchers is the morphological freedom it offers in all languages it has been studied in. For example, the derivational suffix *–ness* in English can only be attached as a suffix to an adjectival stem; however, the word *book* as a free morpheme can combine with other (types of) linguistic elements in various positions (e.g., *bookshop*, *bookworm*, *handbook*, *passbook*, *playbook*), hence eliminating the predictability factor.

Finally, compounds provide a particularly useful vehicle for disentangling morphological, orthographic and semantic effects in language processing, and thus allow for the examination of one potential effect in the absence of the other two. Thanks to this particular feature, the questions of whether compounds are represented by their monomorphemic units or just as an ordered set of morphemes or whether the semantic representations of the constituents of both semantically transparent and opaque compounds are available during processing can be answered in much more revealing ways. Taking into account all of these, compounding can shed light on precisely what form and level of representation may contribute to word identification and how morphological units are represented in the mental lexicon.

2.2 Models of Morphological Processing and Representation in L1

In the psycholinguistic literature, two main approaches underlie the models of morphological processing which attempt to unveil how words are processed and represented in the mental lexicon. One is called *the single mechanism approach*, which essentially presupposes that a single mental system accounts for the representation of words. The other is called the *dual-mechanism approach*, which posits the presence of two separate systems. Within single mechanism models, two subtypes of models have been put forward based on whether complex words are represented as full forms or stems/roots are assumed to be stored and processed separately from affixes. These are known as the *single mechanism associative (connectionist) models and single mechanism rule-based models, respectively,* and they differ quite markedly from each other.

The debate on how morphologically complex words are processed remains as a central issue ever since Taft and Forster (1975) proposed the idea of an obligatory decomposition mechanism for all morphologically complex words. According to the *full decomposition hypothesis*, morphologically complex words are represented in the mental lexicon by their stems and affixes, and morphological decomposition takes places before lexical access occurs. However, this theory was soon challenged by Butterworth (1983), who suggested a competing analysis for the role of morphological structures in processing. *The full listing hypothesis* arising from the idea that full parsing may not work because of the idiosyncrasies that appear in complex words suggests a non-decompositional account. In this account, morphologically complex words are not treated as separate units of stems and affixes; instead, they are represented as single units in the mental lexicon, and are thus stored and processed as whole forms. Full-listing is claimed for all complex words including the processes of regular past-tense formation. While the full-listing hypothesis meets the requirements of the economy of processing principle by claiming direct retrieval of morphologically complex words is less demanding than parsing them into their constituents (Frauenfelder & Schreuder, 1992), the full-decomposition hypothesis works in line with the economy of storage principle, which suggests keeping all words, single or complex, as full forms in the mental lexicon places great demand on and leads to a heavy memory load in the brain. Besides, proponents of full-listing postulate the view that a mechanism that obligatorily parses *teacher* as *teach* and the suffix *–er* will waste effort to incorrectly segment *suffer.* Proponents of full-decomposition, on the other hand, are able to offer an immediate explanation for novel combinations such as *hopefuller*.

These two theories of the mental lexicon situate themselves at the two extremes of a continuum; however, investigations into the structure and organization of mental lexicon have indicated that neither of these extreme approaches is fully satisfactory by itself to explain and rationalize the mental operations underlying the processing of lexical items. That is the reason why *the dual-mechanism approach* was introduced, which argues for the presence of two distinct mechanisms in morphological processing (Pinker, 1991; Pinker & Ullman, 2002; Ullman, 2001a). Models from this approach suggest that storage and computation operate in parallel during the processing of complex words.

2.2.1 Single Mechanism Models

Associative models of morphological processing propose that all words, regardless of their morphological structures (simple or complex), are learned, stored and processed as whole units within a single associative system. This model suggests that connections between words which are represented in a distributed network of orthographic, semantic and phonological information are formed through associative processes. Such models eliminate morphology, and in a broader sense grammar, as a resource for the mental representation of language and processing and as a target of language acquisition (Clahsen & Verissimo, 2016). The most widely known example of associative models is the *pattern-associator model* introduced by Rumelhart and McClelland (1986). This model particularly focuses on the acquisition of past tense inflection in English. According to this model, during the processing of past tense forms (both regular and irregular), only one mechanism operates and between the stem and past tense forms an array of route associations are stored and in this way novel responses could be generated through immediate generalizations from the stored forms. This model contains no explicit rules and words are not segmented into their base and affixes, so all words are represented as whole words with semantic and phonological links between them. However, this model has been criticized in that it has generalization problems with regular verbs (Pinker & Prince, 1988). Many other associative models with a range of characteristics are likely to be found in literature, but these models could not provide an in-depth and satisfactory explanation for the processing of morphologically complex forms.

Single mechanism rule-based models claim that in the processing and representation of complex words there exists only one combinatorial system in which morphologically complex words are decomposed into smaller units. One of the earliest examples of rule-based models is the *Prefix Stripping Model* of Taft and Forster (1975). Based on the findings they obtained from their lexical decision experiments, they produced a word recognition model displayed in Figure 1. This model proposed that before lexical access occurs, prefixed words are decomposed into their stems and prefixes, which results in the decomposition of a complex word such as *disagreement* into its stem *agree*, prefix *dis-*, and suffix *-ment*. In this respect, storing the stem for different words does not turn into a burden and also enables a more organized mental lexicon. A more recent model called *the rules-and-competition model* proposed by Yang (2002) suggests that the past tense verb forms, both regular and irregular, are treated by a rule-based approach. While the past forms of regular verbs are composed through the default *–ed* suffix, irregular verbs follow a series of phonological rules to form their past tense forms (e.g., vowel shortening, *feed- fed;* -t suffixation + vowel shortening *lose- lost;* -t suffixation + rime(a) *bring- brought*). According to this model, language users do not learn the past tense forms; they just learn the rules. The competition, as noted in the name of the model, shows up when the given verb cannot be associated with any rules. In that case, the past tense form of the verb is generated by employing the default rule. However, this model is argued to have some problems regarding the irregular rule classes (Silva, 2009) in terms of the effect of frequency on the rules of irregular past tense formations. When Yang (2002) compared the rates of correct usage, high frequency verbs have been found to correlate with accuracy, which leads to question the effectiveness of rule-based models in explaining the processing of irregular word forms.

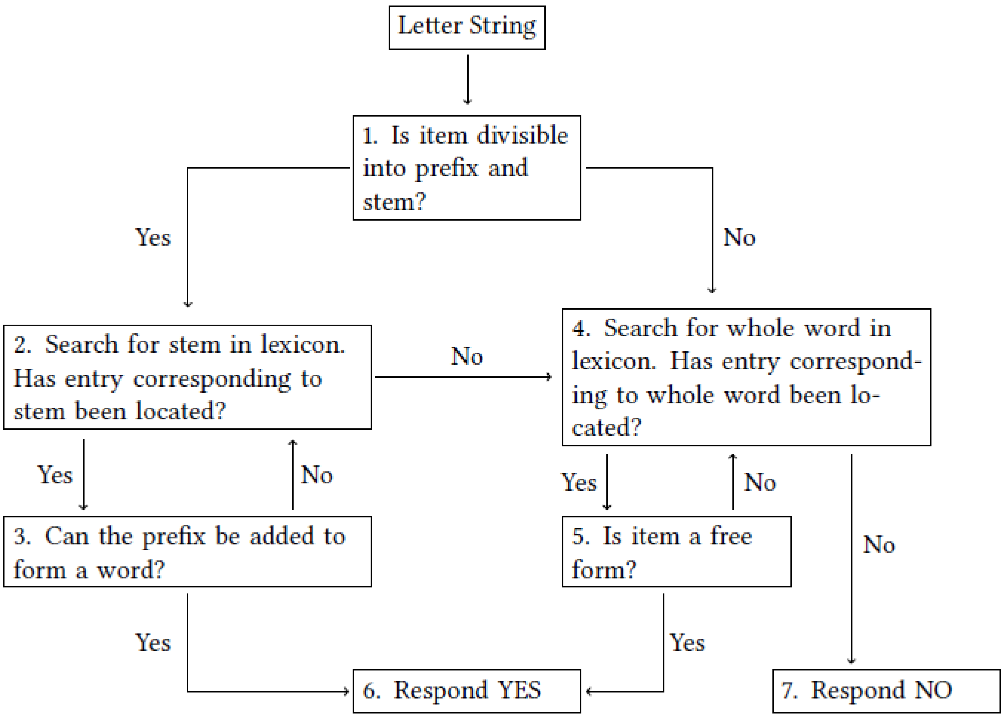

Figure 1 Model for word recognition (Taft & Forster, 1975)

2.2.2 The Dual-Mechanism Model

Single mechanism models, which propose only one mechanism in the representation and processing of morphologically complex word forms, have been found to be inadequate in accounting to evaluate the complete nature of the mental system.

Besides, findings of experiments have indicated that only a dual mechanism may account for the processing differences observed between the words inflected through irregular formulations (e.g., *go-went, tooth-teeth*) and regular formulations (e.g., *show-showed, book-books*). The former process implies that the structures are generated my means of memory storage and retrieved from the mental lexicon in pure associative means. The latter, regular, forms relate to the rule-driven aspect of language processing. Thus, instead of relying on a single mechanism, Pinker (1991) proposed the *dual mechanism model*, which encompasses both associationist and rule-based models operating concurrently.

The dual mechanism model accommodates two disparate systems, the associative memory, which underlies the mental lexicon and which is considered to involve arbitrary sound-meaning mappings, and the rule system, which is associated with the mental grammar and which emphasizes the more productive and creative aspect of grammar generation such as producing complex forms or phrases (Pinker & Ullman, 2002). In this respect, the dual mechanism model postulates that regular word forms are generated by rules through a series of computations in the mental system, irregular word forms on the other hand are stored and represented as whole units in the mental lexicon. However, as noted by Alegre and Gordon (1999) regular word forms, the frequency of which are higher than 6 per million are inclined to favour full form storage in lexicon, which offers the idea of storage for regular forms is within the bounds of possibility, as well, depending on their frequency, though. Another property of dual mechanism model is its function of using a blocking system, which eliminates overregularization errors. When the necessary features are activated in the associative network, which results in the retrieval of the irregular form from the lexicon, an inhibitory signal sent to the rule system of mental grammar, which blocks the process of suffixation. The simplified version of the model is illustrated in Figure 2.

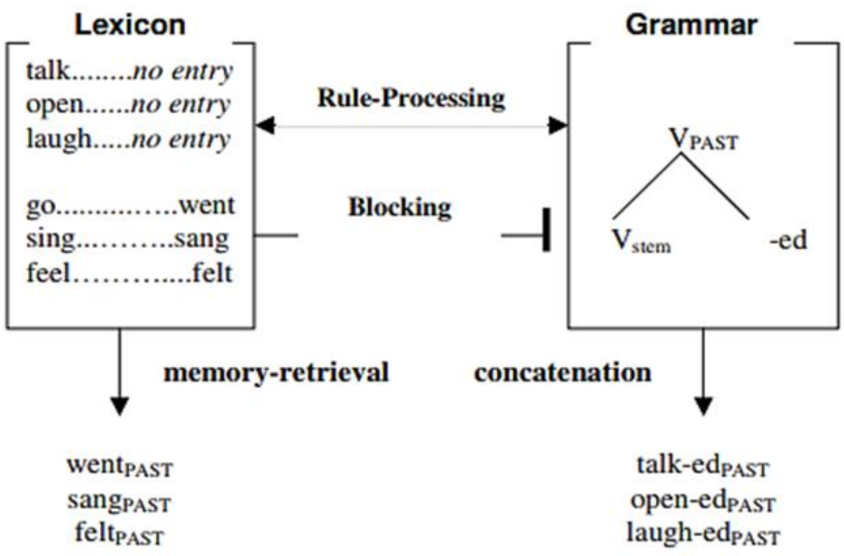

Figure 2 A simplified representation of the Dual-Mechanism Model (Kırkıcı, 2005)

There are also other models similar to the dual-mechanism model. One example is the *Augmented Addressed Morphology Model (AAM)* proposed by Caramazza, Micelli, Silveri, and Laudanna (1985). Caramazza and his colleagues claimed that the retrieval of words as full forms proceeds more quickly compared to morpheme-based activation and thus whole-word access is accepted as a more favoured route for known words. The decomposition route is employed only for words that have not been encountered before. Another model, proposed by Frauenfelder and Schreuder (1992), is called the *Morphological Race Model (MRM).* According to this model, two routes are assumed, one of which is the direct route while the other route involves parsing, and both routes race in parallel as the name suggests. However, factors such as frequency, phonological and semantic transparency are important in determining the route to be taken.

As an extension to the dual-mechanism model, Ullman (2001a, 2001b) proposed the *Declarative/Procedural Model*. This model posits a distinction between declarative memory and procedural memory, claiming that lexical processing draws on two independent domain-general memory systems located in the brain. The declarative memory system is assumed to be rooted in the medial temporal lobe, while the procedural memory system is represented in the frontal lobe and the basal ganglia.

The declarative memory system is charged with learning and using of arbitrary information like facts and events that represent semantic and episodic knowledge associated with associative processes. The procedural memory system is mostly associated with learning motor and cognitive skills and takes part in the use of rule-based processes. When these memory systems are approached in terms of morphological processing, the declarative memory is thought to be involved in the processes of memorizing irregular words (e.g. *went*, *teeth*), while the procedural memory is bound to compute regularly inflected words through a stem and affix segmentation procedure (e.g., *walk+ing*, *class+es*). This model also presents some specific predictions for second language processing, which will be discussed in the following section.

2.3 Approaches to Morphological Processing and Representation in L2

Although the research on language processing has to date mainly focused on native speakers, experiments have recently started to incorporate second language learners with a growing body of interest in non-native language processing. Two main views have been proposed concerning whether the nature of non-native processing is similar to the mechanisms involved in native processing or whether L2 learners choose a different processing route from L1 speakers. The first view basically supports the idea that L1 and L2 processing follow a similar path; however, the factors such as, transfer, age of acquisition and automaticity may influence L2 processing. On the other hand, the alternative view emphasizes a more fundamental differences between L1 and L2 processing.

2.3.1 Same Mechanisms for L1 and L2 Processing

While a second language is usually learned later in life, an entire L1 system is already in place with a fully established brain network processing sounds, words, and sentences. Therefore, it is quite plausible to presume that the same brain network which is already set for the first language is recruited when learning a second language. With the aim of investigating whether L1 and L2 processing are managed by the same neural mechanisms, Abutalebi (2008) introduced an analysis of functional neuroimaging studies and found that the same neural system is shared during native and non-native processing. In addition, Indefry (2006) also suggested that the same cortical regions are activated in both L1 and L2 processing. Another study comparing brain networks of native and non-native speakers (Weber, Luther, Indefrey, & Hagoort, 2016) also revealed that activation and connectivity patterns during the processing of complex sentences overlap in native and non-native language speakers.

The *shared systems* view posits that L2 learners employ the same mechanisms of language processing as L1 speakers do, but L2 processing may still be affected by various factors. One of these is reported as L1-L2 differences, which may influence L2 acquisition and processing. For example, in their event-related brain potential (ERP) study, Tokowicz and MacWhinney (2005) reported the effect of L1 transfer on L2 processing. They constructed three conditions to test whether L1 English speakers were sensitive to violations in their L2 Spanish. The first condition consisted of matching constructions formed in a similar way in English and Spanish (i.e. auxiliary marking), the second condition tested the mismatching constructions which do not share similar formulations (i.e. determiner number agreement), and the final condition included no-matching constructions applying to the L2 only (i.e. determiner, gender agreement). The findings revealed that the L1 English learners of L2 Spanish were sensitive to violations in matching constructions, whereas they did not display sensitivity to violations in L2 constructions which were different from the constructions in their L1. These findings confirmed the existence of L1 transfer effects which contribute to the successful processing of the construction showing similarity in the L1 and the L2.

Similarly, Perani et al. (1998) focused on the effect of age of acquisition (AoA) on the neuronal substrate of L2. They carried out two studies with two groups of subjects, both of whom were highly proficient in L2 but differed in terms of the AoA of their second language. Perani et al. found that listening to Italian stories yielded similar patterns of activation for both early and late bilinguals. Another study by Wartenburger, Heekeren, Abutalebi, Cappa, Villringer, and Perani (2013) confirmed the influence of AoA on the grammatical processing of Italian-German bilinguals.

By using functional magnetic resonance imaging (fMRI), they compared two groups consisting of early-acquisition and late-acquisition bilinguals. Early-acquisition bilinguals did not differ in terms of their grammatical judgements, in that, similar activation patterns were observed in the L1 and the L2. However, in late acquisition bilinguals, significant language-specific differences were obtained, which suggested that AoA may affect grammatical processing in L1 and L2 either in a facilitatory or an inhibitory way. Another study specifically examining the effect of AoA (Xue, Liu, Marmolejo-Ramos, & Pei, 2017) aimed to distinguish the processing of early learned words in the L2 from late learned ones for L1 Chinese native speakers of L2 English. The findings displayed that early learned words offered a processing advantage in terms of both accuracy and speed. They further discovered that the effect of AoA was more marked for irregular words and in the semantically related condition, which suggested that arbitrary mappings between word forms and semantic concepts might be the origin of AoA effects and early acquired words might display more semantic interconnection compared to late acquired ones.

As another potential factor that produces difference in L1 and L2 processing, Hasegawa, Carpenter, and Just (2002) put forward the idea of reduced automaticity in L2 processing. Using the fMRI technique, the relationship between the cortical substrates which support the native language and second language comprehension was investigated. Native Japanese speakers with moderate fluency in English listened to sentences the difficulty of which were manipulated in L1 Japanese and L2 English. The findings displayed that more cognitive effort was needed to process English, but the same neural mechanisms were found to take part in both L1 and L2 processing. Besides, negative sentences elicited more activation compared to affirmative sentences especially in English, which may suggest that the structural difficulty of negation yields a greater impact on cortical activation. These results suggest that L2 processing requires more computation, which results in lower automaticity in second language processing and relatively poorer performance. In a similar vein, McDonald (2006, 2008) discussed the point that processing difficulties because of low working memory capacity better explains late learners' poorer performances. Her studies have displayed significant correlations between accuracy in grammatical judgment performances and memory span.

2.3.2 Different Mechanisms for L1 and L2 Processing

A view raised against the shared system hypothesis, which emphasizes the similarities between native and non-native language processing systems, postulates that L1 and L2 processing patterns differ in more fundamental manners within the domain of grammar (Clahsen & Felser, 2006; Ullman, 2001a). An analysis of previous studies investigating the processing of complex words by high proficiency L2 learners has indicated that explicit differences exist between L1 and L2 processing of morphologically complex forms, which may not be fully accounted for by factors like L1 transfer effects, processing speed and age of acquisition (Clahsen, Felser, Neubauer, Sato, & Silva, 2010).

Ullman's Declarative/Procedural Model (Ullman, 2001b) was primarily established to account for morphological processing and representation in L1, but holds some specific implications for L2 processing. Similar to the view suggesting language acquisition is constrained by a critical period (Lenneberg, 1967), learning an L2 might also be tied to maturational constraints, especially in late learners who never attain the same level of proficiency in the L2 as in their L1 (Johnson & Newport, 1989). This is because L2 learners rely more on the declarative memory than the procedural memory (Ullman 2001b, 2005). This tendency toward relying more on the declarative memory in L2 learners is attributed to the increased release of oestrogen after puberty, which expands the declarative system, but limits the procedural memory system. As a result of this, the linguistic structures which are typically processed through the procedural system in L1 (e.g., regular forms like *look-ed* and *book*-s) may be processed through the declarative system in the L2. In addition, although it is considered that L2 learners make more use of the declarative memory compared to the procedural memory, as they attain a high proficiency level in L2, it seems likely that they become skilful enough to utilize the procedural system.

Clahsen and Felser (2006) analysed the performance of adult L2 learners and monolingual children in a series of tasks and then further compared their performance with adult monolinguals. They concluded that child and adult first language processing patterns mostly overlap, but some differences arise in their performance which stem from possible cognitive developmental limitations. Nevertheless, they claim that these differences are more qualitative in nature and are not likely to be explained by lack of working memory resources, processing speed, L1 transfer, or partial acquisition of the target grammar. They postulated the *Shallow Structure Hypothesis (SSH),* which suggests non-native processing relies basically on semantic rather than syntactic information, which is why second language processing is less sensitive to syntactic representations compared to native language processing. The SSH further advocates that even when the same structure is shared by the L1 and the L2, L2 processing is expected to be less sensitive to grammatically-based information.

2.4 Effects of Semantic Transparency in Morphological Processing

Accounts of morphological processing differ in terms of how early the semantic effect is posited to emerge during visual word recognition. The difficulty in answering this question stems from the face that words which share morphological information are mostly related in form and meaning as well. Thus, it is not a straightforward task to distinguish the influences of morphological relatedness from the effects of form and meaning overlap. In this respect, accounts vary to resolve whether semantic effects obtained in priming task is a result of orthographic and semantic similarity arising from a shared morpheme or whether they emerge as the lexical level. The latter gives rise to another question of when semantic and morphemic whole word representations are activated during the recognition and if they interact.

The *obligatory prelexical decomposition account*, also known as the *sublexical model*, suggests that the decomposition of morphologically complex words into morphemes precedes and leads lexical access (Rastle, Davis, & New, 2004; Taft & Forster, 1976; Taft, 1994). This decomposition process, which is automatic and purely based on orthography, approaches words as units of form ignoring meaning. In this respect, the words *dollar* and *teacher* are processed in the same way because *–ar* in *dollar* can be treated as an affix in the same way as *–er* in *teacher*. Thus, from this perspective, the absence of a semantic relation between *doll* and *dollar* is insignificant at this early decomposition stage. On the other hand, the *supralexical model* suggests that initial access is based on whole form representations (Giraudo & Grainger, 2000, 2001). According to this model, the decomposition of lexical units occurs following the access to whole word representations and semantic representations are also activated at the whole word level; thus, the processing of a morphologically complex word is constrained by its morpho-semantic properties.

