Accessing Deverbal Nouns in L1 and L2 Arabic: A Masked-Priming Experiment

Sohaib Alwaheidi[1], Filiz Çele[2]

ORCID: [1]0000-0001-6198-0303, [2]0000-0002-1290-9217

[1 2]İstanbul Aydin University, Faculty of Arts and Sciences, 34295 Küçükçekmece/İstanbul

[1]sohaibalwaheidi@aydin.edu.tr, [2]filizcele@aydin.edu.tr

(Received 27 October 2022; Accepted 8 June 2023)

ABSTRACT: The current study examines how non-native speakers process deverbal nouns of Arabic. Unlike Indo-European languages, the word-formation process in Arabic occurs in a discontinuous manner. The root morpheme (carrying the core semantic information) interlocks in the word pattern morpheme (which holds the phonological and morpho-syntactic information). Research on Arabic shows that Arabic native speakers decompose derived and inflected (deverbal nouns and verbs) complex words during lexical processing. Priming studies on word processing did not appear to have consistent findings on whether L2 speakers decompose or fully list the complex forms; Using a masked-priming experiment, this study examined whether native and non-native speakers of Arabic decompose derived words, particularly, deverbal nouns in real-time. We tested a group of L1 Turkish /L2 Arabic learners and L1 Arabic speakers on six experimental conditions in which the relationship between prime and target is either morphological, orthographic, or semantic. The results indicated priming effects in the morphological conditions for native speakers, but not for non-native speakers. This shows that native speakers decompose deverbal nouns into their word patterns and root morphemes whereas non-native speakers list them as whole forms during online processing. These findings support the claim that L1 and L2 use different strategies in real-time processing of derived words.

Keywords: Morphological processing, masked-priming, discontinuous morphology, deverbal nouns, L1 Turkish, L2 Arabic

http://doi.org/10.18492/dad.1195380

Dilbilim Araştırmaları Dergisi, 2023/1, 131-155

D1 ve D2 Arapçada Fiilden Türemiş İsimlerin İşlenmesi: Bir Maskelenmiş Çağrıştırma Deneyi

ÖZ: Bu çalışma, anadili (D1) Türkçe/ikinci dili (D2) Arapça olan yetişkinlerin Arapçada fiilden türemiş isimleri nasıl işlediklerini araştırmaktadır. Hint-Avrupa dillerinden farklı olarak, Arapçada kelime türetim süreci kesintili bir şekilde (süreksiz) gerçekleşir. Çekirdek anlamsal bilgiyi taşıyan kök sözcük, sesbilimsel ve biçim-sözdizimsel bilgiyi taşıyan biçimbirimlerle (word pattern) birbirine kenetlenir. Sözcük işleme üzerine yapılan çalışmalar, D1 Arapçada fiilden türemiş karmaşık isimleri (deverbal nouns) ve çekim ekli fiilleri işlerken, D1 konuşanların bu sözcükleri kök ve (yapım/çekim) eklerine ayrıştırarak işlediklerini göstermektedir. Diğer bir deyişle, D1 Arapça konuşanlar çok ekli sözcükleri çevrimiçi işlerken, bütünsel listeleme yerine ayrıştırma yöntemini kullanmaktadırlar. D2'de yapılan çalışmalarda ise, D2 Arapça konuşanların türemiş veya çekimli filleri işlerken bu iki yöntemden hangisini kullandıklarına ilişkin henüz tutarlı bir sonuca varılmadığı gözlenmektedir. Bu çalışma, bir maskelenmiş çağrıştırma deneyi kullanarak, D2 Arapça konuşanların, fiilden türemiş isimleri çevrimiçi işlerken, ayrıştırma ya da bütünsel listeleme yöntemleri arasından hangisini tercih ettiklerini araştırmaktadır. Bu amaçla, D1 Türkçe/D2 Arapça konuşanlar ile D1 Arapça konuşanlara çağrıştırıcılar ve hedef sözcükler arasında biçimbirimsel, yazımsal, ve anlamsal ilişki içeren altı farklı koşulda hazırlanmış bir sözcük değerlendirme testti verilmiştir. Sonuçlar sadece D1 konuşanların çağrıştırıcı ve hedef sözcük arasında biçimbirimsel ilişkinin olduğu koşulda anlamlı çağrışım etkisi olduğunu göstermiştir. Bu bulgular D1 Arapça konuşanların fiilden türemiş isimleri çevrimiçi işlerken, ayrıştırma yöntemini kullanırken, D2 Arapça konuşanların ise bütünsel listeleme yöntemini tercih ettiklerini göstermektedir.

Anahtar sözcükler: Biçimbirimsel işleme, maskelenmiş çağrıştırma, süreksiz morfoloji, fiilden türemiş isimler; D1 Türkçe, D2 Arapça

1 Introduction

The literature on word processing in psycholinguistic research approves that native speakers tend to use morphological information during their online word recognition. The priming effects demonstrating this are found in purely morphological conditions rather than orthographic or semantic conditions. These findings confirmed that L1 speakers use morphological information in the L1 word processing (e.g., Jacob et al. 2017; Kırkıcı and Clahsen 2013; Neubauer and Clahsen 2009).

On the other hand, the research on L2 word processing is still providing conflicting evidence regarding whether L2 speakers use the same mechanisms as those of native speakers in processing morphologically complex words. Some studies have used lexical decision tasks and overt visual, auditory, and cross-

modal priming in examining the inflectional morphology. They demonstrated that L2 speakers decompose inflected forms (Feldman, Kostić, Basnight-Brown, Filipović Đurđević and Pastizzo, 2010; Gor & Jackson, 2013). However, using, mostly, the masked-priming task, some studies failed in providing priming effects for inflected forms (Silva & Clahsen, 2008; Neubauer and Clahsen, 2009; Clahsen et al., 2010; Clahsen, H., Balkhair, L., Cunnings, I., and Schutter, J. S. 2012;). Word processing did not appear to have consistent findings on whether L2 speakers decompose or fully-list the complex forms; even the priming effects found in this domain are only partial (e.g., Silva & Clahsen, 2008). The conflicting results are also found in the derivation domain. For example, Clahsen, H., Felser, C., Neubauer, K., Sato, M., and Silva, R. (2010) did not find priming effects for the derived words in their L2 participants. On the other hand, Diependaele, Dunabeitia, Morris, and Keuleers (2011) were able to find priming effects for their two groups of L2 participants in their masked priming experiment carried on derivationally related prime/target pairs. Derivational and inflectional morphology do indeed share some linguistic properties.

According to theories in morphology such as Distributed Morphology (Harley & Noyer, 1999), derivational and inflectional morphemes add different information types when added to stems of words. When derivational morphemes are added to the branches, they add semantic information and change the word category. The derivational suffix -er in the word write, forms the agent word (writer = 'person who writes'). The example also shows how a word category changes from a verb to a noun., meaning that the result of derivation is a potential new lexeme. On the other hand, inflectional morphemes add abstract grammatical information such as the suffix -ed (e.g., tense or agreement; walk present → walked past). However, the product of the inflectional process yields new forms of the same lexeme. According to recent research by Reifegerste, J., Elin, K., & Clahsen, H. (2019), derivational morphology is a pure linguistic process in which new lexemes are made and to which a new entry is made. On the other hand, inflectional morphology is a grammatical process that spells out morpho-syntactic features. With this being given, morphologically complex words have an internal abstract structure according to the generative frameworks.[1] The question is whether this internal abstract structure is organized or not. we do expect native speakers to have this organization, but for L2 speakers, the debate is still ongoing, which makes forming expectations about it difficult.

