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THE PROCESSING OF AMBIGUOUS MORPHEMES IN TURKISH

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Arts.

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ABSTRACT

THE PROCESSING OF AMBIGUOUS MORPHEMES IN TURKISH

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Studies investigating the processing of linguistic ambiguity have to date mostly focused on lexical ambiguity. Morphemic ambiguity, on the other hand, has been less frequently studied in spite of its cross-linguistic prevalence. An intermediate level of representation (i.e. the lemma level) between form and meaning has been claimed to successfully account for the processing of ambiguous morphemes in English and Chinese. Moreover, meaning frequency has been found to affect the processing of these morphemes. Dwelling on this background, this thesis investigated whether an intermediate level of representation could be used to explain the processing of morphemic ambiguity in derived homonymous words (i.e. *yan*, Eng., side or to burn, in *yanıcı,* Eng., flammable*)* in Turkish. The second aim was to examine whether the relative meaning frequencies of the ambiguous morphemes would modulate the processing of morphemic ambiguity in Turkish. A masked priming lexical decision task (SOA: 50 ms) designed with four prime types (i.e. dominant, subordinate, opaque, unrelated) and two target types (i.e. dominant and subordinate) was run with adult Turkish native speakers. The results showed that no significant morpho-semantic priming was obtained, and the effect of the meaning frequency was not significant, which could imply that no intermediate level of representation is necessary. However,

a statistically non-significant trend in the data indicated a different pattern of processing for the dominant and the subordinate targets, which could still be explained by an intermediate level of representation and the effect of the meaning frequency.

Keywords: morphemic ambiguity, meaning frequency, lemma level representation, null result, masked priming

ÖZ

TÜRKÇEDE ANLAM BELİRSİZLİĞİ BARINDIRAN BİÇİMBİRİMLERİN İŞLEMLENMESİ

Ataman, Esra

Yüksek Lisans, İngiliz Dili Öğretimi

Tez Yöneticisi : Doç. Dr. Bilal Kırkıcı

Eylül 2019, 96 sayfa

Anlam belirsizliğinin işlemlenmesini araştıran çalışmalar günümüze kadar çoğunlukla sözlüksel anlam belirsizliğine odaklanmıştır. Öte yandan, biçimbirimsel anlam belirsizliği farklı dillerdeki yaygınlığına rağmen daha az çalışılmıştır. Yazım ve anlam arasında yer alan baş sözcük seviyesinde bir temsilin (İng., lemma level representation) İngilizce ve Çincedeki anlam belirsizliği barındıran biçimbirimlerin işlemlenmesini başarılı bir şekilde açıkladığı ileri sürülmüştür. Buna ek olarak, anlam sıklığının da bu biçimbirimlerin işlemlenmesini etkilediği görülmüştür. Bu arka plana dayanarak, bu tez, yazım ve anlam arasında yer alan baş sözcük seviyesinde bir temsilin Türkçede türetilmiş yapıdaki eş sesli sözcüklerde yer alan biçimbirimsel anlam belirsizliğinin (Örn. *yanıcı* sözcüğündeki *yan* biçimbirimi) işlemlenmesini açıklamada kullanılıp kullanılamayacağını araştırmıştır. Çalışmanın ikinci amacı Türkçede anlam belirsizliği barındıran biçimbirimlerin anlam sıklıklarının bu biçimbirimlerin işlemlenmesini etkileyip etkilemediğini incelemektir. Dört farklı hazırlayıcı sözcük türü (baskın, ikincil, geçirimsiz ve ilintisiz) ve iki farklı hedef sözcük türü (baskın ve ikincil) kullanılarak hazırlanan maskelenmiş hazırlama deneyi yetişkin ana dili Türkçe katılımcılara uygulanmıştır. Sonuçlar istatistiksel olarak

anlamlı bir biçim-anlambilimsel hazırlama etkisinin olmadığını göstermiştir. Anlam sıklığının anlamlı bir etkisi de bulunamamıştır. Bu bulgular yazım ve anlam arasında yer alan baş sözcük seviyesinde bir temsile olan ihtiyacı ortadan kaldırmıştır. Fakat veride istatistiksel olarak anlamlı olmayan ancak 'baskın' ve 'ikincil' hedef sözcüklerin işlemlenmesinde farklılık ortaya koyan göz ardı edilemeyecek bir örüntü saptanması yine de yazım ve anlam arasında yer alan baş sözcük seviyesinde bir temsil ve anlam sıklığının etkisiyle açıklanabilir.