These two accounts diverge in terms of the unit (whole words or morphemes) providing access to the lexicon even though both of them can be categorized as *form-then-meaning accounts* because the activation of semantics occurs only after the form is analysed (Rastle & Davies, 2008). *Form-then-meaning* accounts are criticized because it is argued that even in the earlier stages of word recognition, morpho-orthographic and morpho-semantic processes do not operate independently. Thus, proponents of *form-with-meaning accounts* claim that form and meaning are two interdependent processes and even if the early stages of word recognition is regarded as a pure orthographic stage, the effects of semantic transparency at early stages confirms the presence of semantic influence (Diependaele, Duñabeitia, Morris, & Keuleers, 2011; Feldman, O'Connor, & Moscoso del Prado Martín, 2009).

2.5 Compound Representation in the Mental Lexicon

The representation and processing of compound words are of special interest in the psycholinguistic literature in that they play a critical role in understanding the fundamental aspects of mental structure. Nevertheless, the theories that have been proposed to this day to explain how morphologically complex words are processed and stored in the mind have remained largely limited to inflectional and derivational processes. Besides, the unpredictable and highly productive nature of compounding has left it rather ambiguous and controversial regarding its representation and processing.

When the theories postulated to illustrate complex word representation in the previous sections are taken into consideration, the question emerges whether compound words are represented and processed as whole units as suggested by full-listing models (Butterworth, 1983; Bybee, 1995), or as individual constituents analysed through combinatorial mechanisms as posited by full-parsing models (Taft & Forster, 1976), or alternatively by making use of both mechanisms as proposed by dual-route models (Baayen et al., 1997; Koester et al., 2007; Zwitzerlood, 1994). As described above, full-listing models suggest that all simplex and complex words are stored in the mental lexicon as whole units. Therefore, from this perspective, compound words are represented as whole words, which results in whole-word retrieval during lexical processing. For example, *sea*, *food* and *seafood* are hence represented as separate entries in the lexicon, and the input *seafood* is accessed directly without any further operation. However, such a system would be rather incapable of managing novel compounds as there is always the possibility to encounter a compound which has never been heard of. At the other extreme, the full-parsing hypothesis proposes that all words are decomposed into their constituent elements as an obligatory procedure. For example, the compound, *seafood* would first be segmented into *sea* and *food*, and then these constituents would be used to access the full form, *seafood*. The viable drawback of this latter model is that it eliminates the possibility of a fast processing advantage. Because obligatory decomposition is demanded even for high frequency words which are possibly lexicalized, even a word like *blackboard* is processed through its constituents. Besides, this system, which is not corrected by a whole-word processer, will have difficulty with some mono-morphemic words such as *hostage* which only includes morphemic substrings (i.e. *host – age*) in orthography (Libben, 2006). The dual-route model on the other hand, suggests that both direct retrieval and decomposition routes operate together during lexical access (Bertram & Hyönä, 2003, Shreuder & Baayen, 1995).

Libben (2006) suggests that compounds potentially allow for both storage and computation and exemplifies further that a compound like *houseboat* may either be stored or computed through its constituents, or both. In order to investigate which of these patterns is/are preferably followed, he proposes two alternatives for the mental system to possibly pursue: the maximization of storage efficiency and the maximization of computational efficiency. Assuming that the human mind seeks to maximize computational efficiency, it is expected that words are to be represented as whole units, so that no effort would be put on morphological decomposition. On the other hand, if the mental system seeks to maximize storage efficiency, then it is predicted that compound words are represented by their constituents, which eliminates storage cost.

However, the results of recent studies on compound recognition have revealed that instead of seeking one of these two extremes, the human lexical system seeks for the maximization of computation and storage together, which Libben (2006) calls "maximization of computational and storage opportunity." Instead of computing and storing less, the maximization of opportunity suggests that the mind computes and stores as much as possible. Both compound words and their constituent morphemes are represented in the mental lexicon with links between them. However, while trying to maximize opportunity, this system becomes unable to maintain efficiency since the mechanism has to decide whether the words should be processed by their constituents or as whole units, which either makes it operate too slowly to be effective or generate many errors. These three situations are displayed in Figure 3.

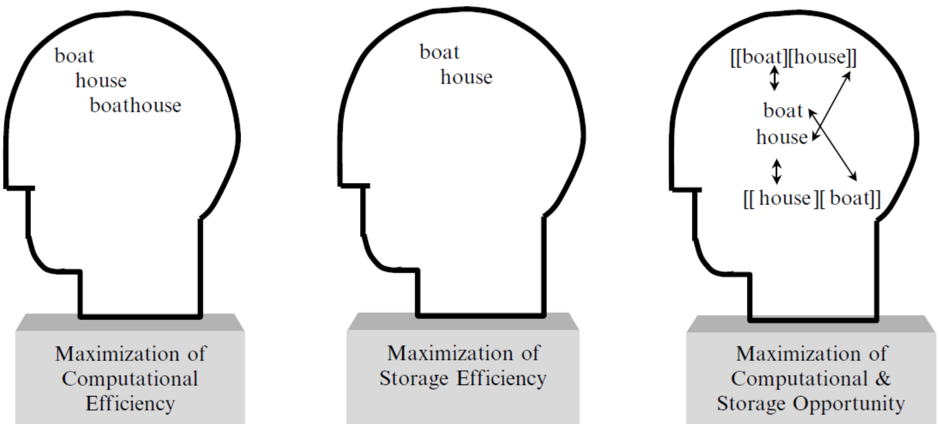

Figure 3 The representation of compound words in the mental lexicon (Libben, 2006)

The horse race models of word recognition (Allen & Madden, 1990) suggest a simultaneous activation of whole-word and constituent morphemes. This process is affected by the frequency of occurrences of each entry in the lexicon in that the entry which wins the race of processing will take priority. In this case, a word such as *blackboard* is processed as a whole and through its constituents *black* and *board* simultaneously, which results in bi-directional activation (see Figure 4). *The relation* *network model* (Lamb, 1998) ties in with Libben's connectionist approach. In Lamb's view, as opposed to the idea that the mind is a device for storing and establishing symbols, it is seen as a network system and the information lies in this system's connectivity. According to this system, understanding a compound is based upon its constituents and understanding it as a whole unit is not an either-or question since these two processes operate in parallel.

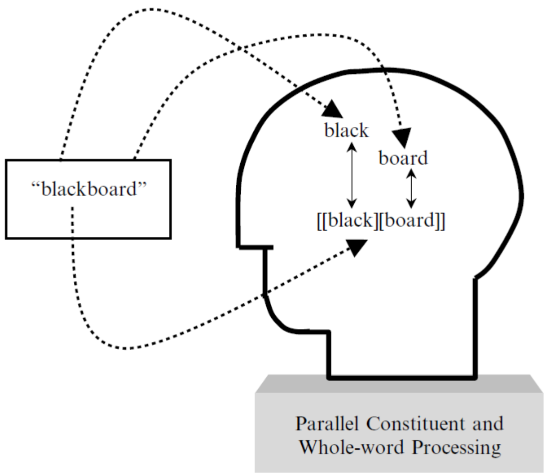

Figure 4 Parallel constituent and whole word processing (Libben, 2006)

The main reason for choosing such a complex structure is that it does not necessitate further decision making because all the possible representations that could be activated will be activated. In this case, novel compounds are processed through their components as no whole word representation for novel compounds is present in the mental lexicon. In addition, for frequent words, activation will follow the whole-word route as it will be faster; for less frequent words, on the other hand, the morphological route might be pursued. However, as has been suggested, if both whole words and constituents are activated simultaneously, then it means either redundant activation or competing activation. Taken all together, this system may create serious problems for the compounds whose meanings as an independent lexical entry do not show parallelism with their constituents.

Compounds which have a straightforward relationship between their components and their whole-word representations, such as *boathouse* and *houseboat*, do not create a problem during processing by decomposing them into their constituent morphemes as it is possible to derive their meaning from their constituents. However, even these relatively obvious cases pose some complications. Even if it seems clear that *houseboat* is a kind of boat which one can use as a house, it is also open to interpretations which will make the case more complicated, such as, what if it is a boat shaped like a house. Even worse, there are many compounds which do not have transparent relations with their components at all. *Strawberry*, for example, is a compound whose initial constituent does not contribute to the compound's overall meaning. As discussed by Jarema (2006), experimental evidence indicates that compounds which are semantically opaque do not follow the same pattern of cross-activation between the whole form and constituents. In this respect, the following three assumptions shed some light on the pattern of compound activation. The first alternative suggests that semantically opaque words are processed without being subject to decomposition (Sandra, 1990; Zwitserlood, 1994). Another possibility is that the representations of semantically opaque words are different from semantically transparent ones (Libben, 1998). The final alternative is that the connection between the whole form of an opaque compound and its components is less strong or even absent. All these possibilities in general suggest less activation for the constituents of semantically opaque compounds. Considering this, Libben (1998) proposes a model indicating the compound representation and constituent activation at three levels: stimulus level, lexical level and conceptual level (see Figure 5). At the lexical level, both transparent and opaque compounds are represented in the same way; however, at the conceptual level they differ because only the constituents which contribute to the compound's overall meaning are connected to their corresponding conceptual representation.

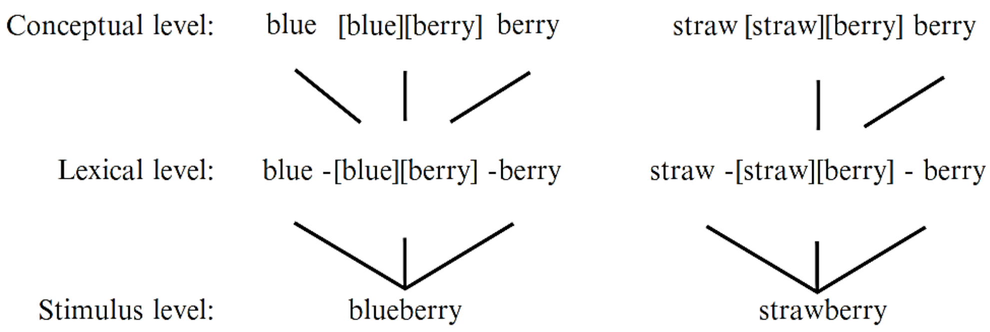

Figure 5 Three levels of representation of compounds (adapted from Libben, 1998, in Jarema, 2006)

Another possible explanation suggests that semantic opacity does not have to diminish constituent activation; instead, it generates a mismatch of activation (Libben & de Almeida, 2001). For example, when the compound *elderberry* is taken into consideration, semantic representations activated by the word *elder* as an independent morpheme do not overlap with the semantic representations which are activated by *elderberry*. In such a case, a semantic mismatch arises and the inappropriate semantic activation is required to be inhibited, which requires an extra effort and in priming experiments, in particular, increases the response time due to this demanding post-recognition procedure.

The concept of morphological head in compound words and their representation in the mental lexicon add further controversy to the issue. Jarema (2006) states that even though the importance of the first constituent in left to right processing has been confirmed in typologically distinct languages (Finnish, German, Greek and Polish), incompatible results were obtained from some other studies, which emphasizes the bigger role of the head in compound processing (Marelli, Crepaldi, & Luzzatti, 2009). It is hence suggested that the significance of the first constituent might be independent of the role of headedness in compound processing. Libben (2006) proposes two possibilities in terms of the representation of heads in the mind. One possibility is that no head concept is represented in the word; instead, it might be derived from the speaker’s knowledge about the properties of the target language. In English, for instance, the head is always the rightmost constituent of the compound. Nevertheless, in languages like French, which has both right-headed and left-headed compounds, this treatment does not work properly. According to this view, headedness is not associated with the way compounds and their constituents are represented in the mental lexicon, and therefore between the head and its monomorphemic representation a stronger link is assumed to exist compared to the link between the modifier and its monomorphemic representation. The other possibility is that morphological headedness might be a property of a word, but the question of how this property is represented cannot be completely settled.

To summarize, headedness and constituent transparency may have a role in how compound words are represented in the mental lexicon and the way they are processed.

2.6 Previous Studies on Morphological Processing

The representation and processing of morphologically complex words has been the focus of debate for the last four decades and numerous studies have been conducted employing different tasks (e.g., priming, lexical decision, self-paced reading) in different modalities (auditory, visual) and with varying methods (behavioural, neurological) in an attempt to shed light on the structure of the mental lexicon by investigating how and when complex words are decomposed into their constituent morphemes. Although the great majority of experimental work has examined how inflected and derived forms are processed by native speakers (e.g., Alegre & Gordon, 1999; Clahsen, 1999; Diapendaele, Sandra, & Grainger, 2005; Giruaudo & Grainger, 2000; Rastle, Davis, Marslen-Wison, & Tyler, 2000), a growing body of research has begun to focus on the non-native processing of inflected and derived words (e.g., Hahne, Mueller, & Clahsen, 2006; Neubauer & Clahsen, 2009; Pliatsikas & Marinis, 2013; Portin, Lehtonen, & Laine, 2007). Studies investigating the processing of compounds, on the other hand, are relatively fewer in number even though a close scrutiny of compounding may be highly informative in understanding how complex words are processed. In this manner, the findings of earlier studies investigating compound processing will be summarized in this section as the main focus of the present study is compounding. Even though this study employs the masked visual priming paradigm, relevant past research adopting different techniques will also be discussed briefly.

2.6.1 Studies on the L1 Processing of Compound Words

The central issue in research on the processing of compound words is the extent to which the constituents of a compound contribute to the whole word recognition and the role of semantic transparency of the constituents in this process. More specifically, the main questions are whether compound words are decomposed into their constituent morphemes before whole word access (a sublexical decomposition route; Rastle et al., 2004) or whether the constituents are contacted after the whole word has been identified (a supralexical decomposition route; Giraudo & Grainger, 2001). Or, alternatively, instead of following one single route, are complex words processed through the parallel performance of both sublexical morpho-orthographic segmentation and supralexical morpho-semantic segmentation (the hybrid model; Diependaele et al,. 2005, 2009)?

Experiments carried out by Taft and Forster (1976) and Andrews (1986) are among the earliest studies to use the lexical decision task for the investigation of how compound words are processed. It was found that compound non-words which contain two real morphemes were more demanding to reject during a lexical decision task compared to compound nonwords which contained one or no real morphemes. This indicated that the constituent representations involved in compound nonwords were activated during processing, which can be taken as evidence for morphological decomposition. Another early study on compound processing is the one by Monsell (1985), who conducted a delayed repetition priming experiment. He compared the priming effects between constituent morphemes with whole words for semantically transparent, opaque compounds and pseudocompounds. Transparent compounds (e.g., *bedroom*) are those whose meaning is related to the meaning of their constituents while the meaning of opaque compounds (e.g., *deadline*) is not related to its constituents. Pseudocompounds (e.g., *restaurant*, *chocolate*), on the other hand, are monomorphemic units which contain letter strings that correspond to a real morpheme. The priming effects obtained from these three types of words did not yield a difference, which was taken to suggest that compound words are represented as whole words in the mental lexicon just like monomorpehmic words.

However, in a subsequent priming study on Dutch compounds, Sandra (1990) demonstrated that semantic transparency has an influence on the lexical processing of compounds. Sandra carried out three lexical decision experiments. In the first experiment, he tested whether opaque compounds (e.g., *melkweg* milk:way 'milky way' or *vleermuis* vleer:mouse 'bat') and pseudocompounds (e.g., *zonde* 'sin', which contains the string *zon* 'sun') were subject to automatic morphological decomposition. The primes were either related or unrelated to the first or second constituent of the targets, but not related to the compound meaning. The example prime-target pair for the word initial position is *melk* 'milk' - *melkweg* 'milky way', and for the word final position *muis* 'rat' - *vleermuis* 'bat'. The findings did not show a facilitation effect for opaque compounds or pseudocompounds which are primed by their first or second constituents; however, for the opaque compounds in the related condition, a 25 ms facilitation effect was obtained for the second constituent position. In his second experiment, Sandra tested whether semantically transparent compounds (e.g. *melkfles* milk:bottle 'milk-bottle') are decomposed during word recognition. The procedure of the second experiment was similar to the first experiment, but this time transparent compounds were used as targets. When transparent compounds were used as targets, related primes produced faster reaction times both in word-initial and word-final position, but the word initial position still yielded larger facilitation. In the third experiment, related prime-target pairs were used for both transparent and opaque compounds, but only for the word-final position. The results displayed facilitation only for transparent compounds. The findings of these experiments indicated significant priming effects for transparent compounds in both word initial and word final conditions, but no reliable priming effects for opaque and pseudocompounds were obtained, which could be taken as evidence against automatic decomposition disassociated from semantic effects.

Another study on compound processing in Dutch was conducted by Zwitserlood (1994), who also used a lexical decision task. However, differently from Sandra (1990), Zwitserlood classified the compounds used as semantically transparent, partially opaque and fully opaque. In the first experiment, the first and second constituents were primed by the compound words (e.g., *kerkorgel* ‘church organ’ which is transparent in meaning, *drunkorgel* ‘drunkard’ whose meaning is related to the first constituent *drunk* ‘drink’ only, and *klokhuis* ‘core of an apple’ whose meaning is related neither to *klok* ‘watch’ nor *huis* ‘house’). The findings revealed facilitatory priming effects for all three types of compounds. In the second experiment, targets which were semantically related to the constituent morphemes were primed by semantically transparent, partially opaque and fully opaque compounds. The findings indicated semantic priming effect for only transparent compounds (e.g., *priester* ‘priest’ primed by *kerkorgel* 'church organ') and partially opaque compounds (e.g., *bier* ‘bier’ primed by *drankorgel* ‘drunkard’), but not for fully opaque ones (e.g., *tijd* ‘time’ primed by *klokhuis* ‘core of an apple’). It was claimed that the constituent priming effects in Experiment 1 showed that even fully opaque compounds are processed through decomposition indicating that morphological segmentation is available at the lexical form level. In the second experiment, the absence of facilitatory priming effects in fully opaque compounds suggested that the semantic representations of the compounds were not activated in the fully opaque condition. All together, these findings can be interpreted as supportive of the idea that fully opaque compounds can be decomposed at the lexical form level similar to partially opaque and transparent compounds, but fully opaque compounds and their constituents are not semantically connected in the lexicon.

Libben, Gibson, Yoon, and Sandra (2003) also investigated constituent activation in transparent and opaque compounds. In their study, a four-way distinction was used for compounds, which were classified as fully transparent compounds (TT, e.g., *car-wash*), two types of partially transparent compounds in which the head is transparent (OT, e.g., *strawberry*) and modifier is transparent (TO, e.g., *jailbird*), and fully opaque compounds (OO, e.g., *hogwash*). In their first experiment, a word recognition task was conducted in which the participants were expected to answer whether they had seen the given words before. The targets were presented in two different conditions. In the first condition, targets were presented as one word (e.g., *hogwash*), while in the second condition they were presented as separate words (e.g., *hog wash*). The researchers assumed that if the compounds are processed as whole words without decomposition, then the split condition, where the same targets are separately displayed, should yield an inhibitory effect on target compound identification. Libben et al. (2003) specified four "dominant results" for their first experiment: (a) each type of compounds produced longer recognition latencies when they were presented in split form, (b) the TO and OO compounds (the compound with opaque heads) took longer to be recognized than the OT and TT compounds (compounds with transparent head), (c) compounds containing opaque elements hold the same pattern in the split condition, (d) the TT and OT compounds are not influenced by prior presentation as intact stimuli (written as one word) as much as TO and OO compounds. These results suggest that the split cost is higher for compounds which have opaque heads, which suggests a weaker decomposition effect for these two conditions. In their second experiment, Libben et al. employed a constituent priming paradigm in order to explore whether prior activation of the constituents facilitates the recognition of the compound. The primes consisted of either the first or the second constituent of the compounds or some neutral morphemes, and each subject saw the same target compound twice. For example, the target *hogwash* was preceded by a neutral prime (e.g., *tree – hogwash*), and by either its first constituent (e.g., *hog – hogwash*) or its second constituent (e.g., *wash – hogwash*). Constituent priming led to reduced response latencies for all compound types, independent of the position of the constituent serving as the prime. The compounds with opaque heads (TO and OO) were more difficult to process than the compounds whose heads were transparent (OT and TT). OT and TT compounds displayed similar patterns of reaction time (RT) and OO and TO compounds did not produce decreased priming effects as opposed to prior expectation. In addition, the response times yielded from TT, TO and OT conditions were shorter when they were primed by their first constituents, but the difference between OT and TT in both word-initial and word-final conditions was found to be larger than for the TO compounds. A considerable RT difference was found between the TT and OT pairs and between the TO and OO pairs. Because every compound was seen twice by every subject, repetition priming effects were obtained as in Experiment 1, but only for TO and OO compounds.

Considering all these findings, Libben et al. (2003, p. 63) conclude that "semantic transparency plays a critical role in the processing of compounds". More importantly, they remark that a compound's semantic transparency as a whole is directly connected with the transparency of the compound's individual morphemes, and that this does not depend on whether they are in the position of the morphological head or non-head. If semantic transparency was regarded as a property of the whole word, then TO, OT and OO compounds would not have been distinguishable, which was not seen in their results. If the reason behind constituent priming effects were the number of opaque elements, then TO and OT compounds should have demonstrated similar patterns, which was not observed. All in all, Libben et al. state that the pattern of the findings of their experiments requires the adoption of a complex view involving "the opacity of individual morphemes in a construction, their position in the string, and their morphological and semantic roles in the meaning of the word" (Libben et al., 2003, p. 63).