This paper deals with the processing of deverbal nouns in Arabic, the paper's focus is on derivational morphology in Arabic. Previous processing studies on the Arabic language indicated that native speakers perform similarly to natives

1 See also Kunduracı (2013: 104-107), for example, for a non-transformational discussion on derivation vs. inflection in autonomous morphology.

of other languages with different family roots (e.g., English). The morphologically complex words in Arabic are decomposed during online lexical processing (Boudelaa & Marslen-Wilson, 2001; 2004; 2005; 2011; 2013). The reasons behind conducting such a study on Arabic language are the inconsistent findings in the literature regarding L2 processing of derived words, the different word-formation process in Semitic languages, and finally, the little information we have about Arabic as L1 or L2. This paper aims to find out whether L2 speakers of Arabic (Turkish L1) process deverbal nouns in the same manner as native speakers or not.

The structure of the article is as follows. Section 2 reviews L1 and L2 processing of derivational morphology, followed by a brief discussion of the morphological structure of deverbal nouns in Arabic and the motivation of the study. Section 3 involves the study, in which we present research questions, participants, the mask-primed experiment, and experimental items. In Section 4, the results of the study are presented. The discussion of the findings and conclusion are given in Section 5.

2 Literature Review

2.1 L1 Processing of Derivational Morphology

The general view and the consistent findings we have in complex word processing come from the literature on native language processing. The general research view concludes that native speakers use morphological markers (derived and inflected) in their online processing. It means that their online processing depends, to a large extent, on their grammatical information; this indicates that natives focus more on the complex word forms' morphological label during the early processing time. In Clahsen et al. (2010), native German speakers showed priming effects of structure and relied on the decomposition model of processing and consequently no reliance on storage. In another study, deadjectival nominalizations used in Silva and Clahsen (2008) showed significant morphological priming effects in their group of L1 speakers of English that is similar to Clahsen, H., Felser, C., Neubauer, K., Sato, M., and Silva, R. (2010). Other languages with a different family root, like Turkish has been tested as well, and the findings regarding L1 processing showed that they are similar to Indo-European languages like English. For example, Kırkıcı and Clahsen (2013) proved, in their study, that derived word forms are processed in a decomposition manner by the native speakers of Turkish. To sum up, studies which took into consideration L1 processing of complex word forms concluded that native speakers do store the stems and derivational morphemes separately and that they use the grammatical knowledge during the early stages of visual word recognition (e.g., Clahsen et al., 2003; Marslen-Wilson, 2007).

According to Boudelaa and Marslen-Wilson (2005), the Arabic language holds a different morphological system and word-formation processes from English, for example. The difference is in discontinuous (non-concatenative) morphology, which Arabic mostly uses and that includes two abstract morphemes (root and word pattern). Despite having different morphology, Boudelaa and Marslen-Wilson (2001) used the Cross-modal priming to compare priming effects between visual targets and auditory primes. The conditions came in four types with varied semantic and morphological relationships. The results indicated that morphologically related pairs prime each other whether they share a transparent or an opaque semantic relationship. The findings here indicate the use of the decomposition route by the L1 speakers of Arabic. Arabic and Hebrew showed the same priming effects regardless of the semantic relationship when word pairs share a root (Froster et al., 2000). In keeping with Boudelaa and Marslen-Wilson (2001), pairs sharing the same word pattern were compared with pairs sharing phonological but not morphological pairs. The results also stated priming effects for the pairs sharing the same word pattern. Boudelaa and Marlsen-Wilson's (2005) masked priming experiment concluded that root priming is more robust than pattern priming due to the findings they had in a series of SOAs they used in the experiment.[2] Root priming appeared significant at all the used SOAs (32ms, 48ms, 64ms, and 80ms), while on the other hand, they found substantial priming in the 48ms and 64ms for the pattern morpheme. Boudelaa and Marslen-Wilson (2011), also found that the root's productivity determines the priming, not the word patterns priming. In other words, priming happens if the root is productive, while the pattern productivity is not as important as the root productivity. Building on the literature we reviewed, we predict similar priming effects both in L1 and L2.

In conclusion, studies that took into consideration L1 processing of derived complex word forms indicated that parsers tend to use the decomposition model and rely on their grammatical knowledge rather than reliance on the storage and whole-word processing. Also, in languages with discontinuous morphology, the results are obtained in parallel with languages with continuous morphology.

2.2 L2 Processing of Derivational Morphology

The data regarding non-native processing of derived and inflected word processing is still inconclusive, as indicated in the introduction above. To start with, Silva and Clahsen (2008) tested whether native and non-native speakers process derived and inflected word forms similarly or differently, the results indicated priming effects for native speakers for both derived and inflected words. On the other hand, non-native speakers showed different priming

2 SOA: Stimulus Onset Asynchrony.

patterns. Derived words revealed reduced priming effects and inflected words did not show priming effects at all. They concluded that native and non-native speakers are different when it comes to derived and inflected word processing. The fact that native speakers showed priming and non-native speakers did not, indicate that non-native speakers rely more on lexical storage and less on combinatorial processing of morphologically complex words than native speakers. The previous research by Silva and Clahsen (2008) did not appear to provide the same results between their L1 and L2 groups. In Clahsen, H., Felser, C., Neubauer, K., Sato, M., and Silva, R. (2010), L1 and L2 speakers of German did not seem to be similar in their processing of the nominalization morphemes. Native speakers, as mentioned earlier in the paper, showed significant priming effects that were absent in the results of non-natives of the German language. The same study with the same experiment was replicated by Clahsen et al. (2012) to question whether the brief time given to the non-native group participants could be the reason for the lack of priming. Even after providing extra time, the results were the same in the L2 group. The amount of data here as well as the lack of significant priming in the derivational domain, which is similar to the inflectional one, does indeed indicate that L2 speakers do not rely on the decomposition model while processing these words, which in other words prove their reliance on storage and whole-word access. It also entails that during the online word processing, L2 speakers do not make use of grammatical knowledge.

The research on L2 processing does not seem to be consistent and conclusive due to the other side of researchers stating that L1 and L2 processing are not fundamentally different. For instance, Diependaele, Dunabeitia, Morris, and Keuleers (2011), tested pair words with a derivational relationship, the outcome was priming effects for both groups of natives and non-natives. Dal Maso and Giraudo's (2014) work indicated that L2 speakers are sensitive to morphological markers as long as they acquire them. They found that rare affixes did not show priming in their L2 data while frequent and productive affixes were parallel between the L1 and L2 participants. Freynik, Gor and O'Rourke (2017) took derivational morphology into account. The analysis indicated that using the cross-modal priming, native and non-native speakers of Arabic showed priming effects. The study concludes by stating that both groups have the same way of organization of the (mental) lexicon. Previous research on the processing of multi-morphemic words by L1 Arabic speakers provided clear-cut evidence on the existence of the morphological structure employed by parsers while processing the complex words (Boudelaa and Marslen-Wilson, 2011). The lack of research on Arabic as an L2 language in the literature of psycholinguistics makes it challenging to predict the type of mechanism that might be employed by L2 speakers. Freynik, Gor, and O'Rourke (2017) provided evidence for the native-like processing by L2 speakers of Arabic when the prime and target shared a root.