Anahtar Kelimeler: biçimbirimsel anlam belirsizliği, anlam sıklığı, baş sözcük seviyesi temsili, sıfır sonuç, maskelenmiş hazırlama

To My Family and All the Dreamers out there

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
BOSS	Basic Orthographic Syllabic Structure
CVC	Consonant-Vowel-Consonant
e.g.	Exempli Gratia
ERP	Event-related Potentials
etc.	Et Cetera
i.e.	Id Est
ms	Millisecond
RT	Reaction Time
SOA	Stimulus Onset Asynchrony
SD	Standard Deviation
vs.	Versus

CHAPTER 1

INTRODUCTION

1.1. Background to the Study

How the mental lexicon is organized and what kind of mechanisms are used for lexical access are fundamental questions in psycholinguistics. In this regard, morphologically complex words (e.g. *worker*) have been a source of interest because they are the ideal stimuli to explore whether lexical items which are made up of different parts (i.e. a stem and an affix) are stored in and retrieved from the lexicon as a whole (i.e. *worker*) or in a decomposed fashion (i.e. *work* and *-er*) (Kazanina, Dukova-Zheleva, Geber, Kharlamov, & Tonciulescu, 2008; Wilson, Tyler, Waksler, & Older, 1994).

While some studies have been in favor of the full-form storage (e.g. Bybee, 1995) of morphologically complex words, others have suggested morphological decomposition (e.g. Taft, 1979; Taft & Forster, 1975). In the full-form storage account, morphologically complex words are not represented as divisible units (i.e. morphemes) but instead as single and unanalyzed whole words (Wilson et al., 1994). In the morphological decomposition account, on the other hand, it is claimed that morphologically complex words are represented in the form of different morphemic units. For example, in order to access the morphologically complex word *worker*, the processor has to divide it into its morphemes (i.e. *work* and *-er*). Thus, it has been proposed that morphemes play a vital role in the organization of complex words in the lexicon (Kazanina et al., 2008).

Morphemes are defined as the smallest functional units and are regarded as the building blocks of the meaning of a morphologically complex word (Rastle, Davis, & New, 2004; Taft & Kougious, 2004). The proposal claiming that morphemes are

accessed in the course of retrieving the morphologically complex words from the lexicon has received a considerable amount of support from word-frequency and priming studies. For instance, it has been suggested that the word-frequency of the stem morpheme (e.g. *work*) could affect the processing of the morphologically complex word (e.g. *worker*) derived from that stem (e.g. Bertram, Schreuder, & Baayen, 2000; Rastle et al., 2004).

In morphological priming studies, a lexical item is presented before the presentation of another lexical item. The prior item (i.e. prime) is frequently in a way (i.e. morphologically, orthographically or semantically) related to the latter item (i.e. target), and it is investigated whether the prior item has an effect on the processing of the latter compared to an unrelated baseline (i.e. a morphologically, orthographically or semantically unrelated item). In this regard, presenting a morphologically complex word (e.g. *employer*) before the presentation of its stem (e.g. *employ*) facilitated the recognition of that stem compared to a morphologically unrelated word (e.g. *addition*) (Rastle et al., 2004). This finding was in line with the idea that the constituent morphemes are accessed while processing the morphologically complex words (e.g. Taft, 1979; Taft & Forster, 1975).

However, a question remaining unanswered was whether this morphological decomposition was only valid for semantically transparent words (e.g. *worker*) or whether it could also be extended to the semantically opaque words (e.g. *corner*). In semantically transparent words (e.g. *worker*), the meaning can be derived from its constituent morphemes (i.e. *work* and *-er*) whereas the meaning of a semantically opaque word (e.g. *corner*) cannot be computed from its constituent morphemes (i.e. *corn* and *-er*) (Davis & Rastle, 2010).