Jarema, Busson, Nikolovar, Tsapkini, and Libben (1999) conducted a similar study on French and Bulgarian compounds. The comparison of French and Bulgarian is interesting since compounds in Bulgarian are right-headed (as in English), but French has both right-headed and left-headed compounds, which allows distinguishing between linear position and headedness effects. As in Libben et al. (2003), Jarema et al. conducted two experiments that employed constituent repetition priming (while targets were the compounds, either their first or second constituents served as primes) in a lexical decision task. For the experiment in French, left-headed TT e.g. *haricot vert* bean:green 'green bean', TO e.g., *argent liquide* money liquid 'cash', and OO *éléphant blanc* elephant:white 'white elephant', i.e., something whose cost exceeds its benefits, compounds were used. Besides, right-headed and left-headed OT type compounds were included (e.g., *garçon manqué* boy:failed 'tomboy' for the left headed compound condition, and *grasse matinée* fat:morning 'sleep-in/lie-in' for the right-headed compound condition). The results indicated priming effects in all compound types, for both word-initial and word-final conditions. Significantly larger priming effects were obtained for the initial constituents of the left-headed compound; however, no similar effects were found for right-headed compounds. Additionally, the difference across transparency status did not produce any priming facilitation for the left-headed compounds. In their second experiment, Jarema et al. studied Bulgarian compounds using the compound categories suggested by Libben (2003). The results showed that the second constituent of TO compounds yielded significantly weaker priming effects and no constituent priming effect was obtained for OO compounds, which suggests that the recognition and processing of compound words in Bulgarian seem to occur as whole units. In this respect, the results of Jarema et al. (1999) for Bulgarian and Libben et al. (2003) for English pattern together in that both reported reduced priming effects in TO-type compounds. The results of the second experiment, which was on Bulgarian compounds indicated that stronger priming effects were yielded in the word-initial constituent condition for the TT, TO and OO compounds and for left-headed OT compounds. Jarema et al. (1999) concluded that this pattern of results can be taken as evidence for the mixed effect of headedness and position for the head initial conditions. Accordingly, it is claimed that the absence of larger priming effect for the word-initial position in the right-headed OT compounds resulted from the diminished effects of linear order and headedness. Even though each constituent has a facilitatory effect on the recognition of the compound, the first constituent's facilitation derives from its position while the second constituent's effect can be attributed to its status as the head.

German is another language which is extremely well suited for the investigation of compounding. As stated by Smolka and Libben (2017), compounding in German is an exceptionally productive word formation process and has a consistent morphological headedness. In this respect, it offers a good experimental ground for psycholinguistic investigations. Smolka and Libben (2017) focused on the effects of semantic transparency of first and second constituents on compound processing in German. Applying an overt visual priming experiment and manipulating the transparency of modifiers and heads, they examined whether the processing of German compound words is driven by semantic transparency. In the experiment, each compound pair held the same head (e.g., *Hundeauge* 'dog's eye' and *Hühnerauge* 'corn', literal: 'hen's eye') and in each pair, the modifier of one of the compounds was semantically transparent (e.g., *Hund* 'dog' in *Hundeauge)* and the other was opaque (*Huhn* 'hen' in *Hühnerauge*). Compounds were preceded by either their transparent or opaque modifiers, or unrelated controls. Through head manipulation, compounds like *Pferdeohr* ('horse's ear') or *Eselsohr* ('dog-ear';

literal: ‘donkey’s ear’), which were preceded by their transparently or opaquely related head *Ohr* (‘ear’), or an unrelated control were also included. The results showed that the frequency of a compound was a facilitatory factor, while the head frequency was inhibitory. However, modifier frequency was facilitatory when it was not the prime and inhibitory when it was the prime. In sum, their findings illustrate that compound constituents and their whole word representations compete in compound processing. Besides, frequencies of the components and whole-words influence compound processing. However, they inferred that lexical representations in German can be attributed to the constituents of a compound without any distinction between head and modifier, and independently of semantic transparency.

Shoolman and Andrews (2003) employed masked priming technique to examine morphological influences on lexical decision performance. Their stimuli consisted of transparent (e.g., *bookshop*) and opaque (e.g., *jaywalk*) compound words, monomorphemic words which have a compound-like structure (e.g., *fracture*, *hammock*), and nonwords consisting of two real words (e.g., *toadwife*) and two nonwords consisting of two nonword constituents (e.g., *skensile*). All compound words were presented as targets, and their first or second constituents or unrelated strings served as primes. In order to examine the strategic influences of morphological decomposition, nonwords consisting of the combinations of unrelated words and consisting of two nonwords were compared with word-word nonwords which were constructed from highly associated words (e.g., *fastslow*) or reversed versions of the real compounds (e.g., *droprain*). They found that in word classification both first and second constituent primes yielded facilitatory effects compared to unrelated primes, which suggested during lexical retrieval, first constituents do not have a special role. However, in nonword classification, the position of the lexical constituents played a role in the decision process. Nonwords with a nonword first constituent were classified more accurately and quickly compared to the ones with a real word in the first position regardless of whether the element in the second position was a word or nonword. Besides, nonwords consisting of two word elements were classified less accurately and more slowly than word-nonwords words. These two item types also displayed different priming effects in that word-nonword items made use of the constituent primes, but a slight inhibition effect was observed in word-word items. This pattern of priming effects indicated orthographic or lexical overlap instead of morphological relationships. However, the performance differences observed between compound and noncompound words were in line with the assumption that there was an explicit representation of morphological relationships in the mental lexicon and they suggest that this is not simply a consequence of the semantic relationship between the morphological constituents and the whole form. No evidence of a difference between semantically transparent and opaque compounds was reported; rather, their findings implied localized representations of morphologically complex words which are activated through the representations of their constituent morphemes (Taft, 1991, 1994).

Shoolman and Andrews' (2003) overt presentation of compound words as the targets of the experiment questions the locus of priming effects in terms of whether the observed priming effects are a result of automatic processing. With this argumentation, Fiorentino and Fund-Reznicek (2009) used compound words as the primes and their first and second constituents as the targets in their study. Using the masked priming paradigm, they investigated if compounds are segmented into their constituent morphemes during visual recognition via a lexical decision task. They included transparent (e.g., *flagpole*) and opaque (e.g., *hallmark*) compounds and an additional orthographic overlap (e.g., *plankton*) category by controlling their frequency, neighbourhood effects and number of letters. Both in their first experiment where they used first constituents as targets, and in the second experiment where the second constituents were used as targets, they reported strong priming effects independent of the semantic transparency of the compound words. However, no priming effect was observed in the orthographic overlap condition. These findings provide further evidence for across-the-board morphological-level decomposition at the early stages of word recognition regardless of the constituent position and semantic transparency and for morpheme-based compound processing.

Perea, Duñabeitia, Acha, and Carreiras (2007) investigated the recognition of Spanish and Basque compounds in a lexical decision task. Spanish and Basque are two languages with different internal structure regarding compound words. While compounds in Spanish are right-headed, Basque is random in headedness. They found that second constituent frequency plays an important role in reaction times both in Basque and Spanish. They state that their findings support the decomposition theory in that compounds are decomposed before lexical access.

As Myers (2006) stated, Chinese plays a rather critical role in our understanding of compound processing as compounds are extensively used in the language as the dominant word formation process. However, Myers further argues that it is pretty complicated to define the concept of a word in Chinese due to the nature of Chinese orthography, which makes the role of compounding a rather complicated issue. As a variation to a visual lexical decision task, Chen (1993), Tsai (1994), and Lee (1995 as cited in Myers, 2006, pp. 182,187) manipulated the stimulus-onset asynchrony (SOA) between the appearance of the first and second constituents of bilexical compounds. All their studies demonstrated positive constituent frequency effects dependent on semantic transparency for transparent compounds, but negative or absent for opaque compounds, and on SOA. Chen (1993) found a negative effect of frequency at the longest SOA (200-600 ms) regardless of semantic transparency and suggested that the negative effect of constituent frequency might have been obtained due to the competition between the whole word and its constituents as consistent with Libben et al.'s (2003) proposal.

In an attempt to clarify the influence of semantic transparency, Peng, Lui, and Wang (1999) carried out a visual lexical decision experiment by manipulating the frequency of the stimulus words and holding transparency constant and found a positive frequency effect. However, when they held the frequency constant, they observed that frequency effects depended on semantic transparency in that for semantically transparent compounds the frequency effect was reported positive, but for opaque compounds, the effect was negative. Peng et al. (1999) suggested that for opaque compounds, the activation was inhibited because of the competing semantics of the constituents, and thus a significant priming effect was obtained only for semantically transparent compounds. Liu and Peng (1997) also obtained similar findings in a visual priming task with an SOA of 86 ms. Their findings signalled early decomposition for semantically transparent compounds but whole-word access for opaque compounds, which implies the presence of supralexical segmentation in Chinese compound processing.

The role of semantic transparency was also investigated through eye movement studies. Pollatsek and Hyönä (2005) conducted three experiments to explore the eye-fixation patterns in the silent reading of compounds in Finnish. In the first two experiments, subjects were asked to silently read sentences presented on a computer screen. The semantic transparency of compounds occurring within the sentences, as well as the frequency of the first constituents which occurred in a split position, were manipulated, but their whole word frequencies were matched. Target words were integrated in the sentences and their positions were arranged closer to the beginning of the sentences. Pollatsek and Hyönä found that the gaze duration was influenced by the frequency of the first constituents, but semantic transparency of the compounds did not make any difference. More regression was observed to the prior words after opaque compounds, and also the words following opaque compounds were skipped more often compared to those following transparent compounds. The third experiment made use of an eye movement contingent display chance technique. To be more precise, the first two letters of the second constituents were presented in the same way as the original word, but the following letters were replaced with similar letters. Finally, they reported that semantic transparency did not produce any reliable facilitation.

Another similar eye-tracking study on English compounds was carried out by Frisson, Niswander-Klement, and Pollatsek (2008). Differently from Pollatsek and Hyönä (2005), Frisson et al.(2008) employed TT, OT, TO and OO type compounds and the frequencies of the first components were kept close to each other. They compared three types of opaque compounds with a set of transparent compounds. For all three sets, no significant differences between transparent and opaque compounds were reported on any eye movement measure, which replicated the results of the previous study with Finnish compound words (Pollatsek & Hyönä, 2005). Experiment 2 made use of the same sets of compounds, but this time a space was inserted between the constituents. Unlike their first experiment, this experimental condition yielded a transparency effect. Considering all these findings, Frisson et al. (2008) concluded that “when an assembly route is forced” (p. 87), transparency plays a role and directs towards the decompositional route, and added that this is a plausible finding. As the compounds are presented as separate words, the decomposition route is more likely to be taken in such a way that first the meanings of the individual words are accessed and this is followed by the integration of the two meanings. Thus, if a compound is semantically transparent, the integration process is expected to be rather straightforward, but if the compound is opaque or partially opaque simply integrating two meanings will create a semantic anomaly and the whole word meaning will be sought, which is in parallel with their findings as they reported differences between spaced transparent and opaque compounds in terms of gaze durations.

Juhasz (2007) investigated the influence of semantic transparency on the recognition of English bilexemic compound words (e.g., *dollhouse*) by recording eye movements. Transparent and opaque compound words were embedded in neutral sentence frames with particular care for the position of the targets in the sentence (not located either in the first two or last two positions), and the lexeme frequencies were manipulated. On gaze durations, a main effect of transparency was obtained, but it did not interact with the lexeme frequency. In this respect, Juhasz (2007) concluded that both transparent and opaque compounds are decomposed in a similar way during the early stages of word recognition since the frequency of both constituents influenced gaze durations and these did not interact with the compound’s transparency. In addition, on the go-past duration measure, main effects of transparency and second constituent frequency were observed. Go-past duration is described by Juhasz (2007, p. 382) as “the sum of all fixations on the compound plus the duration of any regressions back to the beginning of the sentence before the reader moves their eyes to the right of the compound”. However, first constituent frequency had a significant effect only for transparent compounds, but no such effect was observed for opaque compounds. Juhasz states that the reason of this interaction can be a result of the simplicity of integrating the semantically transparent and high frequent concepts into the sentence. She also refers to Libben’s (1998) model, which offers three levels of compound word recognition: stimulus, lexical and conceptual. Transparent compounds are connected to their constituents at both lexical and the conceptual levels and if these are highly frequent concepts, then this will further help the integration process. Whereas opaque compounds will be linked to their constituents only at the conceptual level and the frequency of their constituents will not make any difference at this level.

2.6.2 Studies on L2 Processing of Compound Words

The majority of morphological processing studies have considered native speakers in an attempt to understand the L1 pattern of language representation and processing. In spite of being much fewer in number relative to the studies on native processing, studies investigating non-native language processing have gained importance in recent years. In the L2 compound processing literature, the main focus of experimental studies has been English as a second language, but in terms of the L1s studied, a variety of languages (e.g., Chinese, Korean, German, Spanish) have been discussed.

De Cat, Klepousniotou, and Baayen (2015), for example, investigated the processing of English noun-noun compound words in order to determine to what extent the performances of native speakers of English and L1 Spanish and German speakers of L2 English differ and to identify the nature of possible differences. The study focused on whether a structure having an equivalent word order in L2 speakers' native language had an effect on their processing of noun-noun compound words in their second language; moreover, it was investigated whether such an effect was because of differences in grammatical representation, which referred to the incomplete acquisition of the relevant structure. They conducted two masked primed lexical decision experiments in which compounds were presented with their constituents in licit (e.g., *coal dust*) vs. reversed (e.g., *dust coal*) order. In the first experiment, reaction times were recorded through a speeded lexical decision task while in the second experiment a delayed lexical decision task with EEG registration was used. Regarding accuracy, no significant group differences were obtained in the licit word order, implying that non-native speakers have fully acquired the grammatical representations. However, native speakers of Spanish made slightly more errors and had longer response latencies in the reversed order condition, which was interpreted as L1 inference effect because the reverse order in English matches the licit order in Spanish. The EGG data further supported this interpretation. In brief, their findings proved the existence of morphological decomposition by advanced Spanish and German speakers of English and German with L1 inference effects. They state that their findings confirmed the significance of the Third Factor in L2 research (Chomsky, 2005 as cited in De Cat et al., 2015) in that the effects of L1 cannot be fully inhibited during L2 processing even though the target representation has been acquired.

Another study investigating English compound processing, this time by adult Korean-English bilinguals, was conducted by Ko (2011). Ko employed a masked priming lexical decision task including a forward mask (500 ms) and a backward mask (150 ms) with a 50 ms prime duration. Four different conditions (+M+S+O, +M-S+O, -M-S+O, and -M+S-O) were designed by manipulating morphology (M), semantics (S) and orthography (O), but no masked priming effect in any of the four conditions were obtained. The results indicated that Korean-English bilinguals do not segment compound words into their constituents while processing English compound words, which suggested that the whole-word access route is followed by Korean native speakers in L2 compound processing.

Another study on Korean-English bilinguals was carried out by Ko, Wang, and Kim (2011) in order to find out whether constituents of compound words in one language were activated while processing compounds in another language. Two experiments employing a lexical decision task were administered to Korean-English bilinguals. Their results provided evidence for both morphological decomposition and cross-language activation in the bilingual processing of compound words. Similar findings were also obtained by Cheng, Wang, and Perfetti (2011), who studied Chinese-English bilinguals. Similarly, they used a lexical decision task using compound words from two languages and including two types of compound words: transparent (e.g., *bookshop*) and opaque (e.g., *deadline*). Their findings showed that semantically transparent compound words were judged more accurately by Chinese-English bilinguals.

Lemhöfer, Koester, and Schreuder (2011) investigated compound reading in both native and non-native speakers of Dutch using a lexical decision task. They made use of two-constituent noun compounds which were identical in their first constituents, but differed in the legality of the boundary bigram. They grouped their participants as the 'cue present' group (e.g., *fie**ts**bel*; illegal biagram) and the 'cue absent' group (e.g., *fiet**sp**omp*; legal), thus providing an orthotactic cue at the position of the morpheme boundary. They found that both native and non-native speakers yielded shorter response latencies in the compound condition where an orthotactic cue was present. Additional analyses indicated that native speakers made use of these cues for only long compounds and no such tendency was observed for non-native speakers. These findings suggest that orthotactic parsing cues are benefited from during compound processing both by native Speakers of Dutch and German-Dutch bilinguals, which offers evidence for compound decomposition in L2 processing.

Alonso, Castellanos, and Müller (2016) conducted a study on native English speakers and native Spanish speakers of English to examine the degree of morphological structure in native and non-native lexicon. A lexical decision task was used including masked priming of the compounds' constituents in isolation. Besides, two orthographic conditions were created to control the role of orthography in possible priming effects. Both native and non-native speakers displayed reliable priming effects for the morphological condition, but not for orthographic condition compared to an unrelated baseline, which is unmediated by semantics. In addition to contributing further evidence for the presence of morphological structure in native speakers' mental lexicon, their findings suggest that at relatively advanced L2 learners, lexical representation and access in a second language are qualitatively comparable.

Another study, which has an experimental design similar to the present study was carried out by Li, Jiang, and Gor (2015). They conducted a series of masked priming experiments in order to investigate the early automatic processes of visual recognition of English bimorphemic noun-noun compounds in native and non-native speakers. Results indicated robust and statistically equivalent masked priming effects both in the semantically transparent condition (e.g., *teaspoon –TEA*) and opaque (e.g., *deadline –DEAD*) conditions, regardless of the constituent position. However, no priming effect was observed with orthographic control pairs designed for both word-initial (e.g., *restaurant–REST*) and word-final (e.g., *beverage- AGE*) positions. Similarly, advanced Chinese learners of English yielded robust and statistically equivalent priming effects in both transparent and opaque compound conditions and in both positions. However, in the orthographic overlap condition, clear priming effects were reported for the word-initial overlap position; however, for the word-final position no such effect was obtained. Li et al. suggest that the existence of orthographic priming should not simply rule out morphological priming in compound conditions as there were no orthographic priming effects observed in the word-final overlap condition, which indicates the priming was morphological in nature. They conclude that early English compound recognition is mediated by morpho-orthographic decomposition mechanism not only in L1, but also in L2 morphological processing.

When the findings of all the previous studies investigating compound processing in L1 and L2 are taken together, it is possible to find evidence both for morphological and orthographic priming effects at an early stage of word recognition, but these effects are often conditioned by factors such as prime duration, position-in-the-string and headedness effects, constituent frequency and neighbourhood density and proficiency effects in L2. Additionally, reaching a common conclusion about the effects of semantic transparency on compound word recognition does not seem achievable in that whether only semantically transparent compounds are processed by means of decomposition or in both transparent and opaque compounds the constituent morphemes are activated. Schäfer (2018) discusses that several factors make a straightforward comparison of these research studies difficult. One of these factors is that none of the experiments reported were replicated in an exactly same manner apart from some attempts in different languages. In addition, the method of establishing semantic transparency does not seem exactly the same in that some researchers classified the compounds in different categories of semantic transparency, others used scales and asked their participants to rate the transparency of the words. Finally, different sorts of tasks were used or slightly differing variations of these tasks were employed. All in all, even though the results of the previous studies make a great contribution to the field, they are unable to give a very clear picture on the locus of morphemic representation. In addition, it is quite evident that more research in different languages on L2 processing of compound words is required to be able to make a more direct comparison between the L1 and L2 lexicon and to assess the generalizability of the findings.

CHAPTER 3

EXPERIMENT 1: MASKED PRIMING OF WORD-INITIAL COMPOUND CONSTITUENTS IN TWO DIFFERENT L2 PROFICIENCY GROUPS

This chapter consists of four main sections. The first section introduces the background to Experiment 1. The second section defines the research questions and predictions specific to Experiment 1. The methodology of the experiments is described in the following section, followed by the presentation of the results in the final section.

3.1 Background to Experiment 1

Although the findings coming from studies on the processing of compounds produce some highly relevant data for a better understanding of morphological processing, studies focusing on the compound representation and processing are underrepresented in both the L1 and the L2 processing literature. This underrepresentation refers not only to the insufficient number of studies focusing on compound processing but also to the range of target languages explored. In this respect, the general aim of the present study is to investigate which language processing mechanisms are at work in L2 compound processing and to probe for early automatic processes activated during the visual recognition of English compound words in non-native processing by means of masked priming lexical decision experiments. The study also seeks to examine the role of constituent position in compound processing by testing if a compound word primes its constituents equally. If the compound word does not prime its constituents equally, then it aims to find out whether the initial or the final constituent produces facilitative priming effect for compound word recognition. Experiment 1 focuses on the effect of compound-initial position on compound processing in two groups of nonnative speakers at two different proficiency levels (low and high proficiency). As discussed in Chapter 2, compounding is found in a vast number of languages owing to its productivity, simplicity and high frequency. Compounding, which is a productive means of word formation in English, is the process of combining two (and in some instances more) free morphemes, i.e., nouns, adjectives or verbs, to compose a brand-new word, a compound word (Hamawand, 2013, p. 201). They may appear as one word (e.g., *bedroom*), two hyphenated words (e.g., *ice-cold*) or sometimes as two separate words (e.g., *fire alarm*). Each language has its own rules to develop and use these compound words; for instance, in Finnish, German and Dutch novel compounds are quite common and they are developed rather productively (Hittmair-Delazer, Andree, Semenza, Blesser, & Benke, 1994; Juhasz, Starr, Inhoff, & Placke, 2003). Even though English is not as spontaneous, there are also no systematic rules to put two or more free lexemes together (Juhazs, et al., 2003).

In English, compound words follow the Right-hand-Head Rule, which is the principle proposed by Williams (1981) suggesting the second constituent (the right-most element) of a compound is the head of the word (Libben & Jarema, 2006; McGregor, Rost, Guo, & Sheng, 2008). Fundamentally, the head of the compound specifies its category and the most prominent lexical and semantic characteristics of the compound (e.g., *doghouse* is a kind of *house*, not a kind of *dog*). On the other hand, the left-most constituent assumes the modifier role and provides a delicate specification to the compound meaning (a *doghouse* is house meant for *dogs*) (Marelli, Gagné, & Spalding, 2017). The interaction between the two constituent meanings is defined by the relation binding them. That is, a change in the meaning of the compound head shaped by the modifier is the outcome of more than a simple addition of two individual parts. Indeed, when it is joined with different heads, the same modifier may bring about a particular change in the meaning of the compound. For instance, a *snow ball* describes a ball made of snow, whereas, a *snow shovel* is a kind of shovel used for snow. Nevertheless, it may not always be possible to infer the meaning of the compound from the constituent meanings as sometimes the meaning of the novel combination crucially differs from its constituents regarding the final result. This conflict arises from the degree of transparency of the compound, which ranges from totally transparent cases as in *birthday*, where the meaning of the compound can easily be understood from its constituents, to highly opaque cases as in *deadline*, where the meaning of the compound is not consistent with its components and mostly arbitrary. This often complicates the process of arriving at correct interpretations of the meaning of a compound.