In conclusion, current psycholinguistics research has not come to a clear end regarding the L1 and L2 processing of complex derived word forms in Arabic, which is one of the basic motivators of the current research.

2.3 Discontinuous Morphology in Arabic

The nature of Arabic morphology and its word-formation process differ from the frequently-tested languages in the literature. For instance, English generally displays continuous morphology in which stems and affixes combine via concatenation. On the other hand, Arabic, like other Semitic languages, generally shows non-concatenation for word formations. Arabic morphology is templatic with morphemes being discontinuous. These morphemes are the root and word pattern units. Firstly, the root morpheme is usually made of three consonants that carry the core semantic information, such as the root {ʕ-l-m} maintaining the general meaning of 'knowledge, learning, or lead'. Secondly, the word pattern is a template containing vowels and provides a syllabic structure of the words, formal and semantic information {e.g., faːʕil (active participle/agent) 'doer'}. The derivation in the Arabic language takes place as the root morpheme interlocks between the template pattern. For instance, the derivation process outcome between the previously given root and the pattern is the word {ʕaːlim}, which is 'the person who possesses knowledge or information'. It is worth mentioning that the grammatical and semantic information change according to the type of pattern added to the root, with the root keeping its general meaning. However, a derivation from the same root is not always as transparent as the example provided above. Sometimes the general meaning changes as the outcome of a derivational process may result in a range of different meanings from the general one carried by the root morpheme due to the pattern unit.[3]

2.4 Motivation of the Study

There are certain reasons why we chose to carry out this experimental study on the Arabic language. The primary and most important reason is the lack of attention on Arabic among the researchers of psycholinguistics and word processing, which led to a lot of information about Indo-European languages but not Semitic languages, Arabic, in particular. Also, Arabic has a different kind of morphology as stressed above: Word formation in Arabic is done through discontinuous morphology. Moreover, Arabic has a different orthographic system, which is consonantal alphabetic, (كاتب- writer) and the direction of

3 Anderson (1992: 57–58) presents an autonomous, a-morphous approach to Arabic morphology and morphophonology. See also McCarthy (1981) for details about discontinuous morphological systems.

writing, which is from right to left. As a Semitic language that has not received much attention among the researchers in psycholinguistics, we believe that it is essential to add Arabic processing between the native and non-native speakers of Arabic to the body of the relevant literature. We believe that our study's findings will allow further research in morphological processing with more attention to less-tested languages like Arabic, which has different morphological and orthographic systems. Finally, our most important aim is to contribute to the current literature with a new experimental study on Arabic. We aim at helping the readers and those who are interested in word processing know whether derived words are processed in the same way with L2 speakers. We believe that our study will provide new insights into the problem and debate (native-like processing or not) that has not been resolved yet.

3 Methodology

This study uses the masked experiment paradigm to find out an answer for one of the most important questions asked in psycholinguistics as to investigate whether L1 and L2 speakers can process derived words in the same or different way. Processing complex words in psycholinguistics would go with the full-listing pattern, which is processing the given words as whole units or splitting the words into their constituent morphemes. The former is referred to as decomposition. Parsers would also go for the two patterns, which is called the hybrid model of processing. This study aims to find out the preferred mechanism used by L1 and L2 speakers of Arabic. See Silva and Clahsen (2008).

3.1 Research Questions and Predictions

This study aims to find out answers to the following specific questions. Here we also provide our predictions for the questions:

1. Do native Arabic speakers decompose the deverbal nouns into a word pattern and a root morpheme, or do they store them as complete forms?
2. Do L2 speakers of Arabic decompose the deverbal nouns into a word pattern and root morphemes or keep them as complete forms?

The Arabic language has provided strong evidence for the morphological structure available in the lexical representation of the parsers' multimorphemic words (Boudelaa and Marslen-Wilson, 2013). Boudelaa and Marslen-Wilson also proved that the morphological structure is available during processing the complex forms of words in several other studies (e.g., Boudelaa and Marslen-Wilson, 2001, 2004, 2005). Furthermore, Boudelaa and Marslen-Wilson (2013: 1459) state that "words sharing a root will prime each other effectively regardless of whether their semantic relationship is transparent or opaque." That is to say that native Arabic speakers can decompose the Arabic words into the main two

units, word patterns, and roots in accessing these words. It signifies that the lexicon of L1 speakers of Arabic is organized, which is proved by the previously mentioned studies. The conclusions found are due to the morphological build rather than the orthographic and/or semantic relationship meaning that participants are guided by their grammatical information rather than the meaning or semantic relatedness and form or orthographic relatedness. Since the goal of the study is to find out whether grammatical information is available or not in the very early time of online processing, semantic and orthographic information should not be the factors that guide the participants, grammatical information should.

Building upon what we have mentioned, L1 speakers of Arabic are expected to process the complex deverbal nouns using the decomposition mechanism, which means that deverbal nouns would be broken into the word pattern and the root. Also, processing these words (the morphologically related ones) would be faster than the unrelated counterparts. This priming effect is also predicted to be due to morphological relatedness and not due to the orthographic and semantic relationship.

If we suppose the native-like processing by the L2 speakers, they will decompose deverbal nouns in L2 Arabic into the word pattern and the root.

3.2 Participants

Our study included 42 participants who were divided into two groups. The first group consisted of our native-speaker participants. The number of the first group was 21 subjects. The mean age of the first group was 24.80, while the range of their ages was (18-34). Seven of the subjects in the first group were females. The participants were from Palestine, Syria, and Egypt. The participants volunteered to participate in the study; in other words, they weren't paid for their participation. All the participants acquired Arabic as their L1 from birth. All the participants were asked to state what they saw in the experiment. None of the participants reported seeing the prime word except for only one participant who noticed the prime's existence but without telling what words he noticed.

The second group of participants, whose results were compared with the first group, included the same number of participants as 21 (mean:23, range:18-36, female:12, male:9). All the participants were native Turkish speakers who learned Arabic after the age of 11. All the subjects in the L2 group were proficient speakers of Arabic. Some of our L2 participants were already Arabic language teachers. Some of them were also interested in Islamic studies, which enhanced their speaking skills by giving lectures at some Islamic centers which were delivered only in Arabic. Finally, L2 participants were not paid to participate in the study.

In the following section, we indicate how we could decide that the participants of the study were proficient, in other words, advanced in Arabic.