Some studies have indicated that 'obligatory' decomposition process could be extended to semantically opaque items, which could be interpreted as morpho-orthographic segmentation. It was called 'orthographic' because such items (e.g. *corner-corn*) were orthographically but not morphologically or semantically

related. The reason why it was called ‘morpho-orthographic’ relied on the absence of facilitation for items like *brothel-broth* in contrast with the facilitation for *brother-broth*. This difference was attributed to the fact that *-el* was not a morpheme (i.e. legal suffix) in English unlike *-er*. Therefore, the decomposition procedure was claimed to be sensitive to the morpho-orthographic information available (Rastle et al., 2004).

Some other studies challenged the idea that the decomposition route could be extended to semantically opaque words and proposed that the facilitation obtained from semantically transparent words (e.g. *worker-work*) was not equally valid for semantically opaque words (e.g. *department-depart*) (Feldman, O’Connor, & Moscoso del Prado Martín, 2009). Thus, the effect of semantic transparency led to the claim that morpho-semantic information also contributed to the recognition of morphologically complex words (Feldman et al., 2009; Feldman, Milin, Moscoso del Prado Martín, O’Connor, & Cho, 2015; Feldman, Kostić, Gvozdenović, O’Connor, & Moscoso del Prado Martín, 2012). In addition to the controversy regarding the contribution of morpho-orthographic or morpho-semantic information to the recognition of morphologically complex words, another line of research has focused on whether an intermediate level of morphology (i.e. a lemma level) capturing the correlation between orthography and semantics could be used to explain the recognition of complex words (Taft, 2003). Studies investigating this question made use of the ‘masked priming’ paradigm. The procedure in masked priming studies is similar to priming studies (see above), but the presentation of the prime is masked through the use of hashtags or other visual material and the presentation duration is extremely short so as to avoid conscious perception (i.e. 50 ms).

For instance, earlier evidence for the existence of an intermediate level came from masked priming studies comparing the facilitation for only orthographically related (e.g. *future-futile*), only semantically related (e.g. *pursue-follow*), and orthographically, morphologically, & semantically related (e.g. *virus-viral*)

morpheme-like units (e.g. *vir* or *fut*). Priming was found only for orthographically, morphologically and semantically related pairs. Since sharing only orthography or semantics was not sufficient for facilitation, it was suggested that there should be an intermediate level where the processor distinguished the two meanings (i.e. different lemmas were activated) whose orthographic representation was the same.

Further support for the intermediate level came from studies examining ambiguous morphemes. Ambiguous morphemes (e.g. *train*) have been regarded as the ideal stimuli because they have the same orthographic or phonological appearance (*train*) for different meanings ('vehicle' or 'to prepare someone for something'). Pairs such as *trainer-train*, which are made up of a morphologically complex word derived from one meaning of an ambiguous morpheme as the prime and its stem as the target, led participants in experimental studies to report the related meaning (to prepare someone for something) as the first meaning that came to their minds in a masked priming experiment. However, no such reporting bias was obtained for pairs such as *tutor-train*, which were only semantically related. Considering the fact that the ambiguous morphemes shared their orthography, and only semantic priming failed to emerge within the short presentation duration (50 ms), an intermediate level was required so that the processor could distinguish between the two different meanings of an ambiguous morpheme (Taft & Nguyen-Hoan, 2010).

Most of the studies investigating the processing of ambiguity have dealt with lexical (i.e. whole-word) ambiguity (e.g. *bark* 'cover of a tree' or 'loud noise made by dogs'); however, morphemic ambiguity (e.g. *stick* in *sticky* or *in* in *inside*) has not attracted enough attention in the literature although it has frequently been reported in different languages (e.g. English, Dutch, Chinese). Depending on the morphemic ambiguity effect, the presence of morphological decomposition is presupposed because morphemically ambiguous items are ambiguous at the morpheme-level (i.e. *stick*), but not at the lexical level (i.e. *sticky*). In other words, such an effect can only be obtained if the processor decomposes a morphologically

complex unambiguous word into its constituent morphemes, and realizes that the stem morpheme is ambiguous. Most of the support for the existence of the morphemic ambiguity effect has been obtained from studies conducted on English (e.g. Taft & Nguyen-Hoan, 2010) and Chinese (e.g. Tsang & Chen, 2010, 2013; Tsang, Wong, Huang, & Chen, 2014).