The role of semantic transparency in the processing of morphologically complex words is a critical issue since it is suggested that the transparency of a compound word determines whether it has its own representation in the mental lexicon or is represented by its constituents (Schreuder & Baayen, 1995). Accordingly, totally opaque compounds are stored as whole words in the mental lexicon since the constituents do not give provide information about the meaning of the compound (Libben, Gibson, Yoon, & Sandra, 2003). However, the results of experiments testing the effect of transparency are not always consistent as there are findings indicating that transparent and opaque compound words are represented and accessed in a similar way (Fiorentino et al., 2007, 2009; Libben, 1998; Zwitserlood, 1994). Therefore, in the present study transparent and opaque compounds were included in order to investigate whether transparency had an influence on the representation of the morphologically complex words in English. Finally, the research focused on noun-noun combinations since they are referred to as the most productive type of compounding and form the largest group of compounds in English (Algeo, 1991). Besides, the variety of semantic relationships between the constituents of a noun-noun compound word sets an ideal ground for examination.

3.2 Research Questions and Predictions

The research questions and predictions specific to Experiment 1 are as follows:

1. How do native speakers of Turkish process noun-noun compound words in their second language, English, during the early stages of visual word recognition?

- Do native speakers of Turkish decompose English noun-noun compounds into their constituent morphemes?

2. Is L2 compound processing and recognition mediated by semantic transparency and/or orthographic overlap?

- Will morphological priming effects be observed in both transparent and opaque compounds? If any such effects are obtained, will there be any difference between these two types of compounds?

- Are pseudocompounds decomposed into their constituent morphemes during early stages of visual word recognition in L2?

3. Do the processing patterns observed differ depending on whether the experimental targets are first or second constituents within compounds?

- Does a compound word prime its first constituent?

4. Does the processing of compound words change as a function of L2 language proficiency?

To address the first research question, whether native speakers of Turkish decompose noun-noun compounds in their L2 English, the following predictions were made. If L1 Turkish users of L2 English process compound words by decomposing them into their constituent morphemes, a priming effect is predicted to occur in the test condition compared to the unrelated condition, which suggests shorter RTs for the target words in the related condition. Such a finding would lend support to the sublexical morpho-orthographic decomposition model of complex word processing (Rastle, Davis, & New, 2004; Taft & Forster, 1976; Taft, 1994). On the other hand, if there is no facilitative priming effect, it could be concluded that Turkish native speakers do not decompose compound words in L2 English into their components; instead they store and retrieve noun-noun compounds (and possibly also other morphologically complex words) as full forms in their mental lexicon, which would be a result supportive of Single Mechanism Accounts.

It is also predicted that facilitative priming effects in both transparent and opaque conditions will be observed as both transparent (e.g., *bedroom*) and opaque (e.g., *deadline*) compounds can be decomposed into their constituents. However, the degree of priming is expected to be different in transparent and opaque conditions.

In transparent compounds, the priming effect is expected to be due to the morphological, semantic and orthographic overlap between the prime-target pairs; however, due to the lack of semantic overlap in the opaque prime-target pairs, less priming effect is expected in opaque condition. This finding would be in parallel with the Hybrid Account (Diependaele, Sandra, & Grainger, 2005, 2009) which proposes both sublexical morpho-orthographic and supralexical morpho-semantic processing function in a parallel way during early stages of visual word recognition. Moreover, in the orthographic overlap condition involving pseudocompounds (e.g. *hammock-ham*), negative (inhibited) priming or null priming effects are expected because the lexical representation of a pseudomorpheme (e.g. *ham* in *hammock*) is not likely to be accessed if morphological decomposition occurs automatically or semantic factors are involved.

In relation to the third question, it is predicted that both first and second constituents of transparent compounds will produce facilitative priming effects in processing in parallel with Sandra' (1990) and Libben's (2003) findings. However, as opposed to the findings of Li et al. (2005) who found priming effects both in word-initial and word-final position, it is expected that the word-initial position will yield smaller priming effects because in English the second constituent, which functions as the semantic head, determines the meaning and the word category and thereby influences the processing of compound words. Besides, no priming for the opaque and pseudocompound condition is expected. Such a result could easily be taken as evidence against automatic decomposition because if automatic decomposition occurred, all complex words would be expected to be decomposed before the whole word access (Rastle, Davis, & New, 2004; Taft & Forster, 1976). However, if such a priming effect is obtained nevertheless in these conditions, this could be attributed to form priming rather than semantics.

Finally, different priming effects are expected for low and high proficiency L2 speakers as it has been reported that L2 proficiency has an impact on the links between L1 and L2, and the concepts in the mental lexicon (Kroll & Stewart, 1994). High proficiency L2 learners are more likely to develop a connection to the L2 concept system rather than relying on their L1. Thus, higher proficiency in L2 leads to the employment of the procedural memory more rather than the declarative memory (Ullman, 2005). Accordingly, in parallel with the findings of De Cat et al. (2015) the high proficiency level L2 learners in the present study are expected to rely on procedural memory which will generate stronger priming effects compared to the low proficiency level L2 learners as long as they process the complex word forms by decomposing them into their constituent morphemes. On the contrary, in the low proficiency group, the declarative memory is expected to be applied and instead of decomposition, words are expected to be stored as full forms in the mental lexicon.

3.3 Experimental Methodology

The experimental technique for both experiments to be carried out in the current study was the masked priming paradigm. In masked priming experiments, the prime word is preceded by a forward mask, and sometimes followed by a backward mask, which consist of a string of symbols, for example, a set of hash marks (########) and matches the prime in length (regarding the number of letters they have) or can be longer than the longest prime word. The forward mask is displayed for approximately 500 milliseconds (ms) and immediately afterwards, the prime is presented for a very short time which is typically 34-60 ms (Rastle & Davis, 2008) hardly ever exceeds 80 ms (Neubauer & Clahsen, 2009) in order to avoid conscious processing. The prime is followed by the target word on which the participants perform a lexical (word/nonword) decision. The forward mask and target should stay on the screen longer than the prime to ensure an effective masking process. Moreover, prime words are presented in lower case letters while the targets are presented in upper case letters so as not to create any visual overlap between these two words.

In the masked priming technique which was devised by Forster and Davis (1984), the aim is to minimize the likelihood of any strategic effects and make sure the participants are unaware of the presence of the prime and of the relationship between the target and the prime. The “stimulus onset asynchrony” (SOA), which refers to the interval between the onset of the prime and the onset of the target, is usually kept brief in order to avoid conscious identification of the primes and also reduces the probability of adopting any predictive strategies. The priming effect obtained out of this procedure is more likely to represent automatic processing, which offers an insight into the structure of the mental lexicon. Furthermore, through a proper manipulation of the SOA, different sorts of linguistic information, such as orthographic, morphological, semantic and so on, can be attained. Thus, data obtained from masked priming experiments contribute to the debates on whether morphological effects are produced by formal (orthographic/phonological) or semantic overlap, or are generated from lexical structure. In this respect, the masked priming paradigm was employed in this study as it is an appropriate tool to examine the processing of morphologically complex word forms.

In masked priming experiments, the most common manipulated variable is the prime- target relationship, which generally involves three different conditions: (a) morphologically, orthographically and semantically related prime-target word pair (+M+S+O; e.g., *teacher-TEACH*); (b) a morphologically and orthographically related, but semantically unrelated/opaque prime-target word pair (+M-S+O; e.g., *department-DEPART*); and (c) an exclusively orthographically-related prime-target word pair (-M-S+O; e.g., *brothel-BROTH*). Priming arises when the representation of the target word is activated by the prime word and hence the processing is facilitated (Forster, 1998). The difference between related and unrelated conditions is considered as a measure of priming. A priming effect is obtained when mean reaction times obtained from these different conditions are compared. Priming occurs when the reaction time for the related condition is shorter than the unrelated condition; however, when there is no statistically significant difference between these two conditions, no priming effect is observed.

3.3.1 Participants

70 native speakers of Turkish, consisting of 38 low-proficiency L2 learners and 32 high-proficiency L2 learners participated Experiment 1. The participants with low proficiency, made up of 28 males and 10 females, and aged 18-22 (mean: 19, SD: .95, median: 19), were all undergraduate students at Eskişehir Osmangazi University, Department of Foreign Languages. They were first exposed to English in formal classroom settings between the ages of 10-14 (mean: 10.16, SD: 1.53, median: 10)

and experienced learning in their home country (mean 8.84 years, SD: 1.88). On the other hand, participants with high proficiency consisted of 8 males and 24 females with an age range of 18 to 24 (mean 20.44, SD: 2.05, median: 20). They were all undergraduate students in their freshman year at the same university in the Department of Foreign Language Education. Their first exposure to English was between the ages of 7-12 (mean: 9.69, SD: 1.14, median: 10) in a classroom environment (mean year of exposure: 10.75, SD: 2.15). All participants stated that they were born in Turkey and started learning Turkish from birth and none of them reported to have lived in an English speaking country more than six months.

The participants took the Oxford Quick Placement Test (OPT) around one month before the experiments to confirm they belong to the two different L2 language proficiency groups. Participants in the low proficiency group obtained a mean score of 27.65 (SD: 3.67) out of 60, which corresponds to A2 (Waystage / Elementary) level according to the Common European Framework of Reference for Languages (CEFR), which is a description of language ability levels created by the Council of Europe. The high proficiency L2 learners' mean score was 43.68 (SD: 6.93) out of 60. This corresponds to the B2 (Vantage) level according to the CEFR. The difference between these two OPT scores was found to be statistically significant ($p < .001$)

All participants participated in the experiments voluntarily and were not paid for their involvement. The experiments were performed in two months. Each participant was tested only once and did not take part in more than one experiment or experimental list. All participants were naïve with regard to the purpose of the experiments. They all had normal or corrected-to-normal vision, no history of learning disabilities or brain impairment. Table 1 and 2 below summarize the background information of the participants in Experiments 1a, 1b and 2a, 2b (the latter two will be discussed in more detail in Section 4.3.2) .

Table 1 Background Information of the Turkish Learners of English in Experiments 1a and 2a

	Experiment 1a Priming of word-initial position in low proficiency group (n=38)		**Experiment 2a Priming of word-final position in low proficiency group (n=36)**			
	Mean	***SD***	***Mean***	***SD***	***Statistics***	***p***
Age	19	0.95	19.31	0.98	U=552	.128
Female/Male	10/28		9/27			
Age of Onset of Acquisition	10.16	1.53	10.36	0.83	U=594.5	.188
Length of Instruction	8.84	1.88	8.94	1.28	U=667	.848
OPT	27.65	3.67	25.52	3.71	U=589	.302

Table 2 Background Information of the Turkish Learners of English in Experiments 1b and 2b

	Experiment 1b Priming of word-initial position in high proficiency group (n=32)		**Experiment 2b Priming of word-final position in high proficiency group (n=32)**			
	Mean	***SD***	***Mean***	***SD***	***Statistics***	***p***
Age	20.44	2.01	20.13	1.38	U=488	.739
Female/Male	23/9		24/8			
Age of Onset of Acquisition	9.69	1.14	9.94	0.8	U=414	.076
Length of Instruction	10.75	2.15	10.22	1.6	U=455	.434
OPT	43.68	6.93	45.31	5.74	U=445	.368

3.3.2 Materials

A 3 (Condition/Prime Type: +M+S+O, +M-S+O, -M-S+O) X 2 (Relatedness: related/unrelated) design was adopted in the present study. +M+S+O condition was used for transparent compounds, which corresponds to morphological (M), semantic (S) and orthographic (O) overlap; +M-S+O condition was used for opaque compounds; -M-S+O condition was designed only for orthographic overlap. Opaque and transparent compounds were selected based on Juhasz's (2007) classification where transparent compounds are classified as those in which both lexemes in the compound contribute to the overall meaning of the it (e.g., *toothbrush*) and opaque compounds are classified as those, the meaning of which are not easily computable from the meanings of the two lexemes (e.g., *deadline*).

An initial set of 30 transparent compounds and 30 opaque compounds were composed by intuition and were piloted with native speakers of English (NSs) via an online semantic rating study in order to gather subjective ratings for semantic transparency. The online survey was sent to Fulbright teaching assistants who worked in Turkey via e-mail and also to other native speakers of English through social media. Two different lists were prepared and in each list all 60 compound words appeared only once; half of them were paired with their first constituents and the other half was paired with their second constituents (no rating data were gathered for the monomorphemic words since their "constituents" were nonwords). Two rating tasks were composed and each list was rated by different participants only once. The items were ordered randomly within each list. Participants were provided with two examples to make explicit what they were required to do. In the first task, 40 native speakers of English rated 60 compound words on a 4-point Likert scale ranging from *Not at all (1), Very little (2), Somewhat (3) and To a great extent (4).* The participants were requested to rate to what extent the constituent morpheme (either the first or the second constituent) contributes to the overall meaning of the compound word as in the example below:

- To what extent does the word "air" contribute to the meaning of the word "airport"?

In the second task, the same list of 60 compound words was used again, yet this time the constituents which were not addressed in the first task were rated in terms of their transparency as in the example below:

- To what extent does the word “port” contribute to the meaning of the word “airport”?

The second task was completed by 49 native speakers of English. The results were used to categorize the compounds; compounds with a mean rating score greater than 2.50 were classified as *transparent*, while those with a score below 2.50 were classified as *opaque*. As a result of these two rating tasks and categorization processes, a set of 40 compounds (20 transparent, 20 opaque) was devised.

The experimental stimuli were matched on word length and log frequency using the information available in the SUBTLEX-UK corpus (Van Heuven, Mandera, Keuleers, & Brysbaert, 2014), which is based on the subtitles of British television programs and includes 201.3 million words from 45,099 BBC broadcasts, and is able to explain more of the variance needed to account for word processing times compared to British National Corpus and the SUBTLEX-US frequencies (Van Heuven et al., 2014).

All the compounds used in the study consisted of noun-noun combinations which appear in unhyphenated single word forms in the online Merriem-Webster dictionary. A set of 20 transparent compounds and 20 opaque compounds were arranged as the morphological primes and their constituents as the targets. Both word-initial (e.g., *airport-AIR*, Experiments 1a and 1b) and word-final (e.g., *airport-PORT,* Experiments 2a and 2b) constituent priming were tested through this procedure.

Furthermore, pseudocompounds, which are described as “polysyllabic, monomorphemic words comparable in length and frequency to the compounds, and whose initial or final syllable(s) is an unrelated ‘accidentally’ embedded noun (e.g., *fur* in *furlong*, *bone* in *trombone*” (Monsell, 1985, p. 186), were also included as the orthographic control condition. Pseudocompounds consisting of 40 monomorphemic words in total were divided into two sets in that 20 of them were arranged for the word-initial overlap condition and the other 20 were used for the word-final overlap condition. The first set contained mono-morphemic words with an embedded pseudo-morpheme falling into the word-initial position and a non-morphological ending (e.g., *costume-COST*); the words in the second set consisted of an embedded pseudo-morpheme in word-final position and a non-morphological onset (e.g., *candidate-DATE*). While the former set of mono-morphemic words were treated as the control items to test word-initial priming, the latter set was used to examine word-final constituent priming.

The lexical properties of the experimental items across transparent, opaque and orthographic conditions were matched with regard to prime length (F (2, 57) = 1.498, p = .232) and constituent length (F (2, 57) = 1.902, p = .159) as well as prime frequency (F (2, 57) = .213, p = .809) and target frequency (F (2, 57) = 2.305, p = .109) in word-initial position (Table 3).

Table 3 Stimuli properties across conditions (1st constituents as targets)

Property	**TT**	**OO**	**Orth1**	**ANOVA**
Prime length	0.89	0.92	0.87	F (2,57) = 1.498, p = .232
Prime log freq.	2.89	3.03	2.98	F (2,57) = .213, p = .809
Target (1st) length	0.60	0.62	0.56	F (2,57) = 1.902, p = .159
Target (1st) log freq.	4.48	4.14	4.29	F (2,57) = 2.305, p = .109

Note: TT: Transparent compounds; OO: Opaque compounds; Orth1: Orthographic control condition for word-initial position; length: mean numbers of letters; log freq: average log10 transformed word frequencies per million words.

Unrelated control compounds were also included in the experiment to match the compound primes. These had no morphological, orthographic or semantic relationship with the target words and did not share any letters falling into the same position. In addition, unrelated control primes containing an embedded pseudo-morpheme either in word initial or word-final position were also employed to pair with the primes in the orthographic overlap position. Unrelated control primes were matched with the related primes in all three conditions in terms of both length (all *F*s > 3.2, all *p*s = 1) and frequency (all *F* > .60, all *p*s = 1, One Way ANOVA) with the related primes. The unrelated control condition provides a baseline to which all the other primes are compared. A sample set of the experimental design and stimuli are displayed in Table 4.

Table 4 Design and Example Stimuli

	Position 1 (Experiments 1a & 1b)		
Prime Type	**Related Prime**	**Unrelated Prime**	**Target**
TT (+M+S+O)	airport	bedtime	air
OO (+M-S+O)	butterfly	honeymoon	butter
Orthographic overlap (-M-S+O)	costume	balloon	cost

Note: TT: Transparent compounds; OO: Opaque compounds; Orthographic overlap: Orthographic control condition for word-initial position; M: morphology, S: Semantics, O: Orthography.

In addition to the critical items, 180 filler pairs including 40 compound words and 20 mono-morphemic words as primes for 60 nonword targets, and 120 nonword primes for 60 word and 60 nonword targets were used in the experiment. After the inclusion of 60 experimental items, the total number of the prime and target pairs in each list reached 240 so that half of the targets required a "yes" response whereas the other half required a "no" response in the masked priming experiment. The nonword targets and primes were matched in length with the real word targets and primes. The experimental primes and targets were matched with the real word filler primes and targets in length and log frequency. Nonwords were generated using the Wuggy software (Keuleers & Brysbaert, 2010), which is a multilingual pseudo-word generator. It is an appropriate instrument to create possible nonwords which do not violate the orthographic and phonological properties of the language under investigation. In this manner, all nonwords (e.g. *lutchlime*) included the same number of letters with an existing word (e.g. *lunchtime*) submitted to the software and respected the phonotactics of the target language.

The target items for the word-initial position were divided into two counterbalanced lists so that one half of the critical targets were preceded by related primes while the other half was preceded by unrelated primes. Each target was encountered only once in each list. Each participant was assigned to a different list and took part in the experiment only once. All prime-target pairs were pseudo-randomized as "this significantly reduces the chance of having a long sequence of trials belonging to the same condition" (Jiang, 2012, p. 67) and eliminates the bias causing undesired priming effects in the experiment. Finally, all the experimental lists were reversed so that 4 lists were obtained in total so as to preclude training effects and fatigue.

3.3.3 Procedure

In each experiment in the present study, a masked priming lexical decision task was employed. The experiments were administered on an HP laptop computer with a 14.1 inch monitor using E-Prime psychological software Version 1.2 (Schneider, Eschman, & Zuccolotto, 2002) and the responses were collected by a Logitech USB gamepad. The experiment was piloted with 8 participants with the intention of making modifications if considered necessary according to the feedback received from the participants.

Prior to each experiment, the participants were provided with a consent form and were informed that they could quit at any time (Appendix B). They were also asked to fill in a background questionnaire to gather information about their demographic and language-learning background (Appendix C). Each participant was randomly assigned to each experiment and experimental list and was tested individually in a semi darkened, sound-attenuated room. All the participants were informed verbally about the procedure and were instructed that their task was to make a lexical decision and respond as quickly and accurately as possible whether the letter string presented on the screen was a real English word or not. Participants were asked to press the button on the gamepad labelled "yes" using their dominant hand if they identified the stimulus as a legitimate English word, or to press "no" with their nondominant hand if they believed the letter string was a nonword. Both right-handed and left-handed participants were told to use their dominant hands when they wanted to say "yes" as a respond to the stimuli. Participants were advised to keep their hands ready on the response gamepad all along the experiment to ensure quick responding.

All stimuli were displayed in white text against a black background in the centre of the screen. The primes were presented in lowercase while the targets were in upper case, Times New Roman 12-point font. The experiment started with a brief display of the instructions followed by a practice session consisting of 10 practice pairs. Practice trials were included with the purpose of familiarizing the participants with the task. After the practice session, participants were provided with a checklist including the words and nonwords presented in the practice session, and they were requested to check the words on the list and tick the ones they had seen in the practice session in order to ensure the prime words were not recognized. No participant stated any conscious awareness of the prime words; just 2 participants reported having caught a glimpse of 'an occasional flash'; however, they were not able to reveal whether that was a word or an arbitrary combination of letters. They were also given the opportunity to ask any questions prior to the real experiment.

Each trial began with a fixation mark '*', which was displayed for 500 ms, and was followed by a blank screen for 500 ms. Blank screen then followed by a forward mask for 500 ms. The forward mask consisted of a row of hash marks '##########' which matched the maximum length of the corresponding prime list. The mask was followed by the prime word -in lower case- for 50 ms. Immediately after the presentation of the prime, the target word –in upper case- was displayed. The target word disappeared as soon as the participant responded via pressing the button or it remained on the screen up to 3000 ms timeout period. A typical trial is displayed in Figure 6.

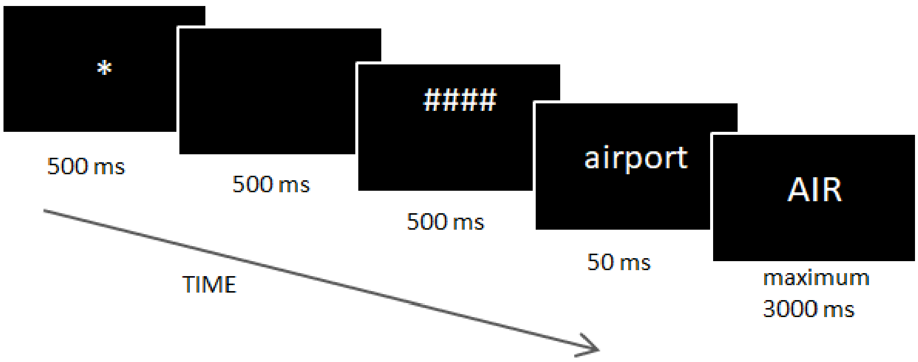

Figure 6 Sequence of screens in each trial in Experiments 1a and 1b.