3.3. Materials

3.3.1 Arabic proficiency test

In order to test the eligibility of the Arabic language for all our L2 participants, they were given an Arabic proficiency test. The test was prepared by the Department of Arabic Language and Literature at Karadeniz Technical University. The researcher got access to the test online. The exam is an indicator of Arabic proficiency. Only participants who are proficient in Arabic could participate while the other participants with limited knowledge of Arabic were excluded. Namely, only students who were able to pass the test were able to take part in the experiment. The average score for passing is 70 out of 100. All the participants were able to pass the exam. Most of the participants were Arabic language learners registered in advanced classes at an Arabic language center in Istanbul. The participants were Arabic language users as well since their bachelor degree requires Arabic.

3.3.2 Vocabulary post-test

To get a clear view of the processing of the complex words used in the study, we gave a vocabulary test for all the L2 participants. Thus we checked whether the target words they encountered are words they know or not. We excluded the unknown words for each participant to account better for their processing.

3.3.3 Masked-priming task

The masked priming paradigm is used to test whether parsers use the decomposition or full-listing models of processing when they encounter any given pairs of prime and target. It can also provide a way of processing either in inflected or derived word forms. Forster and Davis (1984) state that the masked priming is suitable for accounting for the early automatic processing used in word recognition. It is considered early for the fact that the prime word lasts for only 30 to 80ms before the presentation of the targets. This very short time does not allow the participants to see the prime word although they would not be able to tell what exactly that word was. Masked-priming task is designed to present the participants with two words. The first is called prime and the second is called a target. The prime word is presented for a short time before the target and participants are asked to perform a lexical decision task that is (word or non-word). The relationship between the prime and the target is manipulated between

semantic, phonological, orthographic or morphological relations to examine potential influences (Silva and Clahsen 2008). The time between the onset of prime and the target is referred to as SOA which is the Stimulus Onset Asynchrony. Participants should not be aware of the prime words presented to them and for that reason, the primes are also being masked with a string of symbols (e.g. ####). In order to prevent the overlap between targets and primes, the prime words are presented in a lower case and target ones are presented in upper cases. A point to note is that the results obtained from the masked priming are not due to conscious recognition of the primes but rather unconscious recognition because the task does not allow for the conscious recognition of the relationship between the prime and targets. Also, the memory effects are reduced for a better view of the lexical representation.

The present study used the masked experiment task in order to investigate the used mechanism in processing the deverbal noun words in Arabic. The SOA was 50ms for the complex words we presented. The specific short SOA was used to prevent the conscious recognition of words and to prevent the participants from developing strategies while processing the words. In the study, we used the Arabic language as L1 and L2 which means that there is no way of presenting upper and lower cases in the prime and target words which is a property that does not exist in the orthographic system of Arabic. For this reason, we follow Boudelaa and Marslen-Wilson (2005) in which the prime words were presented in 24-point traditional Arabic font size. Target words, on the other hand, were presented in 34-point font size without diacritics.

Our present study is in light of Boudelaa and Marslen-Wilson (2005); we adopt the experimental items from their research on Arabic as L1. The Arabic deverbal nouns took their name since their derivation process is so close to the verbs as they derive from the same consonantal roots. Due to the large number of roots and word patterns they involve, this type of nouns has a high degree of productivity and systematicity; this is to say that a given root can be merged with many word patterns to make many deverbal nouns (Boudelaa and Marslen-Wilson, 2005).

Six conditions, where primes and targets were related in a particular aspect, are adopted and used in our study. In the first condition, the prime and target were associated with each other for sharing the same word pattern, which was either {faaøilun} or {faøiilun} ‘doer’ both of which give the meaning of agent. Sharing a word pattern allows for the vocalic overlap mainly but also may happen in consonants. An example of this condition is [xaalidun] ‘eternal’ [xld] ‘to eternize’ -[ħaarisun] ‘guard’ [ħrs] ‘to guard’.

Condition 2 is an orthographic control that will be compared to condition 1. In this condition, the prime and target share an orthographic relationship, for instance [ʃahwatun] ‘desire’ [ʃha] ‘to desire’-[manðˁarun] ‘sight’ [nðr] ‘to see’.

The root conditions were divided into two, depending on the semantic relationship.

In the third condition, the prime and target share a root and a transparent semantic relationship such as [taħqiiqun] ‘investigation’ [ħqq] ‘to investigate’- [ħaqiiqatun] ‘truth’ [ħaq] ‘right’.

In condition 4, they share a root but an opaque relationship as in [miʕtˁafun] ‘coat’ [ʕtf] ‘to sympathize’- [ʕaatˁifatun] ‘sentiment’ [ʕtf] ‘to sympathize’. The reason for adding two conditions regarding the root morpheme is to find out whether root priming happens regardless of the semantic transparency and opacity.

In obtaining a clear view of the root effects in conditions 3 and 4, condition 5 was added, which included primes and targets orthographically related by sharing 2-3 consonants but not making the same root of the prime. Here pairs show similarity in their orthography but not a morphological relationship; the example is [sulaħfaatun]-[silaaħun] ‘turtle’-‘weapon’.

Finally, condition 6 included primes and targets that share only a semantic relationship. Here roots and even word patterns are not shared between the pairs such as [qitaalun] ‘fight’ [qtl] ‘to kill’-[ħarbun] -‘war’. The six experimental conditions are summarized in the following Table 1 adopted from (Boudelaa and Marslen-Wilson, 2005:212).[4]

[4] Boudelaa and Marslen-Wilson, (2005), give more information and examples about the formation of deverbal nouns. To access the full list of experimental materials in their study, see (Boudelaa and Marslen-Wilson, 2005)

Table 1. Experimental materials adopted from Boudelaa and Marslen-Wilson (2005, p. 212).

Condition	Test	Prime Baseline	Target
	خالد	نهوض	حارس
+WP	xaalidun	nuhuud'un	haarisun
	eternal	getting up	guard
	طائرة	فتور	خالص
+Orth1	t'aa?iratun	Futuurun	xaalis'un
	plane	lassitude	pure
	رئاسة	عاقبة	رئيس
+R+S	ri?aasa	ʕaaqlbatun	ra?iisu n
	president	end	presidency
	ظالم	حريق	ظلام
+R-S	ð'alaamun	hariiqun	ð'aalimun
	oppressor	fire	obsecurity
	إبريق	تأميمٌ	تامّ
+Orth2	?ibriiqun	ta?miimun	taammun
	jug	nationalization	complete
	عمود	حكاية	قصّة
-R+S	ʕamuudun	hikaajatun	qisʕs ʕatun
	post	story	novel

Twenty-four prime-target pairs were made for each of the previously listed conditions. Since the Arabic writing system does not specify the short vowels, all targets were unambiguous by having long vowels. In other words, since short vowels are not overtly written in the Arabic writing system, the used targets included long vowels that are overtly written. Few cases had short vowels, but they were more frequent than their homographs. The goal of our paper is to investigate L2 word processing, for this reason we decided to adopt our experimental materials from Boudelaa and Marslen-Wilson (2005) which had already investigated L1 word processing.