The relative frequency of the different meanings of an ambiguous word is known as *'meaning frequency'* (Tsang & Chen, 2010). Meaning frequency has been claimed to affect morphological processing. In other words, whether a morphologically complex word (e.g. 月蝕, lunar eclipse) is derived from the dominant (e.g. moon) or subordinate (e.g. month) meaning of an ambiguous morpheme (月, 'moon' or 'month') alters the processing pattern. For example, it has been observed that morphologically complex words (compounds) derived from the dominant meaning of an ambiguous morpheme are processed faster than the ones derived from the subordinate meaning in Chinese. Moreover, when the target has the dominant meaning (e.g. 月餅, moon cake), dominant (e.g. 月蝕, lunar eclipse), subordinate (e.g. 月薪, monthly salary) and opaque (e.g. 月台, railway platform) primes are all successful in facilitating the recognition of the target. However, for the subordinate targets (e.g. 月曆, calendar), only the subordinate primes (e.g. 月薪, monthly salary) are facilitatory due to the readily available nature of the dominant meaning. These findings highlighted the significant effect of meaning frequency on morphemic ambiguity resolution (Tsang & Chen, 2013). However, more studies are needed to reveal the effect of meaning frequency on morphemic ambiguity in languages other than frequently studied Chinese.

1.2. Significance of the Study

As discussed in the previous section, different meanings (*stick* 'twig' or 'to adhere') of an ambiguous morpheme (i.e. homonym) have the same appearance at the orthographic and/or phonological level (*stick*), which is not informative about distinguishing these different meanings. Moreover, the absence of only semantic

priming (i.e. *tutor* priming *train*) at very short presentation duration (50 ms) was shown by Taft & Nguyen-Hoan (2010), which eliminated the possibility of distinguishing the different meanings of an ambiguous morpheme directly at the semantic level at the early stages of morphological processing. Thus, exactly at which point the lexical processing system differentiates one meaning of an ambiguous morpheme from the other is still a valid question. Moreover, answering this question could reveal at which point the morphemic meaning is accessed. However, there is an insufficient number of studies investigating ambiguity at the morphemic level. Considering the prevalence of ambiguous morphemes in various languages, it will not be possible to build a whole picture of how morphological processing takes place without accounting for ambiguous morphemes (Tsang et al., 2014).

In the morphological processing literature, the effect of the morpho-semantic information was frequently tested by manipulating semantic transparency. In relevant studies, the comparison has always been between a semantically transparent and an opaque word. However, the number of transparent words (e.g. *departing, departure, departed*) that could be derived from the same stem (e.g. *depart*) is greater than the number of opaque words (e.g. *department*) most of the time. Another variable that could be used to test the contribution of morpho-semantic information, on the other hand, was the morphemic ambiguity and the effect of meaning frequency. Considering the morphemic ambiguity and the effect of meaning frequency, the comparison is between words derived from a dominant and a subordinate meaning of an ambiguous morpheme. In this regard, an equal number of words could be derived from the different meanings (e.g. *yanık* 'burnt' and *yanıcı* 'flammable' & *yanlı* 'biased' and *yansız* 'unbiased') of a homonymous morpheme (e.g. *yan* 'burn' or 'side') in Turkish. Thus, the manipulation of morphemic ambiguity and the meaning frequency rather than the semantic transparency might help to draw clearer conclusions in terms of the contribution of morpho-semantic information to morphological processing (Tsang et al., 2014).

The effect of meaning frequency on morphemic ambiguity resolution is quite an under-studied field. Furthermore, most of the recent evidence comes from one specific language, Chinese, which is a completely different language from Turkish. Therefore, the effect of meaning frequency is worth studying in Turkish because it has the potential to provide some cross-linguistic evidence or counter-evidence to the universality of morphemic ambiguity resolution. To the best of our knowledge, in Turkish, there is no study investigating morphemic ambiguity and manipulating meaning frequency at the same time. In this regard, the current study will fill this gap in the literature.