Each experimental session consisted of 240 trials and involved one break after the first half of the trials was performed. When 120 trials were completed, the software paused and told the participants that they could move on to the next section when they are ready to continue by pressing any button. The complete experimental session lasted approximately 20 minutes. After the experiment, participants were administered a word translation task to further control their knowledge of primes and targets. Each participant was given the list of primes and targets which appeared in the experiment assigned to them and were requested to translate the words in the list. This procedure was critical and taken seriously because knowing the meanings of all the words was necessary to examine the role of semantic transparency in morphologically related pairs.

3.3.4 Data Scoring and Analysis

The data were prepared by making necessary adjustments and excluding undesired data. Practice items and filler information were discarded. Both the prime words and the target words which were reported as unknown by the participants in the post-test were excluded from the data set for the concerned participant. This exclusion procedure affected 1.11 % of the experimental stimuli.

Incorrect responses (nonword responses to real word targets) were excluded from the response time (RT) analysis. This procedure resulted in the deletion of 3.99 % of RT data in Experiment 1a (low proficiency, Position 1) and 2.5 % of Experiment 1b (high proficiency, Position 1). Any RTs below 300 ms and above 1500 ms were removed from the data set, which corresponded to 0.66 % of the experimental items in Experiment 1a and 0.33 % of the items in Experiment 1b. Outliers, defined as any RTs below and above 2 standard deviations of each participant's mean RT, were not included in the final analysis. This resulted in the removal of 1.36 % of the data in Experiment 1a and 1.12 % in Experiment 1b.

All the RTs were log transformed in order to reduce the positive skewness in the distributions. The RT data in each experiment were analysed using a Repeated Measures ANOVA with the factors Prime Type (+M+S+O, +M-S+O, -M-S+O) and Relatedness (related/unrelated), and subsequent planned comparisons were conducted to further investigate the significant main effects. The p-values of all analyses were Greenhouse-Geisser corrected for sphericity violations whenever applicable.

3.4 Results

3.4.1 Experiment 1a. First constituent priming in low proficiency English learners of Turkish

Experiment 1a tested low proficiency L2 learners of English. Table 5 shows the means and number of observations for raw RTs (after the necessary data exclusion procedures) and accuracy rates for the items in each condition. As can be seen, the orthographic-unrelated condition resulted in the highest number of errors whereas the lowest number of errors was observed in the transparent condition. The mean RTs indicate that the participants responded to the target words in the transparent-related condition faster than in the other conditions while the longest mean RTs were obtained in the opaque-unrelated condition.

Table 5 Mean Reaction times and accuracy rates per condition in Experiment 1a (1st constituents as targets, Low Proficiency)

	RT						
	Mean RT (SD) in ms			# of observations		Accuracy	
Prime Type	**Related**	**Unrelated**	**Effect**	**Related**	**Unrelated**	**Related**	**Unrelated**
Transparent	704.55 (78)	713.57 (73.61)	9	364	357	.99	.99
Opaque	741.06 (81)	766.33 (71.37)	25*	285	305	.93	.93
Orthographic	761.59 (78)	752.34 (74.83)	-9	326	300	.95	.91

* < .05.

The accuracy analysis showed a main effect of Prime Type in the participant and item analyses, F_1 (2, 74) = 14.36, p < .001; F_2 (2, 57) = 4. 207, p = .02. Planned comparisons revealed that this resulted from the participants' low accuracy in the opaque and orthographic conditions (Transparent-Opaque: $t(37) = 5.28$, $p < .001$; Transparent-Orthographic: $t(37) = 3.36$, $p = .002$).

A repeated measures ANOVA (Analysis of Variance) for the log transformed RT data in the participant analysis revealed a significant main effect of Prime Type $F_1(2, 74) = 34.96$, $p < .0001$, and of Relatedness $F_1(1, 37) = 5.34$, $p = .026$. The Prime Type x Relatedness interaction also reached significance $F_1(2, 74) = 3.19$, $p = .047$. This pattern of results indicates that the effect and magnitude of relatedness differ across the prime types. Similarly, in the item analysis, there was a main effect of the between items factor, prime type, $F_2(2, 57) = 7.17$, $p = .002$.

Planned comparisons concerning the effect of Relatedness at each Prime Type level were carried out so as to find out whether significant priming effects occur in each of the three prime type conditions. The results of these comparisons revealed a significant priming effect for the opaque condition (25 ms) ($t(37) = 2.59$, $p = .013$), reflecting shorter RTs for the related condition than the unrelated condition, but no significant priming effect was found for the transparent ($t(37) = 1.42$, $p = .163$) or the orthographic overlap condition ($t(37) = .919$, $p = .364$).

The role of semantic transparency was also examined by checking the interaction between Relatedness and Prime Type based on the transparent and opaque conditions only and the interaction yielded no significant difference $F(1,37) = 1.12$, $p = .295$). This finding suggests that there is no difference across the transparent and opaque conditions in terms of the magnitude of priming effect.

In sum, in Experiment 1a, a statistically significant priming effect was obtained for the word-initial constituents of opaque compounds whereas no priming was observed in the transparent and orthographic overlap conditions.

3.4.2 Experiment 1b. First constituent priming in high proficiency English learners of Turkish

Experiment 1b examined first constituent priming in the non-native processing of English compounds by high-proficiency Turkish learners of L2 English. Table 6 displays the raw mean RT and accuracy rates for each condition. The error rate was found to be the highest for the opaque items for both the related and the unrelated condition. Mean RTs show that items in the transparent condition were responded to faster than in the other two conditions while mean RTs obtained in the orthographic condition were the highest.

Table 6 Mean Reaction times and accuracy rates per condition in Experiment 1b (1st constituents as targets, High Proficiency)

	RT						
	Mean RT (SD) in ms			**# of observations**		**Accuracy**	
Prime Type	**Related**	**Unrelated**	**Effect**	**Related**	**Unrelated**	**Related**	**Unrelated**
Transparent	635.31 (72.89)	662.77 (77.37)	27*	305	298	.98	.99
Opaque	662.8 (72.52)	700.13 (75)	37**	281	275	.95	.93
Orthographic	670.56 (76.18)	681.58 (72)	11	295	289	.99	.98

* < .05;
** < .01.

The response accuracy data showed a main effect of Prime Type F_1 (2, 62) = 9.71, p = .001 in the participant analysis, but the item analysis did not yield a significant result F_2 (2, 57) = 2.28, p = .111. This finding was due to the opaque condition having higher error rates than the transparent and orthographic conditions (Transparent-Opaque: t(31) = 3.23, p = .003; Orthographic-Opaque: t(31) = 2.18, p = .37); however, no difference was attained between the transparent and orthographic conditions, t(31) = .701, p = .488.

The analysis of the log transformed RT data yielded a significant main effect of Prime Type in the participants analysis F_1 (2, 62) = 16.6, p < .000, and of Relatedness F_1 (1, 31) = 30.65, p < .0001; nevertheless, for the Prime Type x Relatedness interaction did not reach significance F_1 (2, 62) = 2.24, p = .115. In the items analysis, a main effect of the, between items factor, Prime Type F_2 (2, 57) = 5.64, p < .001 and a significant effect of, within items factor, Relatedness F_2 (1, 57) = 22.42, p < .001 were obtained.

Planned comparisons testing the effect of Relatedness at each level of Prime Type showed significant facilitative priming effects for the transparent condition (27 ms) ($t(31) = 3.42$, $p = .002$) and the opaque condition (37 ms) ($t(31) = 5.57$, $p < .0001$), but not for the orthographic overlap condition ($t(31) = 1.4$, $p = .17$).

The role of sematic transparency was evaluated further by comparing the priming effects in the transparent and opaque conditions, which turned out to be non-significant, $F(1, 31) = 1.27$, $p = .267$).

CHAPTER 4

EXPERIMENT 2: MASKED PRIMING OF WORD-FINAL COMPOUND CONSTITUENTS IN TWO DIFFERENT L2 PROFICIENCY GROUPS

This chapter consists of four main sections. The first section presents the morphological background to Experiment 2. The second section specifies the research questions and predictions designed for Experiment 2. The third section describes the methodology of the experiment, and the results of which are reported in the final section.

4.1 Background to Experiment 2

As a continuation of Experiment 1, Experiment 2 further extends the aim to find out the role of constituent position in compound processing and examines whether a compound word primes its word-final constituent. As in Experiment 1, two groups of non-native speakers with low and high L2 English language proficiency are compared to further investigate the potential influence of proficiency level on the processing of compound word forms.

4.2 Research Questions and Predictions

The research questions and predictions specified for Experiment 2 are similar to those designed for Experiment 1 as all questions were based on the better understanding of compound processing in L2 English. The only difference is that Experiment 2 focused on the potential priming of word-final constituents; therefore, the third research question was reformulated as follows:

Do the processing patterns observed differ depending on whether the experimental targets are first or second constituents within compounds?

- Does a compound word prime its second constituent?

To address the third research question, seeking an answer for whether constituent position leads to a different priming pattern, it is predicted that the priming of the second constituent of the transparent compounds will produce a reliable facilitative priming effect. In English, the second constituents within compounds serve as the heads of compounds and seem to play a bigger role in semantics. Supportive findings come from studies like Zwitzerlood (1994), who found facilitative priming effects for the second constituents as primed by transparent compounds, and Libben, Gibson, Yoon, and Sandra (2003), who obtained similar results. However, no such effect is expected for opaque and pseudocompounds, which are assumed to be accessed and processed as monomorhemic units as concluded by Jerema et al. (1999).

4.3 Experimental Methodology

The same experimental methodology as in Experiments 1a and 1b was employed in Experiments 2a and 2b. Please see Section 3.3 for details.

4.3.1. Participants

68 native speakers of Turkish, consisting of 36 low proficiency L2 learners and 32 high proficiency L2 learners participated in this study. The participants with low proficiency, 27 males and 9 females aged 18-22 (mean: 19.31, SD: .98, median: 19), were all undergraduate students at Eskişehir Osmangazi University, Department of Foreign Languages. They were first exposed to English in formal classroom settings between the ages of 10-14 (mean year of exposure: 10.36, SD: .83, median: 10). On the other hand, participants with high L2 proficiency consisted of 8 males and 24 females with an age range of 18 to 24 (mean 20.13, SD: 1.38, median: 20). They were all undergraduate students in their freshman year in the Foreign Language

Education Department of the same university. Their first exposure to English was between the ages of 7-12 (mean: 9.95, SD: .801, median: 10) in a classroom environment (mean length of exposure: 10.22 years, SD: 1.6). None of the participants reported to have lived in any English speaking country more than six months and all of them stated that they were born in Turkey and that Turkish was their mother tongue.

All the participants took the Oxford Quick Placement Test (OPT) around one month before the experiments to ensure that they belonged to the two different proficiency groups. Participants in the low proficiency group attained a mean OPT score of 26.52 (SD: 3.71) out of 60, which corresponds to A2 (Waystage / Elementary) level according to the CEFR. The high proficiency L2 learners' mean OPT score was 45.31 (SD: 5.74) out of 60. This corresponds to the B2 (Vantage) level according to the CEFR. The difference between these two OPT scores was statistically significant ($p < .001$).

Participation was on a voluntary basis and the participants were not paid for their participation. No participant took part in more than one experiment or was assigned to more than one experimental list. All participants were naïve with regard to the purpose of the experiment. They all had normal or corrected-to-normal vision, no history of learning disabilities or brain impairment. Please see Table 1 and 2 in Chapter 3 for background information regarding the participants taking part in Experiments 2a and 2b.

4.3.2 Materials

As in Experiments 1a and 1b, the experimental design adopted in Experiments 2a and 2b was a 3 (Condition/Prime Type: +M+S+O, +M-S+O, -M-S+O) X 2 (Relatedness: related/unrelated) design. +M+S+O condition was used for transparent compounds, which corresponds to morphological (M), semantic (S) and orthographic (O) overlap; +M-S+O condition was used for opaque compounds; -M-S+O condition was designed only for orthographic overlap.

The same set of compound words as in Experiments 1a and 1b was used in Experiments 2a and 2b (see Section 3.3.2). However, different from Experiments 1a and 1b, in the present experiments, word-final (e.g., *airport-PORT*) constituent priming was tested through this procedure. A set of 20 transparent and 20 opaque compounds was used as the morphological primes and their constituents as the targets. Besides, 20 mono-morphemic words consisting of an embedded pseudo-morpheme in the word-final position and a non-morphological onset (e.g., *candidate-DATE*) were included in the experiment for the orthographic overlap condition. These mono-morphemic items were used in order to examine word-final constituent priming.

The lexical properties of the experimental items across transparent, opaque and orthographic conditions were matched with each other with regard to prime length ($F(2, 57) = 2.128$, $p = .128$) and constituent length ($F(2, 57) = .008$, $p = .992$) along with prime frequency ($F(2, 57) = .862$, $p = .428$) and target frequency ($F(2, 57) = .789$, $p = .459$). The length and frequency information of the experimental stimuli is presented in Table 7.

Table 7 Stimuli Properties across conditions (2nd constituents as targets)

Property	**TT**	**OO**	**Orth2**	**ANOVA**
Prime length	0.89	0.92	0.86	$F(2,57) = 2.128$, $p = .128$
Prime log freq.	2.89	3.03	3.12	$F(2,57) = .862$, $p = .428$
Target (2nd) length	0.60	0.60	0.60	$F(2,57) = .008$, $p = .992$
Target (2nd) log freq.	4.22	4.42	4.43	$F(2,57) = .789$, $p = .459$

Note: TT: Transparent compounds; OO: Opaque compounds; Orth2: Orthographic control condition for word-final position; length: mean numbers of letters; log freq: average log10 transformed word frequencies per million words.

Unrelated control compounds were also included in the experiment to match the compound primes and had no morphologic, orthographic or semantic relationship with the target words. In addition, unrelated control primes containing an embedded pseudo-morpheme in the word-final position were employed to pair with the primes in the orthographic overlap condition. Unrelated control primes were matched with the related primes in all three conditions in terms of both length (all *F*s > 3.2, all *p*s = 1) and frequency (all *F*s > 1.07, all *p*s = 1, One Way ANOVA) with the related primes. The unrelated control condition provided a baseline to which all the other primes were compared. A sample set of experimental design and stimuli is displayed in Table 8.

Table 8 Design and Example Stimuli in Experiment 2

	Position 2 (Experiments 2a & 2b)		
Prime Type	**Related Prime**	**Unrelated Prime**	**Target**
TT (+M+S+O)	airport	bedtime	port
OO (+M-S+O)	butterfly	honeymoon	fly
Orthographic overlap (-M-S+O)	candidate	swallow	date

Note: TT: Transparent compounds; OO: Opaque compounds; Orthographic overlap: Orthographic control condition for word-final position; M: morphology, S: Semantics, O: Orthography.

In addition to the critical items, 180 filler pairs including 40 compound words and 20 mono-morphemic words as primes for 60 nonword targets, and 120 nonword primes for 60 word and 60 nonword targets were used in the experiment. Together with the 60 experimental items, the total number of prime and target pairs in each list reached 240 so that half of the targets required a “yes” response whereas the other half required a “no” response. Thus, it was ensured the participants would not make any prediction about the actual purpose of the experiment or draw conclusions about the order and design of the items. The nonword targets and primes were matched in length with the real word targets and primes. The experimental primes and targets were matched with the real word filler primes and targets in length and log frequency. Nonwords were generated using the Wuggy software (Keuleers & Brysbaert, 2010). Thus, all nonwords (e.g. *lutchlime*) included the same number of letters with the existing words (e.g. *lunchtime*) submitted to the software and all respected the phonotactics of English.

The target items were divided into two lists which were counterbalanced so that one half of the critical targets was preceded by related primes while the other half was preceded by unrelated primes. Each target took place only once in each list. Each participant was assigned to a different list and took part in the experiment only once. Finally, all prime-target pairs were pseudo-randomized and all the experimental lists were reversed to obtain 4 lists in total to preclude training effects and fatigue.

4.3.3 Procedure

The experiments were conducted on an HP laptop computer with a 14.1 inch monitor, and the reaction time and accuracy information were recorded via E-Prime psychological software Version 1.2 (Schneider, Eschman, & Zuccolotto, 2002). A Logitech USB gamepad was used to collect the responses.

The experiments were piloted on 8 participants before the data collection procedure started so as to make modifications if needed. Before each experiment, a consent form was given to the participants and each participant was informed that participation was voluntary and that they had the right to cancel their approval or leave the experiment at any time and without any consequences (Appendix B). They were also asked to fill in a background questionnaire to gather information about their demographic and language-learning background (Appendix C). After the experiment they were provided with a debriefing form including general information related to the purpose of the experiment in common language and contact information in case they had any questions, complaints or concerns about the experiment and the procedure (Appendix D). Finally, they were assured all the data collected through the experiment would be handled anonymously.

Each participant was randomly assigned to each experiment and experimental list and was tested individually in a semi darkened, sound-attenuated room. All the participants were informed verbally about the procedure and were instructed that their task was to make a lexical decision and respond as quickly and accurately as possible whether the letter string presented on the screen was a real English word or not. Participants were asked to press the button on the gamepad labelled “yes” using their dominant hand if they identified the stimulus as a legitimate English word, or to press “no” with their nondominant hand if they believed the letter string was a nonword. Both right-handed and left-handed participants were told to use their dominant hands when they wanted to say “yes” as a response to the stimuli. Participants were advised to keep their hands ready on the response gamepad all along the experiment to ensure quick responding and they were not told about the presence of the prime stimulus.

The masked priming procedure applied in Experiments 1a and 1b was also used in Experiments 2a and 2b. However, this time participants were presented with the second constituents of the compounds as targets. A typical trial is displayed in Figure 7.

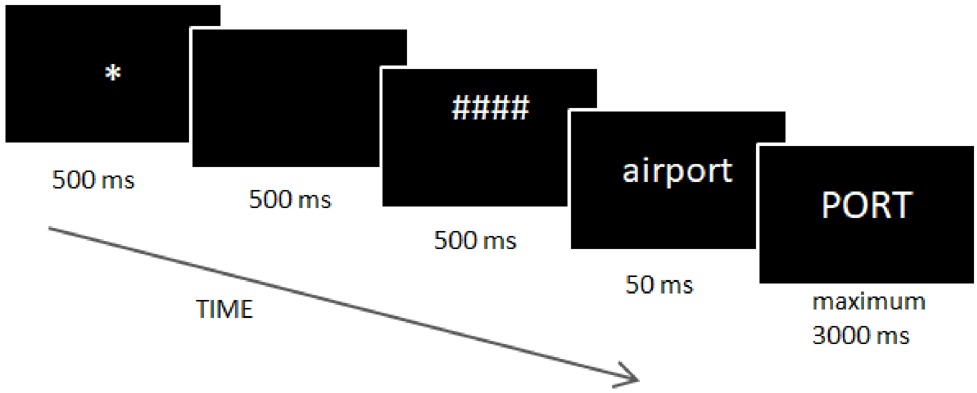

Figure 7 Sequence of screens in each trial in Experiments 2a and 2b.

Each experimental session consisted of 240 trials and involved one break after the first half of the trials was performed. When 120 trials were completed, the software paused and told the participants that they could move on to the next section when they are ready to continue by pressing any button. The complete experimental session lasted approximately 20 minutes. After the experiment, participants were administered a word translation task to further control their knowledge of primes and targets. Each participant was given the list of primes and targets which appeared in the experiment assigned to them and were requested to translate the words in the list. This procedure was critical and taken seriously because knowing the meanings of all the words was necessary to examine the role of semantic transparency in morphologically related pairs.

4.3.4 Data Scoring and Analysis

The raw data obtained from the experiments were prepared by excluding all the practice and filler items. No participant reported awareness of the presence of the primes. As in Experiment 1a and 1b, prime words or target words reported as unknown by the participants in the post-test were removed from the record of the relevant participant. The exclusion of unknown items accounted for the 0.92 % of the experimental stimuli.

Incorrect responses (nonword responses to real word targets) were excluded before further analyses were carried out. This procedure resulted in the removal of 3.24 % of the RT data in Experiment 2a (low proficiency group, Position 2), and 1.97 % of the RT data in Experiment 2b (high proficiency group, Position 2). Any RTs below 300 ms and above 1500 ms were not included in the final analyses, which corresponded to 0.66% of the critical items in Experiment 2a and 0.33 % of the items in Experiment 2b.

As in the previous experiments, outliers, which were defined as RTs below or above 2 standard deviations of each participant's mean RT, were removed. This resulted in the exclusion of 1.28 % of the data in Experiment 2a and 1.18 % in Experiment 2b.

All RTs were log transformed to reduce the positive skewness in the distributions. The reaction times in each experiment were analysed using Repeated Measures ANOVAs, which were followed by planned comparisons. The p-values of all analyses were Greenhouse-Geisser corrected for sphericity violations whenever applicable.

4.4 Results

4.4.1 Experiment 2a. Second constituent priming in low proficiency English learners of Turkish

Experiment 2a explored the priming of word-final constituents in non-native processing of English compounds by low proficiency Turkish learners of English. Table 9 presents the raw mean RT and accuracy rates for each condition. The accuracy rate is lowest for the transparent items in the related and unrelated conditions, whereas it is the highest in the opaque-related condition. Regarding the RTs, items in the transparent-related condition were responded faster to than all the other conditions while transparent-unrelated condition produced the longest mean RTs.