The first condition is referred to as [+WP] for pairs that share a word pattern with an average of 1.2 letters in common. The second condition [+Orth1] placed controls the prime and target overlap in the first condition. The average number of letters shared is 0.9, and these pairs have neither semantic nor morphological relationships. The overlap here was among the vowels. The third condition [+R+S] included primes and targets that share a root and a transparent semantic relationship. In contrast, in the fourth condition [+R-S], the primes and targets shared a root and an opaque semantic relationship. That is to say, the root was the same in [+R-S], but with a different semantic interpretation between the prime and target; this makes the meaning between the root and the full form opaque. Both conditions sharing a root had a 3.4 average number of letters in common. The previous two conditions sharing a root needed a control condition

for their possible orthographic effects, and for that reason, the fifth condition [+Orth2] was added. The average number of shared letters in this condition was 2.5. The overlap in this condition here was among the consonants. Finally, the sixth condition [-R+S] included the semantically related pairs without any morphological relationship. The average of the shared letters is 0.6.

Regarding the baseline primes and targets, it is imperative to state that there was no morphological, orthographic, and semantic relationship between the two pairs. A pre-test was given to native Arabic speakers to decide, on a scale out of 5 points, whether a given word is (1) very unfamiliar or (5) as being very familiar. The word-word pairs accounted for 144 where the target was preceded by a related prime and the same number in which an unrelated prime preceded the target. The 288 word-word prime and target pairs were divided into two versions. The related and unrelated primes were equal in each performance. Also, each of the versions included a similar number of words, pseudo-word prime and target pairs. The 144 pseudo-words were constructed by the researcher following the same overlap done by Boudelaa and Marslen-Wilson (2005) in which we had vowel overlap, consonant overlap, and no overlap. The non-words were constructed by changing some letters of the full form concerning the type of overlap we have just mentioned. The experiment also included ten practice pairs; half were words, and the other half were non-words. The whole investigation then included 586 pairs.

3.4. Procedure

We collected information from two groups of participants, each group was deemed to go through some crucial measures. First, the native speakers, each participant in this group, had to fill a background questionnaire, which includes some questions about his/her linguistic background along with personal and education-related items. After completing this step, each participant had to go through our masked-priming experiment. Secondly, the non-native speakers took the background questionnaire and the masked priming experiment, just like the native speakers. Still, they had to go through a proficiency test to determine their Arabic language proficiency (done before the masked-priming experiment) and a vocabulary post-test to exclude the unknown words from further analysis.

Targets were preceded by a related prime and a baseline prime that does not share any morphological, semantic, or orthographic relationship with the targets, so the whole experiment was divided into two variants to present the targets once in each version. The visual events were three in which the first was the mask itself that included 28 vertical lines shown in the traditional Arabic font in 30-point size. The presentation period was 500ms. We also used the vertical lines instead of the hash marks following Boudelaa and Marslen-Wilson (2005), who found that the vertical lines are more effective. The second event was the prime

word presented in the same traditional Arabic font but 24-point size. The prime words were written without diacritics and presented for 50ms. The last event was the presentation of the target word, which was presented until the participants' decision or after passing of 2000 ms. Following the previous events, the font used was traditional Arabic, and the size was 34-point. The targets were written without diacritics as well. Using a different font size between the primes and targets is due to the absence of upper and lower cases in MSA.

The data was collected on one of the researchers' HP laptop using E-prime 2 Standard. The experiment was run on all the participants who were asked to give a lexical decision to the words they see as accurate and quick as possible. The participants were asked to click on the right key for the words "YES", and the left key for the non-words "NO". The experiment started with a ten trial-practice session; afterward, the primary investigation started as soon as the participant was ready to proceed and made sure that the task was understood. A break was given between the two versions, and simply, the participant could go on with the task pressing the spacebar.

4 Results

In this study, the complex words were presented in 6 different conditions, and the category of these words is deverbal nouns. Three conditions are morphologically based, containing the basic two word formation patterns in Arabic: x and y. 2 conditions are designed to give an orthographic control. The last condition is designed to provide semantic control. In analyzing our data and for finding the statistical difference, we used a mixed design analysis (ANOVA) with two factors, the first is a condition (six levels, +WP,+Orth1,+R+S,+R-S,+Orth2,-R+S) and the second, prime type (two levels, test, and control).

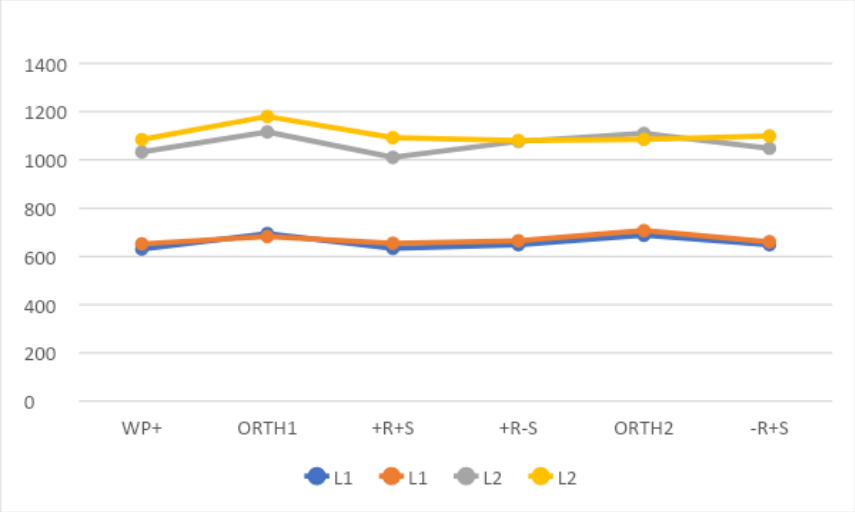
The data displayed in this section regarding RT has been pruned in two ways, excluding participants who have more than 30% errors. It has caused the elimination of one participant from the L2 group. Second, removing data points lying two standard deviations above or below the participants' mean. The data loss in the second step was 0.5%. In this section, we review the native Arabic speakers' results and the results of the non-native Arabic speakers. Finally, we compare the performance of native and non-native speakers. Table 2 below provides mean reading times and SD for the six conditions with their test and control items in L1 and L2 groups.

Table 2. L1 and L2 Speakers' Mean RT for All Conditions

	L1		L2	
	Test	Control	Test	Control
Condition				
WP+	631.06 (89.41)	652.23 (93.21)	1033.09 (202.20)	1084.57 (246.89)
ORTH1	695.03 (126.97)	682.75 (117.77)	1116.21 (206.41)	1180.29 (267.77)
+R+S	633.48 (108.23)	654.63 (106.26)	1010.68 (199.73)	1092.37 (260.56)
+R-S	648.83 (104.25)	664.98 (112.68)	1076.86 (222.18)	1080.77 (213.18)
ORTH2	687.85 (108.29)	707.12 (123.11)	1109.99 (268.03)	1085.51 (226.11)
-R+S	648.75 (80.11)	661.04 (95.23)	1048.28 (200.86)	1099.39 (210.90)

The table above gives the results we obtained in the experiments we ran. The numbers provided are for the mean reaction times for the examined pairs both in the test and control items. First of all, for L1 speakers reading times were shorter in the following conditions +WP, +R+S, +R-S, Orth2 and -R+S. Regarding the second group of our study, L2 speakers, their reading times spent in the test and control items was shorter in the test items for all the conditions as indicated in Table 2. Figure 1 below is designed to show the reading times between the two different groups of participants in the study.