1.3. Research Questions and Predictions

The current study focused on the processing of ambiguous morphemes in Turkish. The term 'ambiguous' is used to refer to 'homonymous' lexical items throughout the entire thesis. Homonymous words can be defined as words that have the same orthographic or phonological appearance but different, semantically unrelated meanings (Lin & Ahrens, 2010; Shen & Li, 2016). Turkish is a shallow-orthography language. In other words, there is a one-to-one correspondence between the graphemes (letters) and phonemes (sounds) in a word (Miller, Kargin, & Guldenoglu, 2014). The homonymous items used in this study could be classified as both 'homographs' and 'homophones' because they have the same orthographic and phonological form. The ambiguity studied in this study is only at the morphemic level. Other than that, the items are unambiguous at the whole-word level. In other words, a derived word such as *yanık* 'burnt' is not ambiguous at the whole-word level. However, its stem *yan* (which could mean either 'side' or 'to burn') is ambiguous.

1. Does the lemma model explain the processing of ambiguous morphemes in Turkish derived words?
2. Does the meaning frequency effect modulate the processing of ambiguous morphemes in Turkish derived words?

Based on the hierarchical framework of word recognition proposed by Taft & Nguyen-Hoan (2010), it was predicted that the interpretation of the ambiguous targets in this study would be biased towards the meaning of the prime word. Furthermore, it was predicted that there would be a stronger facilitation when the primes and targets shared the ambiguous morpheme with the same interpretation. Therefore, a stronger facilitation was expected in dominant prime-dominant target and subordinate prime-subordinate target conditions in this study. Considering the meaning frequency effect suggested by Tsang & Chen (2013), when the target was derived from the dominant meaning, a priming effect was expected in all morpheme-sharing conditions, which were dominant, subordinate, and opaque. On the other hand, when the target was derived from the subordinate meaning, there would be priming only when the primes were also derived from the subordinate meaning because it would be hard for the subordinate meaning to override the dominant meaning in all other conditions.

CHAPTER 2

LITERATURE REVIEW

2.2. The Morpho-Orthographic Segmentation Account

How morphologically complex words are processed has been an empirical question awaiting to be answered for decades, and it retains its prominence today (Beyersmann et al., 2016). As a result of extensive research, it has been suggested that morphologically complex words are obligatorily decomposed into their constituent morphemes (Rastle & Davis, 2003). However, what kind of an interplay exactly exists between orthographic/semantic factors and morphological decomposition is still controversial. Two major accounts have been put forward over the past twenty years to explain the mechanisms underlying the processing of morphologically complex lexical items. Most of the supporting evidence for these different accounts come from masked priming studies.

In the masked morphological priming paradigm, two words, a prime and a target, are presented consecutively. The prime word (e.g. hunter), which is morphologically related to the target word (e.g. hunt), is presented first for a very short period of time (i.e. 50 ms) and is preceded by a forward mask (e.g. hashtags), and the target follows the prime. Due to the presence of hashtags and the short presentation time, which is called the 'stimulus onset asynchrony', participants are unaware of the prime's presence. In this paradigm, the participants are expected to respond to the target item depending on the requirements of the chosen task (e.g. deciding whether the shown item is a word or a non-word in a lexical decision task). If the presence of the prime facilitates the response to the target when compared to a morphologically unrelated baseline, a priming effect is claimed to be obtained. This paradigm has been employed in the majority of studies because it is claimed to tap into the early and automatic stages

of lexical processing different from the later, conscious recognition stage (Forster, Mohan, & Hector, 2003).

The first account that has been proposed to explain the mechanisms underlying the processing of morphologically complex words is called the 'morpho-orthographic segmentation' or 'form-then-meaning' account. In this account, it is proposed that all words are decomposed into their morphemes, not depending on semantic transparency but on morpho-orthographic structure (Rastle et al., 2004). In other words, the lexical processing system is claimed to decompose each morphologically complex (e.g. *worker*) or apparently complex word (e.g. *brother*) into its morphemic constituents if this 'constituent' resembles a morpheme, disregarding the impact of semantic transparency (whether *-er* contributes to the whole-word meaning).