Table 9 Mean Reaction Times and Accuracy Rates across conditions in Experiment 2a (2nd constituents as targets, Low Proficiency)

	RT						
	Mean RT (SD) in ms			**# of observations**		**Accuracy**	
Prime Type	**Related**	**Unrelated**	**Effect**	**Related**	**Unrelated**	**Related**	**Unrelated**
Transparent	706.2 (90)	725.47 (106.62)	19	299	296	.94	.94
Opaque	707.48 (84)	724.41 (113.76)	17	321	310	.98	.97
Orthographic	716.84 (99.24)	710.51 (80.38)	-6	310	323	.97	.97

The accuracy analysis showed a significant main effect of Prime Type across participants and items F_1 (2, 70) = 7.49, p = .001; F_2 (2, 57) = 3.47, p = .038. Accuracy rates were significantly higher in the transparent condition than the opaque and orthographic conditions in the participant analysis (Transparent-Opaque: t(35) =3.01, p = .005; Transparent-Orthographic: t(35) = 2.34, p = .025).

The analysis of the log-transformed RT data demonstrated no significant main effect of Prime Type both in the participant and item analyses F_1 (2, 70) = .024, p = .976; F_2 (2, 57) = .048, p = .958 or Relatedness F_1 (1, 35) = 1.65, p = .206; F2 = (1, 57)

=3.37, p = .071 and Prime Type x Relatedness interaction as well turned out to be non-significant F_1 (2, 70) = 1.25, p = .293; F_2 (2,57) = 1.39, p = .255.

4.4.2 Experiment 2b. Second constituent priming in high proficiency English learners of Turkish

Experiment 2b aimed to investigate the priming of word-final constituents in the non-native processing of English compounds by L1 Turkish high proficiency learners of L2 English. Raw mean RTs and accuracy rates for all conditions are displayed in Table 10. The accuracy rate is the lowest in the transparent-unrelated condition while the opaque and orthographic items in the related and unrelated condition lead to the highest accuracy rates. As for the RTs, targets in the orthographic-unrelated condition were responded to faster than the ones in all the other conditions. The transparent-unrelated condition yielded the longest RTs.

Table 10 Mean Reaction times and accuracy rates across conditions in Experiment 2b (2nd constituents as targets, High Proficiency)

	RT						
	Mean RT (SD) in ms			**# of observations**		**Accuracy**	
Prime Type	**Related**	**Unrelated**	**Effect**	**Related**	**Unrelated**	**Related**	**Unrelated**
Transparent	664.27 (79)	669.01 (70.21)	5	284	281	.97	.96
Opaque	660.52 (82.93)	671.24 (62.89)	11	292	291	.98	.98
Orthographic	660.59 (76.51)	657.02 (72.13)	-3	291	302	.98	.98

The accuracy analysis revealed a marginally significant main effect of Prime Type in the participant analysis F_1 (2, 62) = 3.42, p = .051; however, no significant effect was obtained in item analysis F_2 (2, 57) = 1.09, p = .343. This pattern of results indicated that the accuracy rates did not significantly differ across three Prime Type conditions in the participant and item analyses.

A repeated measures analysis of variance for the log-transformed RT data produced no significant main effect of Prime Type in the participants and item analyses, F_1 (2, 62) = .684, p = .508; F_2 (2, 57) = .368, p = .694. Neither the main effect of Relatedness, F_1 (1, 31) = .912, p = .347; F_2 (1, 57) = 1.58, p = .213 nor the Prime Type x Relatedness interaction, F_1 (2, 62) = .664, p = .518; F_2 (2, 57) = .676, p = .513 reached significance.

4.5 Joint Analysis

The RT data from all four experiments were merged in order to investigate the influence of Position (word-initial vs. word-final) and Proficiency level (low proficiency vs. high proficiency) in addition to the Prime Type and Relatedness analyses.

Table 11 Mean Reaction times and accuracy rates across conditions

	RT						
	Mean RT (SD) in ms			**# of observations**		**Accuracy**	
Prime Type	**Related**	**Unrelated**	**Effect**	**Related**	**Unrelated**	**Related**	**Unrelated**
Transparent	679.59 (84)	694.56 (87)	14.97**	138	138	.99	.99
Opaque	695.47 (86)	717.99 (89)	22.52**	138	138	.99	.99
Orthographic	705.38 (92)	702.92 (82)	-2.46	138	138	.99	.99

* < .05;
** < .01.

Raw mean RTs and accuracy rates for all conditions are displayed in Table 11. When the mean reaction times were examined, targets in the transparent-related condition were responded to faster than the ones in all the other conditions. The opaque-unrelated condition yielded the longest RTs.

The four-way interaction between Prime Type, Relatedness, Position, and Proficiency level was not significant F_1 (2, 286) = .140, p = .869; F_2 (2, 114) = .472, p = .625, nor were the three-way interactions (all *p*s > .073 in both participant and item analyses). The main effect of Position was not significant in the participant analysis F_1 (1, 134) = 1.8, $p = .181$, but was marginally significant in the item analysis F_2 (1, 114) = 2.18, $p = .052$.

A significant main effect was obtained for Prime Type F_1 (2, 268) = 21.18, $p < .001$; F_2 (2, 114) = 2.18, $p = .007$, Relatedness F_1 (1, 134) = 20.34, $p < .001$; F_2 (1, 114) = 19.38, $p < .001$, and Proficiency F_1 (1, 134) = 25.62, $p < .001$; F_2 (1, 114) = 440.43, $p < .001$.

The two-way interaction between Prime Type and Relatedness was found to be significant in the joint analysis in both the participant and the item analysis, F_1 (2, 268) = 5.9, $p = .003$; F_2 (2, 114) = 4.06, $p = .020$. Separate analyses revealed a significant 14.97 ms priming effect in the transparent condition, $t(137) = 3.43$, $p = .001$, and a 22.51 ms priming effect in the opaque condition, $t(137) = 4.37$, $p < .001$; but no significant priming effect was obtained for the orthographic condition, $t(137) = .096$, $p = .924$ (-3 ms). Importantly, the Prime Type x Relatedness interaction reaching statistical significance in the Joint Analysis was not significant in the four separate test carried out in the previous sections (The interaction was significant in the low proficiency processing at position 1 ($p = .047$), yet not significant in high proficiency group at position 1. It was not significant at position 2, in both low proficiency ($p = .293$) and high proficiency ($p = .518$) group. Therefore, these findings of the present analysis prove that the compound priming effects obtained in the current study should not be a mere result of orthographic overlap.

The two-way interaction between Prime Type and Position was found significant as well, F_1 (2, 268) = 24.15, $p < .001$; F_2 (2, 114) = 4.07, $p = .019$. The effect of Prime Type was observed clearly only in the word-initial overlap position in which transparent items were reacted to faster than the opaque items (15.88 ms, $t(69) = 5.33$, $p < .001$) and the orthographic items (25.79 ms, $t(69) = 7.43$, $p < .001$). In addition, the RTs for the opaque items were shorter than the orthographic items (9.91 ms, $t(69) = 2.06$, $p = .042$).

A two-way interaction between Proficiency and Position was also significant in the item analysis, F_2 (1,114) = 16.01, $p < .001$, but it did not reach significance in participant analysis, F_1 (1,134) = .789, $p = .376$). Further tests revealed that the position of the overlap made a difference only for the low proficiency group and the overlap in the word-final position yielded a significant priming effect in both related (29.05 ms, $t(118) = 2.77$, $p = .006$) and the unrelated conditions (25.32 ms, $t(118) = 2.33$, $p = .021$). For the high proficiency group, no statistical difference was found across Positions or (related or unrelated) Conditions; however, unlike the low proficiency group, for the related condition the high proficiency learners were 4.83 ms faster in the word-initial overlap position than the word-final position although for the unrelated condition high proficiency group followed the same pattern as the low proficiency with 13.98 ms faster response time in the word-final position. These results imply that there was no Position effect in high proficiency processing in L2, whereas a Position effect was observed in low proficiency processing with greater priming effects in the word-final position.

CHAPTER 5

DISCUSSION AND CONCLUSION

This final chapter consists of two main sections. The first section presents a brief summary of the current study followed by a discussion of the findings and a general conclusion. The second section suggests directions for future research.

5.1 Summary of the Study and Discussion

The primary purpose of the current study was to explore how noun-noun compounds in L2 English are processed by native speakers of Turkish in the earliest stages of word recognition and what information is used to segment a compound word into its constituent morphemes, and in particular whether semantic information and orthography play a role in the decomposition of compound words. Furthermore, the study investigated the role of constituent morphemes in the access to and representation of compound words in terms of whether or not a compound word primes its first and second constituents equally. The final purpose was to examine whether L2 learners' proficiency is a critical factor affecting the mechanisms used when processing morphologically complex words. In this regard, four masked priming experiments were conducted. Experiments 1a and 1b examined first constituent priming using the compound word as a prime and its first constituent as target (e.g., *bedroom – BED*). While the participants tested in Experiment 1a were low proficiency learners of L2 English, Experiment 1b tested high proficiency learners of L2 English. Experiments 2a and 2b, on the other hand, examined second constituent priming (e.g., *bedroom – ROOM*) with low and high proficiency learners of L2 English, respectively. In the following section, the overall results of the abovementioned experiments will be discussed on the basis of the purposes of this study.

5.1.1 Constituent Priming

With respect to Experiment 1, testing first constituent priming, low proficiency learners of L2 English exhibited robust priming effects only for semantically opaque prime-target pairs (e.g., *deadline* - *DEAD*). Even if it did not reach statistical significance, the semantically transparent priming condition (e.g., *bedroom* - *BED*) yielded a small facilitation effect (9 ms) as well. However, no priming effect was obtained in the orthographic overlap condition (e.g., *restaurant* - *REST*) (-9 ms). The priming effect obtained in the opaque condition may not simply have occurred because of the form overlap as no priming effect was detected in the purely orthographic overlap condition. Besides, the semantically transparent condition also produced some facilitation as opposed to the orthographic overlap condition, where negative priming effects were found. On the other hand, high proficiency L2 learners yielded robust and equivalent priming effects in semantically transparent and opaque compounds, but again no priming was found in the orthographic control condition. This pattern of masked priming effects obtained for L1 Turkish low proficiency and high proficiency learners of L2 English suggests that automatic morphological decomposition occurs at the earliest stages of visual word recognition and this is not simply because of orthographic overlap. Moreover, because transparent and opaque compounds elicited similar facilitation, this morphological activation appears to be independent from semantic transparency and indeed predominantly guided by form analysis.

The findings of Experiment 2, examining second constituent priming in L1 Turkish low proficiency and high proficiency L2 English learners demonstrated that semantically transparent (e.g., *bedroom* - *ROOM*) and opaque compounds (e.g., *deadline* - *LINE*) facilitated the recognition of their constituents (with a priming magnitude of 19 ms in the transparent and 17 ms in the opaque condition for the low proficiency group, and 5 ms in the transparent and 11 ms in the opaque condition for the high proficiency group); however, none of these priming effects reached significance. For the transparent and opaque compounds in the second constituent priming condition, combinatorial processing failed to produce an interpretable meaning, suggesting the unavailability of individual constituent representations. In this case, access to the whole word representations appears to be the dominant mechanism.

While many previous masked priming studies showed facilitation for word-initial and word-final positions (e.g., Li et al., 2015; Fiorentino & Fund-Reznicek, 2009; Alonso et al., 2016) for opaque and transparent pairs, other studies exhibited facilitation for the word-final position only (e.g., Juhasz et al., 2003) and highlighted the priority of the second constituent in compound processing. The head (right-most constituent) is suggested to be the most important component of a compound because it assigns its basic morphological, semantic and syntactic properties to the compound, or put in a different way, a compound receives all its relevant properties from its head constituent (Dressler, 2006). However, the results of the current study provide evidence for first constituent priming in English compound processing. Even though this pattern of results is not common in the literature, it is not unprecedented. Kehayia, Jarema, Tsapkini, Perlak, and Ralli (1999), who investigated constituent activation in compound processing in Greek and Polish, reported that compounds were primed by both their first and their second constituents; however, the first constituents were observed to show an advantage over second constituents. Importantly, compouds in Greek and Polish are right-headed just like in English. Similarly, in a study on Spanish and Basque compounds it was confirmed that decomposition is not influenced by the head position of the compound (Duñabeitia, et al. (2007). The advantage of the first constituent over the second has also been evidenced in aphasiological findings of psycholinguistic studies (e.g., Màkisalo, Niemi, & Laine, 1999; Stark & Stark, 1990). In this regard, the findings of the current study revealing significantly greater magnitude of priming for the first constituent rather than the second constituent suggest that position-in-the-string (possibly related to an initial substring effect) is the leading factor which influences compound processing in native speakers of Turkish learning L2 English.

5.1.2 The Effects of Semantic Transparency

The findings of the current study suggest that semantic transparency does not play a role in the early stages of visual English compound processing either by low proficiency or high proficiency L2 learners. These results indicate that the L2 processing of English compound words is completely guided by form analysis at the initial stages of word recognition where semantic information is not present yet. Regarding the lack of transparency effects, the results of the current study provide new evidence for compound word processing in L2 English (e.g., Li et al., 2005) and lend support to findings obtained in L1 studies (e.g., Frisson et al., 2008; Jarema et al., 1999; Zwitserlood, 1994); however, they run counter to a number of studies suggesting that semantic transparency has a critical role in compound processing (e.g., Juhasz, 2007; Libben 2003; Liu & Peng, 1997; Peng et al., 1999; Sandra, 1990).

5.1.3 The Effects of L2 Proficiency Level

Regarding the similarities and differences between the two proficiency groups, it was found that the low proficiency learners of English were slower (56 ms in transparent, 63 ms in opaque, and 62 ms in the orthographic overlap condition) than the high proficiency group. Apart from this difference, different priming effects were observed for the transparent and opaque compound conditions in Experiment 1. These results partially corroborate the Declarative/Procedural model (Ullman, 2001b), according to which L1 and L2 processing patterns are assumed to be basically similar; however, it is proposed that the mechanisms used may vary depending on the L2 proficiency level. L2 learners make more use of the declarative memory, but as they attain a higher L2 proficiency level, they are able to use the procedural memory to a higher extent. In this regard, the findings of the current study may lend further support to this view in that L2 proficiency level was observed to influence the way the participants processed compound words. The high proficiency L2 participants were found to rely predominantly on the procedural memory similar to native speakers while processing compound words; however, the less proficient L2 participants displayed priming effects for the opaque compound condition only, which was different from the priming patterns of the high proficiency group. These findings suggest that low proficiency L2 speakers rely more on the procedural memory to process opaque compounds, but for the processing of transparent compounds the declarative memory is used. This difference observed between these two groups of L2 speakers may have its roots in differences in their proficiency levels.

When it comes to the findings obtained in the first experiment, where it was found that low proficiency L2 learners process semantically opaque compounds by segmenting them into their constituents but did not decompose semantically transparent compounds when processing, it is not as straightforward to reach a clear-cut conclusion. As the meaning of the semantically transparent compound words can be easily deduced from the combination of individual constituents' meanings, what is expected is that they are not stored in whole word forms as opposed to opaque compounds. One possible interpretation of this pattern of results can be the overall lexical frequency advantage of transparent compounds over the opaque ones. Potentially, more frequent words are more likely to take advantage of whole-form storage, which may develop as a result of using these compound words more frequently; on the other hand, less frequently used compounds may be processed through decomposition. This interpretation seems in line with the *horse race models* of word recognition proposed by Allen and Madden (1990). These models suggest a simultaneous activation of whole-word and constituent morphemes, and this process is influenced by the frequency of occurrences of each entry in the lexicon in that the entry which wins the race of processing will take priority. Admittedly, the absence of a significant masked priming effect at the word-initial position of transparent compounds may partially be caused because the low proficiency L2 learners use semantically transparent compounds more frequently compared to opaque compounds. Another possible explanation is that the link between L1 and L2 might become stronger during the processing of transparent compounds as the compounds which are semantically transparent have direct translations in Turkish; however, it usually becomes more complicated to find a direct translation for the semantically opaque compounds as they sometimes appear to be arbitrary combinations of words and they are also mostly metaphoric. As there are very few studies on L2 processing in the literature that directly compare compound processing at two different proficiency levels, it is not possible to discuss the present results extensively with direct reference to the literature. Thus, the plausibility of these interpretations in this case can be established through further studies comparing compound processing patterns in different L2 proficiency levels.

The results can be interpreted as supporting the view that compound words in English are decomposed into their constituents irrespective of their semantic transparency, and there is the advantage of the first constituent in compound processing. Additionally, no priming in the orthographic overlap condition confirmed that the weight of the evidence still implies a morphological locus of effects. In this respect, considering the locus of morphological decomposition in general, the findings of the present study provide evidence for the *sublexical morpho-orthographic decomposition model* as the most likely account (Rastle et al., 2004). As no reliable semantic transparency effect was found, the findings clearly run counter to the *supralexical morpho-semantic processing model* (Giraudo & Grainger, 2001). Additionally, the present results obtained from compound processing do not lend support to the *hybrid model* which suggests that both sublexical morpho-orthographic and supralexical morpho-semantic processing models run in parallel during word recognition (Diependaele et al., 2005, 2009; Diependaele et al., 2011).

In conclusion, as for the first research question which attempts to shed light on whether compound words decomposed into constituent morphemes or processed as full forms during the early stages of visual word recognition in L1 Turkish learners of L2 English, the present study reveals that automatic morphological decomposition occurs during the processing of compound nouns in L2 English. The following question that further scrutinizes the locus of morphemic representation and is formulated as whether the processes of compound processing and recognition in L2 are mediated by semantic transparency and/or orthographic overlap reveals that the automatic morphological decomposition obtained in this study is irrespective of both semantic information and orthographic overlap. The present study also addressed the question of whether the observed processing patterns differ depending on whether the experimental targets are first or second constituents within noun-noun compounds, and it was concluded that in the recognition of English noun-noun compounds by L2 learners, the lexical representations of only the first constituents play a significant role in the processing of compounds. Finally, as for the last question which was set to elucidate whether the L2 processing of compound words differ as a function of L2 language proficiency, the findings of the present study provide evidence for similar processing mechanisms employed by both high proficiency and low proficiency L2 learners; however, less proficient L2 learners rely more on declarative memory system during the processing of compound words in English.

5.2 Limitations and Suggestions for Further Studies

This study has some limitations which may provide the bases for further studies. First of all, the critical items used in the present study were selected from the English text books used with A2 level (according to the CEFR) participants in order to make sure all participants were familiar with the words. Due to this limitation, phonological overlap could not be obtained for three prime target pairs (e.g., *ballerina-BALL*) in the orthographic control condition created for the first position overlap and for seven prime target pairs (e.g., *bracelet-LET*) formed for the second position overlap. Another constraint regarding the difficulty in finding items resulted in working with a limited set of pairs. As a result of this limitation, a Transparent-Opaque (TO) - Opaque-Transparent (OT) two-way distinction could not be employed for the compounds in the opaque category as suggested by Libben et al. (2003). The present study may be carried forward by further analysing these two categories that the present study had to leave out.

Additionally, this study investigated non-native processing only; however, in order to examine the possible differences and similarities between native and non-native speakers in terms of the representation and processing of compound words, the present study could be replicated with native speakers of English.

Furthermore, the current study focused on noun-noun compounds only, but compound types other than nominal classes (e.g. verbal and idiosyncratic) might also be investigated in order to figure out whether different of similar cognitive mechanisms are employed during the processing of different types of compounds.

What's more, the present study mainly aimed to examine how noun-noun compounds in English are processed by native speakers of Turkish who are all university freshmen and who started to learn English between the ages of 7 and 10. Designing experiments to test participants who started learning English at different ages may also provide valuable data for further studies. Such a comparative analysis may seek an answer to the question whether the onset of age of acquisition creates a difference in second language processing or not.

Finally, there are just a few studies investigating L2 compound processing and in many issues such as frequency effects, headedness vs. position-in-the-string, transparency and morphological family size, there is no cross-linguistic consensus. Therefore, further investigations, not only in English but also with other languages, are essential to shed more light on the structure of the mental lexicon.

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APPENDICES

Appendix A: Human Subjects Ethics Committee Approval

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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06 NİSAN 2016

Gönderilen: Doç.Dr. Bilal KIRKICI

Yabancı Diller Eğitimi

Gönderen: Prof. Dr. Canan SÜMER

İnsan Araştırmaları Kurulu Başkanı

İlgi: Etik Onayı

Sayın Doç.Dr. Bilal KIRKICI'nın danışmanlığını yaptığı yüksek lisans öğrencisi Nurten ÇELİKKOL BERK'in "İkinci Dil İngilizcede Birleşik Sözcüklerin Biçimbilimsel İşlenmesi" başlıklı araştırması İnsan Araştırmaları Komisyonu tarafından uygun görülerek gerekli onay **2016-EGT-043** protokol numarası ile **04.04.2016-13.06.2016** tarihleri arasında geçerli olmak üzere verilmiştir.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Canan SÜMER
Uygulamalı Etik Araştırma Merkezi
İnsan Araştırmaları Kurulu Başkanı

Prof. Dr. Meliha ALTUNIŞIK
İnsan Araştırmaları Kurulu
Üyesi

Prof. Dr. Ayhan SOL
İnsan Araştırmaları Kurulu
Üyesi

Prof. Dr. Mehmet UTKU
İnsan Araştırmaları Kurulu
Üyesi

Yrd.Doç.Dr. Pınar KAYGAN
İnsan Araştırmaları Kurulu
Üyesi

Appendix B: Consent Form

ARAŞTIRMAYA GÖNÜLLÜ KATILIM FORMU

Bu araştırma, ODTÜ Yabancı Diller Eğitimi Bölümü, İngiliz Dili Öğretimi Ana Bilim Dalı'nda Yüksek Lisans öğrencisi Nurten Çelikkol Berk tarafından, Doç. Dr. Bilal Kırkıcı danışmanlığındaki yüksek lisans tezi kapsamında yürütülmektedir. Bu form size araştırma hakkında bilgilendirmek amacıyla hazırlanmıştır.