Figure 1: RT for L1 and L2 speakers



We conducted a two-way mixed-design repeated-measures ANOVA with Condition as within-subjects factor and language as between-subjects factor. The results showed a main effect for condition (F1 (11,407) = 7.115, $p<0.05$, P.ES.16), which is an indicator of the different RT spent on reading the conditions, and a significant interaction between Condition and Language group (F2 (11,407)= 1.858, p=0.043, P.ES.048). There is also a significant effect for language group (F1 (1,37)= 1131.72, p=0.05, P.ES.691). It indicates that RT spent by each group on reading the conditions is significantly different. In other words, the L1 group of Arabic spent shorter time than the L2 groups, which differed significantly from the first group, that is to say that they had longer reaction time.

We also conducted a separate ANOVA for each language group. ANOVA results for L1 showed a main effect indicating that there is a difference in the RT in the conditions (F1 (11,209)= 137, $p<0.05$ P.ES.300). The pairwise results for L1 did not show any significant difference between the six conditions under investigation; however, we carried a paired-samples t-test to examine the difference between the test and control items in each condition, and the results indicated a significant difference in +WP condition ($t(19)=3.395$ $P<0.05$). Another significant difference was found in +R+S condition ($t(19)=1.093$ P=0.029). The rest of the conditions did not show any significant differences in the L1 group. Table 3 given below is designed to give the standard deviation and significance values we obtained from the t-test.

Table 3. t-test table for six conditions in L1 Arabic

L1		
Condition	Standard Deviation	Significance
+WP	27.17	0.002
ORTH1	48.98	0.264
+R+S	39.07	0.022
+R-S	48.30	0.141
ORTH2	77.009	0.265
-R+S	34.76	0.121

The ANOVA results for L2 also showed the main effect (F1 (11,192)= 3.762, p<0.05, P.ES.173), indicating that there is a different RT spent on reading the conditions. The pairwise comparison did not show any significant difference in all the tested needs. However, in t-test results, only one condition showed a significant difference, which is +R+S (t(18)=3.102 P=0.006). One more condition was so close to reaching significance, which is -R+S (t(18)=2.057 P<0.054). The rest of the conditions did not show any significant differences between the control and the test in all conditions in the L2 group. Table 4 below shows the results we have for the L2 speakers.

Table 4. t-test table for six conditions in L2 Arabic (Using information above)

L1		
Condition	Standard Deviation	Significance
+WP	148.73	0.149
ORTH1	150.03	0.079
+R+S	114.78	0.006
+R-S	97.86	0.864
ORTH2	155.46	0.501
-R+S	108.22	0.054

The results of the L2 speakers of Arabic show a significant difference found in one of the six conditions we have in the materials: +R+S. Again, the significant results were obtained from the t-test results. None of the remaining conditions showed priming effects in the L2 speakers.

To sum up the results above, regarding word patterns which include the deverbal word patterns, L1 speakers showed priming effects while L2 speakers did not. Native and non-native speakers were the same in the condition +R+S in which priming effects were found in both groups. The orthographic condition did not show any priming effects in both groups. The significant difference, in +WP, was found in native but not non-native speakers. In this regard, we state that word patterns in Arabic are processed regardless of their orthographic controls. In other words, morphology facilitates the priming rather than the orthography, character-based relationship. Secondly, we turn to talk about the root conditions against the orthographic and semantic controls. In the +R+S we found significant differences in +R+S in both L1 and L2 groups. +Orth2 in both groups did not show any statistical differences. -R+S, on the other hand, did not show any priming both in L1 and L2 groups.

5 Discussion

The present study aims to get an answer to the following questions:

1. Do native Arabic speakers decompose the deverbal nouns into a word pattern and a root morpheme, or do they store them as complete forms?
2. Do L2 speakers of Arabic decompose the deverbal nouns into a word pattern and root morphemes or keep them as complete forms?

When parsers encounter a complex word, they in one hand, employ the decomposition model of word processing, they tend to analyze the encountered words into a stem and units attached to the stem or root. This means that complex words are presented into their constituent structure – pointing to using decomposition rather than full-listing. This emphasizes the organization of stems and morphemes in the brain. The view is supported by Taft and Froster (1975), who, in their article, claimed that word analysis is a prior process and comes before the lexical search on words. In this regard it is important to mention that morphological analysis involves processes and is more complex than lexical search, and that morphological patterns seem to have their self-government and should not be limited by the lexicon (Göksel1998, Kunduracı, 2019).

On the other hand, we shift our focus on the other main model of word processing which is the whole-word or full-listing model. As previously stated, the full-listing model proposes that complex words are stored as full forms. This entails first, that the parser's brain tends to store the words as a whole and second, that parsers in this regard have a single lexicon in which they store all types of words without having to strip off the stems and morphemes. This view of word processing is supported by Butterworth (1983), who also claims that words are not decomposed in the lexicon but rather stored as they are in the brain.

As stated in the previous section, the study here found out that our L1 participants process words with the same word pattern faster than the unrelated

pairs that do not share any relationship. The same pairs sharing a word pattern indicated a shorter reaction time than the orthographic control condition, which did not show any priming effects. Our findings suggest that word patterns are stored separately regardless of the orthographic relationship; this also means that there is an effect of the use of the decomposition model in processing the complex words of Arabic which share the same word pattern, i.e. morphology. These findings go in line with Boudelaa and Marslen-Wilson (2005), who found the same results for their participants who were only native Arabic speakers. The decomposition effects we found in our study also go with the set of studies in the literature, which indicate that complex words are processed faster when they share a morphological relationship. As for L2 speakers, Freynik, Gor, and O'Rourke (2017) used a cross-modal priming paradigm to examine how non-native speakers of Arabic process the highly productive derivational morphology. The L2 group (L1 English) provided priming evidence in the words that share a common root. Additionally, it indicates that priming effects are due to morphology rather than the semantic or phonological overlap between primes and targets.

Our novel contribution comes from our data from the non-native speakers of Arabic who did not show the same pattern of effects as the native speakers. They had a shorter RT in pairs sharing a word pattern against the unrelated controls, which did not reach significance either in our ANOVA or t-test. Our findings here do not go in line with the recent study by Jacob et al. (2017) who found out that the derived words are decomposed in the lexicon as they found priming effects for their L2 participants. It implies that our findings go with Silva and Clahsen (2008, 2012). We state that word patterns are processed and stripped in Arabic regardless of the semantic and orthographic relationship in L1 but not in L2. Parsers tend to fully-list the derived word pairs. These findings exist in the literature, but the finding we add to the literature is the same processing mechanism between native and non-native speakers of Arabic. It is worth mentioning that the time set we used is different than the one used in the study we adapted our items from, Boudelaa and Marslen-Wilson (2005). In their study, they used a set of primes presentation times. In the present study, we used SOA of 50ms. Moreover, Arabic morphology depends on two abstract units which are the word pattern and roots. L2 speakers were in line with L1 speakers in one condition that is +R+S. Both of our groups showed significant priming in this condition which means that roots are organised and consequently processed unlike the word patterns which were not processed by our L2 participants. Further research is needed to navigate this finding.

To conclude, L1 speakers and L2 speakers do not employ the same mechanism when they encounter Arabic deverbal nouns. L1 Arabic speakers are more sensitive to morphology than L2 speakers. This indicates that L1 speakers tend to use the available grammatical information in the very early stages of

processing while L2 speakers (of Arabic) focus more on memory storage. The reason behind the differences we found can be that L2 speakers are more reliable on storage and whole-word access. This also means that L2 speakers do not have or make use of grammatical knowledge as much as L1 speakers.

6 Conclusion

The literature of psycholinguistics, word processing particularly, has been concerned with the mechanisms applied by both L1 and L2 speakers. Since the Arabic language didn't receive much attention among the researchers in this field, it was worthy to compare processing Arabic deverbal nouns between native and non-native speakers who are Turkish speakers of Arabic as their L2. Our study directly compared two groups of Arabic speakers – first being L1 and the second as L2 to find an answer to whether these participants decompose the deverbal nouns of Arabic as a root and a word pattern regardless of the semantic and orthographic relatedness. To answer this question, we used the Masked Priming Task with a 50 ms prime presentation (SOA). We found out that native speakers and non-native speakers of Arabic do not use the same mechanism in processing the Arabic deverbal nouns with priming effects in the L1 group but not in L2. We also found that priming is facilitated when the root shares a transparent semantic relationship, which enhances the priming to derive the decomposition at the 50 SOA. This finding is equal both in L1 and L2 speakers of Arabic. Our study here focused on comprehensive skills, we suggest future research to look at the productive skills such as reading and writing which shall require different research designs.

Author Contributions: This study, as a part of MA thesis study, was conducted by two authors.
Submission statement and verification: This study has not been previously published elsewhere. It is not under review in another journal. Publication of the study has been approved, either implicitly or explicitly, by all authors and the responsible authorities at the university/research center where the study was conducted. If the study is accepted for publication, it will not be published in the same form in another printed or electronic medium in Turkish or any other language without the written permission of the Journal of Linguistic Research.
Conflict of Interest Statement: The authors declare that there are no financial or academic conflicts of interest between themselves or with other institutions, organizations or individuals that may affect this study.
Data Use: In this study, data was collected by the authors from L1 and L2 speakers of Arabic, measuring response time to words, in a masked-prime experiment designed in E-prime software.

Ethical Approval/Participant Consent: İstanbul Aydın University Ethics Committee approval dated 31.05.2023 was obtained from the Ethics Committee. Participants were informed about the research and informed consent was obtained from the participants.

Financial Support: No financial support was received for the study.

References

Anderson, S. R. (1992). *A-Morphous morphology*. Cambridge University Press.

Berent, I., Steriade, D., Lennertz, T. & Vaknin, V. (2007). What we know about what we have never heard: Evidence from perceptual illusions. *Cognition, 104*, 591–630. https://doi.org/10.1016/j.cognition.2006.05.015

Beth-Feldman, L., Kostić, A., Basnight-Brown, D. M., Filipović Đurđević, D., & Pastizzo, M. J. (2010). Morphological facilitation for regular and irregular verb formations in native and non-native speakers: Little evidence for two distinct mechanisms. *Bilingualism Language and Cognition*, *13*(2), 119-135. https://doi.org/10.1017/S1366728909990459

Boudelaa S. & Marslen-Wilson W.D. (2004). Allomorphic variation in Arabic: implications for lexical processing and representation. *Brain Lang, 90* (1-3), 106-116. https://doi.org/10.1016/S0093-934X(03)00424-3

Boudelaa, S. & Marslen-Wilson, W. D. (2001). Morphological units in the Arabic mental lexicon. *Cognition, 81*(1), 65-92. https://doi.org/10.1016/S0010-0277(01)00119-6

Boudelaa, S., & Marslen-Wilson, W. D. (2005). Discontinuous morphology in time: Incremental masked priming in Arabic. *Language and Cognitive Processes, 20*(1-2), 207-260. https://doi.org/10.1080/01690960444000106

Boudelaa, S. & Marslen-Wilson, W. D. (2011). Productivity and priming: Morphemic decomposition in Arabic. *Language and Cognitive Processes, 26*(4-6), 624-652. https://doi.org/10.1080/01690965.2010.521022

Boudelaa, S. & Marslen-Wilson, W. D. (2013) Morphological structure in the Arabic mental lexicon: Parallels between Standard and Dialectal Arabic. *Language and Cognitive Processes, 28*(10), 1453-1473. https://doi.org/10.1080/01690965.2012.719629

Boudelaa, S. (2014). Is the Arabic mental lexicon morpheme-based or stem-based? Implications for spoken and written word. In E. Saiegh-Haddad, & R. Joshi (Eds.), *Handbook of Arabic literacy* (pp. 31-54). Springer.

Butterworth, B. (1983). *Development, writing and other language processes*. Academic Press.

Cao, G. (2016). Morphological decomposition in second language word processing. *Theory and Practice in Language Studies, 6*(1), 209-215. http://dx.doi.org/10.17507/tpls.0601.28

Caramazza, A., Laudanna, A., & Romani, C. (1988). Lexical access and inflectional Morphology. *Cognition, 28*(3), 297-332. https://doi.org/10.1016/0010-0277(88)90017-0

Clahsen, H. (1999). Lexical entries and rules of language: A multidisciplinary study of German inflection. *Behavioral and Brain Sciences, 22*(6), 991-1013. https://doi.org/10.1017/S0140525X99002228

Clahsen, H., Balkhair, L., Cunnings, I., & Schutter, J. S. (2012). The Time Course of Morphological Processing in a Second Language. *Second Language Research, 29*(1), 7-31.

Clahsen, H., Felser, C., Neubauer, K., Sato, M., & Silva, R. (2010). Morphological structure in native and nonnative language processing. *Language Learning, 60*(1), 21-43. https://doi.org/10.1111/j.1467-9922.2009.00550.x

Clahsen, H., Rothweiler, M., Woest, A., & Marcus, G. (1992). Regular and irregular inflection in the acquisition of German noun plurals. *Cognition, 45*(3), 225-255. https://doi.org/10.1016/0010-0277(92)90018-D

Clahsen, H., Sonnenstuhl, I., & Blevins, J. (2003). Derivational morphology in the German mental lexicon: A dual-mechanism account. In H. Baayen & R. Schreuder (Eds.), *Morphological Structure in Language Processing* (pp. 125–155). Mouton de Gruyter.

Coughlin, C. & Tremblay, A. (2014). Morphological decomposition in native and non-native French speakers. *Bilingualism*: *Language and Cognition, 18*(3), 524-542. https://doi.org/10.1017/S1366728914000200

Çotuksöken, B. & Özkan, K. (2011). *Ortaçağ yazıları*. Notos Kitap.