Çalışmanın amacı ana dili Türkçe ikinci yabancı dili İngilizce olan konuşucuların ikinci dildeki birleşik kelimelerin işlemlenme örüntülerini ortaya çıkarmaktır. Araştırmaya katılmayı kabul ederseniz, sizden bilgisayar ortamında yapılacak bir deneye katılmanız beklenmektedir. Yaklaşık on beş dakika sürmesi beklenen bu deneyde bir oyun kolu ya da bilgisayar klavyesi kullanarak, ekranda belirecek kelimelerin gerçek kelimler olup olmadığına mümkün olduğunca hızlı ve doğru bir şekilde karar vermeniz istenmektedir.

Araştırmaya katılımınız tamamen gönüllülük esasına dayalıdır. Çalışmada sizden kimlik belirleyici hiçbir bilgi istenmemektedir. Cevaplarınız tamamıyla gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir. Katılımcılardan elde edilecek bilgiler toplu halde değerlendirilecek ve bilimsel yayımlarda kullanılacaktır.

Çalışma, genel olarak kişisel rahatsızlık verecek sorular veya uygulamalar içermemektedir. Ancak, katılım sırasında herhangi bir nedenden ötürü kendinizi rahatsız hissederseniz deneyi yarıda bırakıp çıkmakta serbestsiniz. Böyle bir durumda çalışmayı uygulayan kişiye çalışmadan çıkmak istediğinizi söylemek yeterli olacaktır.

Çalışma sonunda, bu çalışmayla ilgili sorularınız cevaplanacaktır. Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma hakkında daha fazla bilgi almak için Yabancı Diller Eğitimi Bölümü öğretim üyelerinden Doç. Dr. Bilal Kırkıcı (E-posta: bkirkici@metu.edu.tr) ya da yüksek lisans öğrencisi Nurten Çelikkol Berk (e166825@metu.edu.tr)ile iletişim kurabilirsiniz.

Yukarıdaki bilgileri okudum ve bu çalışmaya tamamen gönüllü olarak katılıyorum.

(Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

Ad- Soyad	Tarih	İmza
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Appendix C: Participant Background Questionnaire

Personal Information			Code:
Last Name:	First Name:		Today's date:
Date of birth:		Female ( )	Male ( )
Telephone number:		Email-address:	
Department :	Student ID No:		
What type of high school did you attend? (*Ex: Anatolian Teacher Training High School*)			
What is your parents' highest educational qualification (mother and/or father)? (please tick)	Primary School ( )	High school ( )	University ( )
	Professional Training ( )	Other (please specify)?	

Which language(s) have you learned? (including your first language, in order of acquisition)			
Language	From which age on?	For how long?	Context of acquisition (at home, at school, other) (please specify)
1.			
2.			
3.			

Current Language Use *(Percentage per week)*

In the first row please write the names of the languages you actually use in everyday life. Please indicate the average percentage you use for each activity / with each communicative partner. The amount should add up to 100% in each row. Please tick NA if the a case does not apply to you.

How often do you use your languages in everyday situations?	Language 1 …………..	Language 2 …………..	Language 3 …………..	Language 4 ……….	Language 5 …………..	**Sum**	
Speaking						**= 100%**	
Listening						**= 100%**	
Writing						**= 100%**	
Reading						**= 100%**	
Overall						**= 100%**	
In which language(s) do you communicate…							
…with your partner?						**= 100%**	**NA ( )**
…with your children?						**= 100%**	**NA ( )**
…with your parents?						**= 100%**	**NA ( )**
…with your friends?						**= 100%**	
…at work / studies?						**= 100%**	

Have you lived in countries other than Turkey?	For how long?	At which age?	Why? (school, studies, etc.)
1.			
2.			
3.			

General health condition

Handedness?	Right ( )	Left ( )		
Eyesight?	Normal ( )	Near-sighted ( )	Far-sighted( )	Other eye problems? Please specify.
	Corrected with?	Glasses ( )	Contact Lenses ( )	
Hearing?	Normal ( )	Impaired ( )	If impaired, please specify	
	Corrected with a hearing aid?	Yes ( )	No ( )	
Have you been diagnosed with any language related impairments (dyslexia, stuttering, etc.)	No ( )	Yes ( )	If yes, please specify	
Have you had any neurological problems? (seizures, stroke, epilepsy, etc.)	No ( )	Yes ( )	If yes, please specify	

Appendix D: Debriefing Form

KATILIM SONRASI BİLGİ FORMU

Bu araştırma, daha önce de belirtildiği gibi, ODTÜ Yabancı Diller Eğitimi Bölümü, İngiliz Dili Öğretimi Ana Bilim Dalı'nda Yüksek Lisans öğrencisi Nurten Çelikkol Berk tarafından, Doç. Dr. Bilal Kırkıcı danışmanlığındaki yüksek lisans tezi kapsamında yürütülmektedir.

Çalışmanın amacı ruhdilbilimsel deneysel yöntemler kullanarak ana dili Türkçe ikinci yabancı dili İngilizce olan konuşucuların ikinci dildeki birleşik kelimeleri işlemleme örüntülerini ortaya çıkarmaktır. Katılmış olduğunuz bu çalışmada ikinci yabancı dilde birleşik kelimelerin işlemlenmesini ortaya çıkaran maskelenmiş hazırlama deneyi uygulanmıştır. Bu çalışma neticesinde ana dili Türkçe olan konuşucuların ikinci yabancı dil olan İngilizce'de biçimbilimsel açıdan karmaşık olan birleşik kelimeleri bütün olarak mı yoksa bileşenlerine ayırarak mı işlemledikleri, aynı zamanda da ikinci yabancı dil yeterliliğindeki farklılıkların ikinci yabancı dildeki birleşik kelimelerin işlemlenmesinde bir fark yaratıp yaratmadığı açıklık kazanacaktır.

Bu çalışmadan alınacak ilk verilerin Mayıs 2017 sonunda elde edilmesi amaçlanmaktadır. Elde edilen bilgiler sadece bilimsel araştırma ve yazılarda kullanılacaktır. Çalışmanın sağlıklı ilerleyebilmesi ve bulguların güvenilir olması için çalışmaya katılacağını bildiğiniz diğer kişilerle çalışma ile ilgili detaylı bilgi paylaşımında bulunmamanızı dileriz. Bu araştırmaya katıldığınız için tekrar çok teşekkür ederiz.

Araştırmanın sonuçlarını öğrenmek ya da daha fazla bilgi almak için aşağıdaki isimlere başvurabilirsiniz.

Doç. Dr. Bilal Kırkıcı (bkirkici@metu.edu.tr)

Nurten Çelikkol Berk (e166825@metu.edu.tr)

Çalışmaya katkıda bulunan bir gönüllü olarak katılımcı haklarınızla ilgili veya etik ilkelerle ilgi soru veya görüşlerinizi ODTÜ Uygulamalı Etik Araştırma Merkezi'ne iletebilirsiniz.

e-posta: ueam@metu.edu.tr

Appendix E: Transparent Items

Prime Type	Related Prime	Unrelated Prime	Target (Pos1)	Target (Pos2)
Transparent	airport	bedtime	air	port
Transparent	classmate	birthday	class	mate
Transparent	doorbell	eggshell	door	bell
Transparent	firewood	bookshelf	fire	wood
Transparent	haircut	boyfriend	hair	cut
Transparent	lifestyle	handbag	life	style
Transparent	newspaper	postcard	news	paper
Transparent	raindrop	teapot	rain	drop
Transparent	snowball	teamwork	snow	ball
Transparent	sunburn	roommate	sun	burn
Transparent	bookshop	classroom	book	shop
Transparent	cookbook	drumstick	cook	book
Transparent	earthquake	bodyguard	earth	quake
Transparent	girlfriend	hairbrush	girl	friend
Transparent	headache	fingertip	head	ache
Transparent	lunchtime	homework	lunch	time
Transparent	policeman	snowstorm	police	man
Transparent	seafood	railway	sea	food
Transparent	spaceship	wallpaper	space	ship
Transparent	teacup	sunlight	tea	cup

Appendix F: Opaque Items

Prime Type	Related Prime	Unrelated Prime	Target (Pos1)	Target (Pos2)
Opaque	butterfly	honeymoon	butter	fly
Opaque	billboard	desktop	bill	board
Opaque	deadline	basketball	dead	line
Opaque	landmark	firefly	land	mark
Opaque	masterpiece	headline	master	piece
Opaque	laptop	skylight	lap	top
Opaque	chairman	landscape	chair	man
Opaque	background	lighthouse	back	ground
Opaque	mushroom	weekday	mush	room
Opaque	countryside	watermelon	country	side
Opaque	brainstorm	keyboard	brain	storm
Opaque	cowboy	airline	cow	boy
Opaque	firework	joystick	fire	work
Opaque	milestone	horseshoe	mile	stone
Opaque	viewpoint	landlord	view	point
Opaque	rainbow	lifeboat	rain	bow
Opaque	pineapple	workshop	pine	apple
Opaque	website	suitcase	web	site
Opaque	ladybird	sunday	lady	bird
Opaque	bookworm	stepfather	book	worm

Appendix G: Orthographic Items (Position 1)

Prime Type	Related Prime	Unrelated Prime	Target (Pos1)
Orth1	ballerina	digestion	ball
Orth1	boycott	candy	boy
Orth1	costume	balloon	cost
Orth1	documentary	investigation	document
Orth1	factory	blanket	fact
Orth1	fluent	diversity	flu
Orth1	funeral	ironic	fun
Orth1	kidney	tension	kid
Orth1	parenthesis	seasonal	parent
Orth1	restaurant	starve	rest
Orth1	bandage	center	ban
Orth1	carpet	billionaire	car
Orth1	cute	banana	cut
Orth1	endanger	battery	end
Orth1	fatigue	combine	fat
Orth1	freeze	lettuce	free
Orth1	harmony	petrol	harm
Orth1	management	publish	man
Orth1	pullover	maintenance	pull
Orth1	terminal	manuscript	term

Appendix H: Orthographic Items (Position 2)

Prime Type	Related Prime	Unrelated Prime	Target (Pos2)
Orth2	agriculture	transparent	culture
Orth2	appoint	beverage	point
Orth2	camouflage	combat	age
Orth2	cereal	knight	real
Orth2	donkey	parent	key
Orth2	implant	skeleton	plant
Orth2	leisure	ostrich	sure
Orth2	proof	arrogant	roof
Orth2	sacred	translate	red
Orth2	stranger	moustache	anger
Orth2	ancestry	accurate	try
Orth2	bracelet	adrenaline	let
Orth2	candidate	swallow	date
Orth2	climate	fright	mate
Orth2	imaginative	elephant	native
Orth2	isolate	geometry	late
Orth2	microphone	electricity	phone
Orth2	protest	violate	test
Orth2	selfish	secure	fish
Orth2	whisky	terrace	sky

Appendix I: Turkish Summary / Türkçe Özet

Giriş

Bir dili anlama ve kullanma insanoğlunun en ayırt edici özelliklerinden biridir ve uzun süredir ruhdilbilimsel araştırmaların konusu olmuştur. İnsanoğlu binlerce sözcüğü hafızasında tutabilme yeteneğine sahiptir ancak, bir sözcüğü anlayabilmek ve kullanabilmek "zihinsel sözlük" olarak da adlandırılan iyi organize olmuş ve yapılandırılmış bir zihinsel sistemle mümkün olan otomatik ve zahmetsiz bir süreçtir. Biçimbilimsel açıdan karmaşık kelimelerin işlemlenme örüntüleri günümüzde ruhdilbilimsel araştırmaların ilgi odağı haline gelmiştir, zira sadece zihinsel sözlüğün yapısını anlayabilmenin yanı sıra, sözcüklerin zihinsel sözlükte nasıl saklandığını ve ihtiyaç duyulduğunda nasıl erişildiğini araştırmak için değerli bir kaynak sunmaktadır.

Biçimbilimsel açıdan karmaşık sözcüklerin işlemlenmesinde biçimbirimin temel öğe olup olmadığı, hem tek biçimbirimli hem de çok biçimbirimli sözcüklerin zihinsel sözlükte nasıl temsil edildikleri ve biçimbilimsel açıdan karmaşık yapıların ne şekilde işlemlendikleri uzun zamandır süregelen bir tartışmanın konusu olmuştur. Taft ve Forster (1975) başlangıçta çok biçimbirimli yapıların zihinsel sözlükle ekleri ve köklerine ayrıştırılmış şekilde temsil edildiklerini öne sürmüşlerdir. Butterworth (1983) ise zihinsel sözlüğüne erişim esnasında hiçbir morfolojik çözümleme yapılmadığını, bunun aksine fark gözetmeksizin basit veya türetilmiş tüm sözcüklerin zihinsel sözlükte listelendiklerini savunmuştur.

Bu konuda devam eden daha güncel bir tartışma biçimbilimsel açıdan karmaşık yapıların işlemlenmesi esnasında tek bir mekanizmanın mı yoksa bir dizi mekanızmasının mı kullanıldığına odaklanmaktadır. Bu doğrultuda ortaya atılan teoriler tekli mekanizma-çağrışımcı modeller, tekli mekanizma- kurala dayalı modeller ve ikili mekanizma modelleri olarak üç başlık altında incelenebilir. Tekli mekanizma – çağrışımsal modeller (Rumelhart & McClelland, 1993), hem basit hem karmaşık sözcüklerin zihinsel sözlükte bütüncül sözcükler olarak yani tam formlarıyla saklandığını ve sözcüklerin diğer biçimleriyle farklı bağlantılar yoluyla ilişkilendirildiğini öne sürmektedir. Çağrışımsal modeller sözcüklerin biçimbilimsel yapılarının sözcük tanıma ve işlemleme süreçlerinde etkin bir rol oynamadıklarını önermektedirler. Tekli mekanizma – kurala dayalı modeller (Ling & Marinov, 1993) ise çağrışımcı modellerin aksine karmaşık sözcüklerin bellekte ek ve köklerine ayrıştırılarak saklandığını savunur ve karmaşık yapıların morfolojik bileşenlerine ayrıştırılma sürecini biçimsel kurallar çerçevesinde açıklamaktadır. Biçimbilimsel açıdan karmaşık yapıların zihinde temsil edilmesinde ve işlemlenmesinde tek bir mekanizmanın etkin olduğunu öneren tekli mekanizma modelleri zihinsel sistemin doğasını net bir şekilde açıklamakta yetersiz bulunmuştur. Ayrıca, deneylerden elde edilen bulgular belli kurallar çerçevesinde oluşturulan karmaşık yapıların (örn: *show+ed* → *showed*, *book+s* →*books*) ve belli kurallarla açıklanamayan düzensiz yapıların (örn: *go* →*went*, *tooth* → *teeth*) işlemleme farklılıklarını sadece ikili bir mekanizmanın açıklayabileceğini göstermektedir. İlk bahsedilen, düzenli yapıların yer aldığı süreç dil işlemlemenin kural odaklı yönü ile ilgilidir; ikinci süreç ise karmaşık yapıların bellekte bütüncül halleriyle saklandıklarını ifade etmektedir. Bu bağlamda ortaya atılan ikili mekanizma modelleri (Pinker, 1999) tek bir mekanizmaya dayanmak yerine, biçimbilimsel işlemleme sırasında hem çağrışımcı hem de kurala dayalı işlemleme süreçlerinin mevcut olduğunu ve birlikte çalıştıklarını öne sürmektedir.

İkili mekanizma modelinin bir uzantısı olarak ortaya çıkan bildirimsel/işlemsel model, sözcük tanıma ve işlemleme sürecinin bildirimsel bellek sistemi ve işlemsel bellek sistemi olmak üzere iki ayrı bellek alt sistemine dayandığını ileri sürmektedir (Ullman, 2005). Bildirimsel bellek düzensiz çekimlenmiş yapıların bütünsel olarak saklandığı çağrışımsal bir yapı olarak kabul edilirken, işlemsel bellek düzenli çekimlenmiş karmaşık yapıların biçimbilimsel açıdan daha küçük birimlere ayrıştırıldığı birleşimsel bir sistem olarak görülmektedir. Bu bellek sistemleri biçimbilimsel işlemleme açısından ele alındığında bildirimsel belleğin düzensiz çekimlenmiş yapıların ezberlenmesi sürecine dahil olduğu düşünülür (örn: went, teeth), işlemsel belleğin ise düzenli çekimlenmiş sözcüklerin eklerine ve köklerine ayrıştırılması sürecinden sorumlu olduğu önerilmektedir (örn: walk+ing, class+es).

Her ne kadar, dil işlemleme süreci üzerine yapılan araştırmalar temel olarak ana dili (D1) konuşucularına odaklanmış olsa da, son zamanlarda yapılan çalışmalar artan bir merak ve ilgiyle ikinci dil (D2) konuşucularını da araştırmalara dahil etmeye başlamıştır. İkinci dilde biçimbilimsel işlemleme süreçlerinde yer alan mekanizmaların ana dilde yer alan işlemleme süreçleriyle benzer olup olmadığı ya da ikinci dil konuşucularının farklı bir işlemleme yolu seçip seçmedikleri konusunda iki ana görüş ortaya çıkmıştır. "Paylaşımlı model" olarak adlandırılan ilk görüş temel olarak ana dil ve ikinci dilde yer alan işlemleme süreçlerinde benzer bir yol izlendiği fikrini desteklemektedir, ancak bununla birlikte bir takım faktörlerin bu süreci etkileyebileceğini de öne sürmektedir. Bu faktörlerden biri D2 edinimi ve işlemlenmesini etkileyebilecek D1 ve D2 farklılıkları olarak öngörülmüştür. Örneğin, Tokowicz ve MacWhinney (2005) olaya ilişkin beyin potansiyelleri (OİP) çalışmalarında D1 transferinin D2 işlemlenmesine etkisi olduğunu, D1 ve D2 arasındaki benzerliklerin işlemleme sürecinin daha başarılı bir şekilde tamamlanmasına katkıda bulunduğunu bildirmişlerdir. Bir diğer faktör ise dil edinim yaşı olarak öngörülmüş, bu alanda yapılan çalışmalar da dil edinim yaşının D1 ve D2'deki dilbilimsel işlemleme süreçleri üzerinde hem kolaylaştırıcı hem de engelleyici etkiler meydana getirebileceğini göstermiştir (Perani, Paulesu, Galles, Dupoux, Dehaene, Bettinardi, Cappa, Fazio & Mehler, 1998; Wartenburger, Heekeren, Abutalebi, Cappa, Villringer & Perani, 2013). D1 ve D2 işlemleme süreçlerinde fark yaratan bir başka potansiyel faktör olarak Hasegawa, Carpenter ve Just (2002) D2'de işlemleme hızının daha düşük olduğu fikrini ortaya atmışlar ve çalışmalarından elde ettikleri sonuçlar doğrultusunda D2'de daha fazla işlemleme gerektiğini ve bunun da ikinci dil konuşucularında daha düşük otomatikliğe ve kıyasla daha kötü performanslara neden olduğunu öne sürmüşlerdir.

D1 ve D2'deki işlemleme sistemleri arasındaki benzerlikleri vurgulayan paylaşımlı model görüşüne karşı ortaya çıkan bir diğer görüş ise D1 ve D2 işlemleme örüntülerinin daha temel düzeylerde farklılaştığını varsaymaktadır ve D2 işlemlenmesinde anadilden transfer, düşük işlemleme hızı ve bellekteki yük gibi faktörlerin D1 ve D2 işlemleme örüntülerinin farklılıklarını açıklamakta tam olarak yeterli olamayabileceğini öngörmektedir (Clahsen & Felser, 2006; Clahsen, Felser, Neubauer, Sato & Silva, 2010; Ullman, 2001a). Öncelikli olarak D1'de biçimbilimsel açıdan karmaşık yapıların zihinde temsil edilme ve işlemlenme süreçlerini açıklamak üzere ortaya çıkan bildirimsel/işlemsel model, D2'deki işlemleme süreçleri üzerine de bazı önemli çıkarımlar taşımaktadır. Bu görüşe göre D2 konuşucuları bildirimsel belleğe işlemsel bellekten daha fazla güvenme eğilimi göstermektedir ve bunun bir sonucu olarak da genellikle D1'de işlemsel sistem yoluyla işlemlenen karmaşık yapılar (örn: look+ed, book+s) D2'de bildirimsel sistem vasıtasıyla işlenir, bu da D2 konuşucularının hem düzenli hem de düzensiz biçimbilimsel yapıları zihinsel sözlüklerinde bütüncül olarak depoladıklarını göstermektedir. Buna ek olarak, D2 konuşucularının bildirimsel bellekten işlemsel belleğe oranla daha çok yararlandıkları düşünülse de, D2 yeterlilik seviyeleri yüksek olan konuşucuların işlemsel bellek sistemini kullanabilecek beceriye erişebilecekleri de ayrıca belirtilmektedir (Ullman, 2005).

Biçimbilimsel işlemleme modelleri, görsel sözcük tanıma süreçleri esnasında anlambilimsel etkilerin ne kadar erken ortaya çıktığı konusunda farklılık göstermektedir. Bu konuya açıklık getirmek biçimbilimsel açıdan benzerlik gösteren sözcüklerin çoğunlukla anlamsal açıdan da ilişkili olması ve dolayısıyla biçim ve anlamın örtüşmesiyle daha zor bir hal almaktadır. Bu bağlamda, hazırlama deneylerinde elde edilen anlambilimsel etkiler, ortografik ve anlamsal benzerliğin bir sonucu mu yoksa sözcüksel düzeyde mi ortaya çıktığı konusunda farklı görüşler mevcuttur. Subleksikal model olarak da bilinen zorunlu ayrıştırma modeli, biçimbilimsel açıdan karmaşık sözcüklerin biçimbirimlerine ayrıştırılması süreci sözcüğün kendisine ulaşılmasından önce gerçekleşmekte ve bu süreci yönlendirmektedir (Rastle, Davis & New, 2004; Taft & Forster, 1976; Taft, 1994). Otomatik ve salt ortografiye dayanan bu ayrıştırma süreci, sözcüklerin anlamını görmezden gelir. Bu bağlamda, *dollar* 'dolar' ve *teacher* 'öğretmen' sözcükleri aynı şekilde işlemlenir çünkü dollar sözcüğündeki *–ar*, tıpkı teacher sözcüğündeki *–er* gibi bir ek olarak kabul edilir ve süreçte *doll* ve *dollar* arasında herhangi bir anlamsal ilişki bulunmaması göz ardı edilir. Öte yandan supraleksikal model ilk erişimin sözcüklerin bütüncül yapılarına dayalı olduğu öne sürmektedir (Giraudo & Grainger, 2000, 2001). Bu modele göre, sözcüklerin biçimbirimlerine ayrıştırılması bütüncül yapılarına erişimden sonra gerçekleşir ve aynı zamanda sözcüklerin anlambilimsel temsilleri de bütüncül düzeyde aktive edilir. Bu nedenle, karmaşık yapıların işlemlenmesi sözcüklerin morfo-semantik özellikleri ile sınırlandırılmaktadır.

Amaç ve Önem

Bu çalışmanın temel amacı ikinci dilde biçimbilimsel işlemleme sürecinin altında yatan bilişsel mekanizmanın çalışma prensipleri hakkında bilgi edinmektir. Bu çalışma ile ikinci dil (D2) İngilizcede iki isimden oluşan birleşik sözcüklerin ana dili (D1) Türkçe olan kişilerce sözcük tanıma sürecinin en erken aşamalarında nasıl işlemlendiği incelenmektir. Bu çalışmanın ikinci bir amacı da birleşik sözcüklerin bileşenlerine ayrılmasında sözcüklerin anlamsal ve yüzey-biçim özelliklerinin herhangi bir etkisi olup olmadığını ortaya çıkarmaktır. Bunlara ek olarak, birleşik sözcüklere erişim ve bu sözcüklerin zihinde temsil edilme şekillerine birleşik sözcüklerin bileşenlerinin etkisi incelenerek bir birleşik sözcüğün ilk ya da ikinci bileşenini eşit bir şekilde hazırlayıp hazırlamadığını keşfetmek amaçlanmıştır. Eğer eşit bir şekilde hazırlamıyorsa hangi bileşenin birleşik sözcükleri tanıma sürecinde kolaylaştırıcı bir rol oynadığını gözlemlemek hedeflenmiştir. Son olarak bu çalışma ile ikinci dildeki yeterlilik düzeyinin biçimbilimsel açıdan karmaşık yapıların işlemlenmesinde önemli bir faktör olup olmadığını belirlemek amaçlanmıştır. Böylelikle, bu çalışma iki farklı yeterlilik grubu arasındaki potansiyel benzerlikleri ve/veya farklılıkları inceleyerek alanyazına daha fazla katkıda bulunmakta ve hatta zihinsel sözlük yapılarının ana dili konuşucularının zihinsel sistemleriyle ne şekilde benzerlik ve/veya farklıları olduğunu anlama fırsatı sunmaktadır.

Biçimbilimsel Odak

Bu çalışmada bileşenlerinin bütüncül sözcük tanıma sürecine katkısını test etmek için daha net ve doğrudan bir zemin hazırladıklarından ötürü temel araştırma konusu olarak birleşik sözcükler seçilmiştir. İkinci dilde birleşik sözcüklerin işlemlenme süreçlerini incelemek üzere dört adet maskelenmiş hazırlama deneyi uygulanmıştır. Deney 1a ve 1b'de birleşik sözcükleri hazırlama sözcüğü olarak, birleşik sözcüklerin birinci bileşenleri de hedef sözcük olarak kullanılmıştır (Örn: *bedroom* "yatak odası"

– *BED* “yatak”). Deney 1a’nın katılımcılarını D2 İngilizce düzeyleri düşük olan ikinci dil konuşucuları oluştururken, Deney 1b’nin katılımcılarını D2 İngilizce düzeyi yüksek olan ikinci dil konuşucuları oluşturmuştur. Öte yandan Deney 2a ve 2b (Örn: *bedroom* “yatak odası” – *ROOM* “oda+sı”) birleşik sözcüklerin ikinci bileşenlerini hazırlamasını test etmiş olup, yine benzer şekilde sırasıyla D2 İngilizce düzeyleri düşük ve yüksek olan katılımcılara uygulanmıştır.

Bu çalışmada iki bağımsız biçimbirimden oluşan isim-isim bileşimlerine odaklanılmıştır ve birleşik kelimelerin her iki bileşeni de tek biçimbirimli sözcüklerden oluşmaktadır. Çalışmanın odağı olarak isim-isim bileşiklerinin seçilmesinin sebebi farklı dillerde de sıklıkla karşılaşılan dilbilimsel yapılar olmaları ve sözcüklerin zihinsel sözlükte depolanması ve işlemlenmesi arasındaki ilişkinin değerlendirilebilmesi açısından etkili bir test alanı oluşturmalarıdır. Ayrıca, isim-isim bileşiklerinin büyük çoğunluğunda ana bileşeni sözcüğün ikinci bileşeni oluşturmaktadır ve bu da sözcük erişimi esnasında ana bileşenin olası özel bir rolü olup olmadığını test edebilmek açısından önem arz etmektedir. Bunlara ek olarak, isim-isim bileşikleri biçimbilimsel açıdan karmaşık sözcüklerin işlemlenmesinde çeşitli düzeylerde var olan anlambilimsel saydamlığın rolünü test etmek için de daha doğrudan bir zemin sağlamaktadır.

Genel Araştırma Soruları

Bu çalışma ile aşağıdaki temel araştırma sorularına yanıt aranmıştır:

D2 İngilizcedeki birleşik sözcükler D1 Türkçe ve D2 İngilizce konuşucuları tarafından görsel sözcük tanıma sürecinin erken aşamalarında bileşenlerine ayrılarak mı yoksa bütüncül sözcükler olarak mı işlemlenmektedir?

D2’deki birleşik sözcük tanıma ve işlemleme süreçlerinde anlambilimsel saydamlık ve /veya ortografik ilişkinin etkisi gözlemlenmekte midir?

Gözlemlenen birleşik sözcük işlemleme örüntüleri deneysel hedef sözcüklerinin isim-isim bileşiklerinin ilk ya da ikinci bileşeni olmasına bağlı olarak farklılık göstermekte midir?

İkinci dildeki yeterlilik düzeyi D2'de birleşik sözcük işlemleme süreci üzerinde bir fark yaratmakta mıdır?

Denekler

Ana dili Türkçe olan 38 düşük yeterliliğe sahip D2 konuşucusu ve 32 yüksek yeterliliğe sahip D2 konuşucusundan oluşan 70 katılımcı Deney 1'de yer almıştır. Düşük yeterliliğe sahip, 28 erkek, 10 kadın ve 18-22 yaş arası katılımcılar (ortalama: 19) SS: .95, medyan: 19), Eskişehir Osmangazi Üniversitesi Yabancı Diller Bölümü'nün lisans öğrencileridir. İlk olarak 10-14 yaş arasındaki resmi sınıf ortamlarında İngilizceye maruz kalmışlar (ortalama: 10.16, SS: 1.53, medyan: 10) ve kendi ülkelerinde öğrenmişlerdir (ortalama 8.84 yıl, SS: 1.88). Öte yandan, yüksek yeterliliğe sahip katılımcılar 18-24 yaş arası 8 erkek ve 24 kadından oluşmaktadır (ortalama 20.44, SS: 2.05, medyan: 20). Hepsi aynı üniversitede İngilizce Öğretmenliği Bölümünde birinci sınıf öğrencileridir. İngilizceye ilk maruz kalmaları, 7-12 yaş arasında (ortalama: 9.69, SS: 1.14, medyan: 10) ve yine sınıf ortamında (ortalama 10.75 yıl, SS: 2.15) gerçekleşmiştir. Tüm katılımcılar, Türkiye'de doğduklarını ve Türkçeyi doğuştan öğrenmeye başladıklarını ve İngilizce konuşulan bir ülkede altı aydan fazla yaşamadıklarını bildirmişleridir. Katılımcılara iki farklı L2 dil yeterlilik grubuna ait olduklarını doğrulamak için deneylerden önce Oxford Yerleştirme Sınavı uygulanmıştır. Düşük yeterlilik grubundaki katılımcılar, 60 puan üzerinden ortalama 27.65 (SD: 3.67) puan elde etmişlerdir. Bu oran, Diller için Avrupa Ortak Öneriler Çerçevesinde A2 seviyesine karşılık gelmektedir. Yüksek yeterlilik grubundaki öğrenciler 60 üzerinden ortalama 43.68 (SD: 6.93) puan alarak B2 seviyesinde bulunmuşlardır.

Deney 2'ye ana dili Türkçe olan ve 36 düşük yeterliliğe sahip D2 konuşucusu ve 32 yüksek yeterliliğe sahip D2 konuşucusundan oluşan 68 kişi katılmıştır. Düşük yeterliliğe sahip katılımcılar, 18-22 yaş arası 27 erkek ve 9 kadından oluşan (ortalama: 19.31 SS: .98, medyan: 19), Eskişehir Osmangazi Üniversitesi Yabancı Diller Bölümü'nün lisans öğrencileridir. İlk olarak 10-14 yaş arasındaki resmi sınıf ortamlarında İngilizceye maruz kalmışlardır (ortalama 10.36 yıl, SS: .83, medyan: 10). Öte yandan, yüksek L2 yeterliliğine sahip katılımcılar 8 erkek ve 24 kadından oluşmakta ve yaşları 18 ile 24 arasında değişmektedir (ortalama 20.13, SS: 1.38, medyan: 20). Hepsi aynı üniversitenin İngilizce Öğretmenliği bölümünde birinci sınıf öğrencileridir. İngilizceye ilk maruz kalmaları 7-12 yaş arasında (ortalama: 9.95, SS: .801, medyan: 10) ve sınıf ortamında (ortalama 10.22 yıl, SS: 1.6) gerçekleşmiştir. Katılımcıların hiçbiri, İngilizce konuşulan bir ülkede altı aydan fazla yaşamadığını ve hepsi Türkçenin anadilleri olduğunu belirtmişlerdir. Düşük yeterlilik grubundaki katılımcılar, CEFR'ye göre Oxford Yerleştirme sınavına göre A2 (ortalama: 26,52 SD: 3,71) yüksek yeterlilik grubundaki katılımcılar da B2 düzeyinde bulunmuştur (ortalama: 45.31, SS: 5.74).

Deneylere gönüllü olarak katılımcılara katılımları için herhangi bir ödeme yapılmamıştır. İki ayda yapılan deneylerde her katılımcı sadece bir kez test edilmiş ve birden fazla deney veya deneysel listede yer almamıştır. Hiçbir katılımcı deneylerin amacı konusunda önceden bilgilendirilmemiştir. Tüm katılımcılar normal ya da düzeltilmiş normal görüşe sahipti, hiçbirinin öğrenme güçlüğü ya da beyin hasarı öyküsü yoktu.

Deneyler: Birleşik isimlerin D2 İngilizcede işlemlenmesi üzerine deneyler

Bu çalışmada kullanılan tüm birleşik sözcükler her iki bileşeni de tek biçimbirimden meydana gelen isim-isim kombinasyonlarından oluşmuştur. Anlamsal açıdan şeffaf (birleşik sözcüğün anlamına, birleşik sözcüğü oluşturan bileşenlerin ilk ya da gerçek anlamlarından ulaşılabildiği sözcük türü) 20 sözcük ve 20 opak (birleşik sözcüğün anlamının, sözcüğü oluşturan bileşenlerin anlamından elde edilemediği sözcük türü) sözcük biçimbilimsel hazırlama sözcükleri olarak tasarlanmış ve Deney 1a ve 1b'de bu sözcüklerin ilk bileşenleri hedef sözcük olarak kullanılırken (örn: *airport – AIR*) Deney 2a ve 2b'de birleşik sözcüklerin ikinci bileşenleri hedef sözcük görevi görmüştür (örn: *airport – PORT*).

Ayrıca, birleşik sözcüklere uzunluk ve sıklık açısından benzer olan ve başlangıç ya da son heceleri sözcüğün bütünüyle alakalı olmayan bir isimden oluşan (örn: *furlong* 'bir milin sekizde biri' - *fur* 'kürk', *trombone* 'trombon' – *bone* 'kemik') tek biçimbirimli sözcükler olarak tarif edilen 40 tane sözde-birleşik sözcük dahil edilmiştir. Bunlardan 20'si sözcük-başlangıç pozisyonundaki örtüşme koşulu için düzenlenmiş (örn: *costume* ‘kostüm’ – *cost* ‘ücret’) ve diğer 20'si sözcük-bitiş pozisyonundaki örtüşme koşulu için oluşturulmuştur (örn: *candidate* ‘aday’ – *date* ‘tarih’). Bu tek biçimbirimli sözcük setleri, birleşik sözcüklerin ilk ve ikinci bileşenlerini hazırlama deneylerine kontrol koşulu olarak tasarlanmıştır ve ortografik denetleme için kullanılmıştır. Bir diğer 60 sözcük de kontrol grubu olarak tasarlanmış, deneysel amaçla kullanılan birleşik sözcüklerle ve tek biçimbirimli sözcüklerle sıklık ve uzunluk açısından eşleşen ancak hedef sözcüklerle biçimbilimsel, ortografik ve anlambilimsel açıdan hiçbir ilişkisi bulunmayan sözcüklerden seçilmiştir (örn: *bedtime* – *AIR*). Tüm bu sözcük türlerine ek olarak, asıl deneyle hiçbir ilgisi bulunmayan, katılımcıların deneyin temel amacını anlamalarını önlemek için seçilmiş 180 sözcük çifti daha eklenmiştir, bunların 120 tanesi gerçek olmayan hedef sözcüklerden oluşmuştur. Sonuç olarak, her bir listede toplam 240 hazırlama ve hedef sözcük çifti kullanılmış, böylelikle hedef sözcüklerin yarısı “evet” yanıtı gerektiren gerçek sözcüklerden diğer yarısı ise “hayır” yanıtı gerektiren gerçek olmayan sözcüklerden meydana gelmiştir. Gerçekte olmayan sözcükler Wuggy programı (Keuleers & Brysbaert, 2010) kullanılarak oluşturulmuştur.

D2 İngilizcede birleşik sözcüklerin işlemlenmesini ortaya çıkaran 2 farklı maskelenmiş hazırlama deneyi hazırlanmış ve her iki deney iki farklı yeterlilik grubuna uygulanmıştır. Maskelenmiş hazırlama yöntemi beş görsel aşamadan oluşmuştur: (1) 500 milisaniye (ms) boyunca ekranda gösterilen ve katılımcıların odaklanmasını sağlayan sabitleme işareti (*) (2) 500 ms ekranda kalan boş ekran, (3) 500 ms boyunca ekranda kalan ve kare (#) işaretlerinden oluşan ön hazırlama aşaması (4) katılımcıların bu aşamada gösterilen sözcükleri bilinçli olarak algılamamaları için sadece 50 ms boyunca ekranda gösterilen hazırlama sözcüğü (örn: *airport*), ve (5) katılımcıların ‘evet’ veya ‘hayır’ tuşlarına basarak yanıt vermesi beklenen ve katılımcının yanıt vermesiyle birlikte bir sonraki aşamaya geçilen ya da 3000 ms’lik zaman aşımına kadar ekranda kalan hedef sözcük (örn: *air*, *port*). Her bir deney yaklaşık 20 dakika sürmüş ve katılımcılara deneyin ilk yarısından sonra bir mola hakkı tanınmıştır. Deney başlatılmadan önce her katılımcının “Gönüllü katılım formu”nu doldurmaları istenerek çalışmada gönüllü olarak yer aldıklarına dair rızaları alınmıştır. Ardından katılımcılara bir art alan sormacası uygulanmış, demografik bilgileri ve dilsel gelişimleri hakkında veri toplanmıştır. Ayrıca katılımcılara sözlü ve yazılı olarak deney süreci açıklanarak, deneyi tamamlamak üzere kullanacakları Logitech^{TM} oyun kolunun ekranda görecekleri sözcüklerin gerçekte var olan sözcükler olup olmadıklarına dair verecekleri yanıtlarda kullanacakları ilgili tuşlar gösterilmiştir. Deney sonrasında katılımcılara deneyde kullanılan sözcükleri içeren bir sözcük testi uygulanmış ve verilen listede görülen sözcükleri kendi dillerine çevirmeleri istenmiştir. Bu süreç biçimbilimsel açıdan ilişkili sözcük çiftlerinde anlamsal şeffaflığın rolünü değerlendirmek açısından önem arz ettiği için ciddi bir şekilde yürütülmüştür.

Deneylerde kullanılan sözcükler SUBTLEX-UK derleminden seçilmiştir (Van Heuven, Mandera, Keuleers, & Brysbaert, 2014). Deneylerdeki sözcüklerin görsel sunumu, katılımcıların yanıt süreleri ve verdikleri yanıtların doğru olup olmadığı E-prime (Schneider, Eschman, & Zuccolotto, 2002) yazılımı ile kaydedilmiştir ve tekrarlı ölçümler için ANOVA kullanılarak analiz edilmiştir.

Genel Sonuçlar

Birleşik sözcüklerin birinci bileşenlerinin test edildiği Deney 1'den elde edilen bulgular düşük D2 İngilizce yeterlilik düzeyine sahip anadilleri Türkçe olan konuşucularda sadece anlamsal açıdan opak sözcüklerde (örn: *deadline – DEAD*) istatistiksel açıdan anlamlı hazırlama etkileri olduğunu göstermiştir. Ancak istatistiksel anlamlılığa ulaşmasa da anlamsal açıdan şeffaf hazırlama koşulunda yer alan sözcük çiftlerinde de kolaylaştırıcı bir hazırlama etkisi (9 ms) gözlemlenmiş ancak ortografik koşulda yer alan sözcük çiftlerinde hiçbir hazırlama etkisi elde edilmemiştir. Öte yandan D2 İngilizce yeterlilik düzeyleri yüksek olan katılımcılar hem anlamsal açıdan şeffaf hem de opak birleşik sözcüklerde anlamlı ve eşdeğer hazırlama etkileri göstermişler ancak yine ortografik kontrol koşulunda hiçbir anlamlı etki bulunamamıştır. Deney 2 birleşik sözcüklerin ikinci bileşenlerini test etmiştir. Hem düşük D2 İngilizce yeterlilik düzeyine hem de yüksek yeterlilik düzeyine sahip katılımcılarda kolaylaştırıcı hazırlama etkisi gözlemlenmiş, ancak elde edilen hazırlama etkilerinin hiçbiri hiçbir koşulda istatistiksel açıdan anlamlı bulunmamıştır. Deneylerden elde edilen bulgular, erken sözcük tanıma süreçlerinde birleşik isimlerin anadili Türkçe ve ikinci dili İngilizce olan konuşucular tarafından bileşenlerine ayrılarak işlemlendiğini, bu sürecin sözcüklerin ortografik özelliklerinden ve bileşenleri ile birleşik sözcük arasındaki anlam ilişkisinden bağımsız olduğunu göstermektedir. D2 konuşucularının göstermiş olduğu biçimbilimsel hazırlama etkileri göz önüne alındığında, sözcük tanıma sürecinin en erken aşamalarında D2 İngilizcedeki birleşik kelimelerin işlemlenmesinin daha çok form analizine dayandığını ve bu aşamada anlambilimsel bilginin henüz var olmadığı sonucuna varmak mümkündür. Ayrıca, ikinci dil İngilizcede birleşik sözcüklerin işlemlenmesinde sözcüğün ilk bileşeninin sözcük tanıma sürecinde önemli bir rol oynadığı gözlemlenmiş, birleşik sözcüklerin ikinci bileşenin ana bileşen rolünü üstlenmesine rağmen elde edilen bu sonuç ana bileşen etkisinden ziyade sözcük dizisindeki pozisyon (başlangıç pozisyonunda yer alan alt dizi etkisi) etkisinden kaynaklandığı sonucuna varılmıştır. Öte yandan, hem D2 İngilizce düzeyi düşük hem de yüksek olan konuşucuların birleşik isimlerin işlemlenmesi esnasında benzer bilişsel mekanizmalar kullandıkları belirlenmiş, ancak yeterlilik düzeyi daha düşük olan konuşucularda ikinci dil İngilizcedeki birleşik isimlerin işlemlenmesinin bildirimsel belleğe daha çok dayandığı gözlemlenmiştir.

Bütün bu bulgular göz önüne alınarak D2 İngilizcedeki birleşik isimlerin anlambilimsel şeffaflıklarına bakılmaksızın bileşenlerine ayrıştırılarak işlemlendiği ve ortografik kontrol koşulunda hiçbir hazırlama etkisi gözlemlenmemesi sebebiyle birleşik sözcüklerin işlemlenmesinde biçimbilimsel faktörlerin rol oynadığı sonucunu çıkarmak mümkündür. Bu bağlamda, bu çalışmadan elde edilen bulgular subleksikal model olarak adlandırılan zorunlu ayrıştırma modelini desteklemekte, (Rastle vd., 2004) biçimbilimsel açıdan karmaşık yapıların biçimbirimlerine ayrıştırılma sürecinin sözcüklere bütüncül olarak erişilmesinden önce gerçekleştiğini ve bu sürecin anlambilimsel etkilerden bağımsız olarak gerçekleştiğini göstermektedir.

Appendix J: Thesis Permission Form / Tez İzin Formu

TEZ İZİN FORMU / THESIS PERMISSION FORM

ENSTİTÜ / INSTITUTE

Fen Bilimleri Enstitüsü / Graduate School of Natural and Applied Sciences ☐

Sosyal Bilimler Enstitüsü / Graduate School of Social Sciences ☐

Uygulamalı Matematik Enstitüsü / Graduate School of Applied Mathematics ☐

Enformatik Enstitüsü / Graduate School of Informatics ☐

Deniz Bilimleri Enstitüsü / Graduate School of Marine Sciences ☐

YAZARIN / AUTHOR

Soyadı / Surname : ....
Adı / Name : ....
Bölümü / Department : ....

TEZİN ADI / TITLE OF THE THESIS (**İngilizce** / English) : ....
....
....
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