Diependaele, K., Duñabeitia, J. A., Morris, J., & Keuleers, E. (2011). Fast morphological effects in first and second language word recognition. *Journal of Memory and Language*, *64*(4), 344–358. https://doi.org/10.1016/j.jml.2011.01.003

Estivalet, G. L. & Meunier, F. E. (2015). Decomposability and mental representation of French verbs. *Frontiers in Human Neuroscience, 9*, 1-11. https://doi.org/10.3389/fnhum.2015.00004

Frauenfelder, U. H. & Schreuder, R. (1992). Constraining psycholinguistic models of morphological processing and representation: The role of productivity. *Yearbook of Morphology Yearbook of Morphology 1991*, 165-183.

Forster, K. I., & Azuma, T. (2000). Masked priming for prefixed words with bound stems: Does submit prime permit? *Language and Cognitive Processes, 15* (4-5), 539-561. https://doi.org/10.1080/01690960050119698

Forster, K. I., & Davis, C. (1984). Repetition priming and frequency attenuation in lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10*(4), 680-698. https://doi.org/10.1037/0278-7393.10.4.680

Freynik, S., Gor, K., & O'Rourke, P. (2017). L2 processing of Arabic derivational morphology. *The Mental Lexicon, 12*(1), 21-50. https://doi.org/10.1075/ml.12.1.02fre

Gor, K., & Jackson, S. (2013). Morphological decomposition and lexical access in a native and second language: aAnesting doll effect. *Language and Cognitive Processes, 28* (7), 1065-1091. https://doi.org/10.1080/01690965.2013.776696

Göksel, A. (1998). Linearity, focus and the postverbal position in Turkish. In *The Mainz meeting proceedings of the seventh international conference on Turkish linguistics* (pp. 85-106). Harrassowitz Verlag Wiesbaden.

Hahne, A., Mueller, J. L., & Clahsen, H. (2006). Morphological processing in a second language: behavioral and event-related brain potential evidence for storage and decomposition. *Journal of Cognitive Neuroscience, 18*(1), 121-134. https://doi.org/10.1162/089892906775250067

Haspelmath, M. (2002). Understanding morphology. Oxford University Press.

Harley, H. & Noyer, R. (1999). Distributed morphology. *Glot International, 4*, 3-9.

Hélène Giraudo, Serena Dal Maso. The notion of entrenchment: A psycholinguistic experiment on L1 and L2 processing of morphologically complex words. Secondo Convegno Interannuale della Societa Di Linguistica Italiana, May 2014, Bolzano, Italy.

Jacob, G., Heyer, V., & Veríssimo, J. (2017). Aiming at the same target: a masked priming study directly comparing derivation and inflection in the second language. *International Journal of Bilingualism, 22*(6), 619-637. https://doi.org/10.1177/1367006916688333

Kırkıcı, B. & Clasen, H. (2013). Inflection and derivation in native and non-native language processing: Masked priming experiments on Turkish. *Bilingualism: Language and Cognition, 16*(4), 776-791. https://doi.org/10.1017/S1366728912000648

Koda, K. (2000). Cross-linguistic variations in L2 morphological awareness. *Applied Psycholinguistics, 21*(3), 297-320. https://doi.org/10.1017/S0142716400003015

Kunduracı, A. (2013). *Turkish noun-noun compounds: A process-based paradigmatic account.* [PhD. Dissertation]. University of Calgary, Alberta.

Kunduracı, A. (2019). The paradigmatic aspect of compounding and derivation. *Journal of Linguistics*, *55*(3), 563-609. https://doi.org/10.1017/S0022226718000518

Kutlay N. & Gürel A. (2017) processing of inflectional and derivational morphology in the second language. 27th EUROSLA, Reading University, England.

Lieber, R. (2009). *Introducing morphology.* Cambridge University Press.

Marcus, G., Brinkmann, U., Clahsen. H., Wiese, R., Pinker, S. (1995). German inflection: The exception that proves the rule. *Cognitive Psychology 29*, 189-256. https://doi.org/10.1006/cogp.1995.1015

Marslen-Wilson, W.D. (2007). Morphological processes in language comprehension. In M. G. Gaskell (Ed.), *The Oxford Handbook of Psycholinguistics* (pp. 175-193). Oxford University Press.

Matthews, P. (1991). Morphology. Cambridge University Press.

Neubauer, K. & Clahsen, H. (2009). Decomposition of inflected words in a second language. *Studies in Second Language Acquisition, 31*(3), 403-435. https://doi.org/10.1017/S0272263109090354

Pinker, S. & Prince, A. (1988). On language and connectionism: Analysis of a parallel distributed processing model of language acquisition. *Cognition, 28* (1-2), 73-193. https://doi.org/10.1016/0010-0277(88)90032-7

Pinker, S. & Prince, A. (1994). Regular and irregular morphology and the psychological status of rules of grammar. *Annual Meeting of the Berkeley Linguistics Society.*

Prasada, S., Pinker, S. (1993). Generalisation of regular and irregular morphological patterns. *Language and Cognitive Processes, 8*, 1-56. https://doi.org/10.1080/01690969308406948

Reifegerste, J., Elin, K., & Clahsen, H. (2019). Persistent differences between native speakers and late bilinguals: Evidence from inflectional and derivational processing in older speakers. *Bilingualism: Language and Cognition*, *22*(3), 425–440. https://doi.org/10.1017/S1366728918000615

Rothweiler, M., Chilla, S., & Clahsen, H. (2012). Subject verb agreement in specific language impairment: a study of monolingual and bilingual German-speaking children. Bilingualism: *Language and Cognition, 15*, 39–57. https://doi.org/10.1017/S136672891100037X

Ryding, K. C. (2005). *A reference grammar of modern Standard Arabic.* Cambridge University Press.

Silva, R. (2008). Morphological processing in a second language: Evidence from psycholinguistic experiments. [Doctoral Dissertation]. University of Essex.

Silva, R. & Clahsen, H. (2008). Morphologically complex words in L1 and L2 processing: Evidence from masked priming experiments in English. *Bilingualism: Language and Cognition, 11*(2), 1-55. https://doi.org/10.1017/S1366728908003404

Sonnenstuhl, I., Eisenbeiss, S., & Clahsen, H. (1999). Morphological priming in the German mental lexicon. *Cognition, 72*(3), 203-236. https://doi.org/10.1016/S0010-0277(99)00033-5

Taft, M. & Forster, K. I. (1975). Lexical storage and retrieval of prefixed words. *Journal of Verbal Learning and Verbal Behavior, 14*(6), 638-647. https://doi.org/10.1016/S0022-5371(75)80051-X

Ullman, M. T. (1999). Acceptability ratings of regular and irregular past-tense forms: evidence for a dual-system model of language from word frequency and phonological neighbourhood effects. *Language and Cognitive Processes, 14*(1), 47-67. https://doi.org/10.1080/016909699386374

Ullman, M. T. (2004). Contributions of memory circuits to language: The Declarative/Procedural Model. *Cognition, 92*, 231–270. https://doi.org/10.1016/j.cognition.2003.10.008

Ullman, M. T. (2005). A cognitive neuroscience perspective on second language acquisition: the declarative/procedural model. *Mind and Context in Adult Second Language Acquisition*, 141-178.

Yule, G. (2010). The study of language. Cambridge University Press.