Longtin, Segui, & Hallé (2003) investigated whether semantic transparency affected the early processing of morphologically complex French words using a masked priming lexical decision task with a 46 ms SOA. Four conditions, semantically transparent (e.g. *plumeau-plume* 'feather duster'-'feather'), opaque (e.g. *rideau-ride* 'curtain'-'wrinkle'), pseudo-derived (e.g. *pinceau-pince* 'paintbrush'-'pliers') and orthographic (e.g. *abricot-abri* 'apricot'-'shelter') were formed. Transparent pairs were etymologically and semantically related, whereas opaque words bore only etymological relation. Pseudo-derived pairs did not bear any semantic or etymological relationship, and these pairs seemed to be morphologically complex since they had the same affixal ending as in the transparent and the opaque conditions, but this affixal ending was not contributing to the whole-word meaning. In other words, the first three conditions were morphologically related, but in the orthographic condition, the items had only orthographic overlap. As a result, a priming effect was obtained for the transparent, opaque and pseudo-derived conditions; however, the effect was inhibitory for the orthographic condition. It was concluded that there was no effect of semantic transparency because no priming difference was found among the transparent, opaque and pseudo-derived items. This was taken as evidence for a semantically blind morpho-orthographic segmentation procedure.

Similarly, in English, Rastle et al. (2004) designed three different conditions to test whether there was an effect of semantic transparency during early word recognition. The authors used a masked priming lexical decision task in English with a 42 ms SOA. In their first condition, prime-target pairs were semantically transparent morphologically related words such as *hunter-hunt*. Semantically transparent words were regarded as the ones whose meaning could be derived from their morphemes. In the second condition, prime-target pairs were semantically opaque and pseudo-suffixed words like *corner-corn*. In this type of items, in other words, the meaning of an apparently complex word *corner* could not be derived from its morphemic parts *corn* and *-er*, and even though *-er* was an existing suffix in English, it was not a suffix in the case of *corner*. The third condition was an orthographic control condition where prime-target pairs were only orthographically related like *brothel-broth (-el* is not an existing suffix in English). It was claimed that if a similar amount of facilitation was obtained for the semantically transparent and opaque conditions, and if this facilitation was significantly higher than in the orthographic control condition, then it could be concluded that the decomposition mechanism was morpho-orthographic in nature and blind to semantic information.

The results showed that *corner* could facilitate *corn* as much as *hunter* could facilitate *hunt*. Furthermore, the amount of facilitation was significantly different from the orthographic control condition. These results were taken as evidence for the morpho-orthographic segmentation account, which assumes a semantically blind decomposition procedure whenever the lexical processing system encounters a morphologically complex or a pseudo-complex word. Moreover, an average of 30 ms priming for transparent lexical items and a 23 ms priming effect for opaque items were reported in the meta-analysis conducted by Rastle & Davis (2008). The authors compiled the findings of various masked priming studies using an SOA of 60 ms or less and found a similar amount of transparent and opaque priming, which was not the case for orthographic controls (Heyer & Kornishova, 2018). Additionally, it was suggested by Rastle & Davis (2008) that this morpho-orthographic segmentation was rapid and pertained to the early stages of lexical processing because when longer SOAs

were used and the participants were aware of the primes, the facilitation for semantically opaque lexical items was found to disappear.

The presence of the same priming patterns for morphologically related but semantically unrelated pairs in non-Indo-European languages such as Hebrew (Frost, Forster, & Deutsch, 1997) and Arabic (Boudelaa & Marslen-Wilson, 2001) also supported the morpho-orthographic segmentation account. Likewise, Kazanina et al. (2008) tested morphologically complex Russian nouns using a masked priming lexical decision task with a 59 ms SOA. Similar to the design of Rastle et al. (2004), there were three conditions, transparent (e.g. *gorka-gora* 'little mountain'-'mountain'), pseudo-derived (e.g. *lunka-luna* 'hole'-'man'), and form (e.g. *parta-para* 'desk'-'air'). In the first condition, the diminutive suffix *-k* contributed to the whole word meaning whereas there was only an apparently morphological relationship since the suffix did not make any semantic contribution in the second condition. In the last condition, the pairs only bore orthographic similarity like the orthographic control condition in Rastle et al. (2004).

Many other studies, including Rastle et al. (2004), used words containing one word-final affix. The novel contribution of Kazanina et al. (2008), however, was to test words with multiple affixes, one being not word-final. For example, the Russian word *gorka* 'little mountain' contains the stem *gor* 'mountain' together with the diminutive suffix *-k* and the nominative singular marker *-a*. The authors investigated whether the morpho-orthographic segmentation claimed to exist for complex words with one word-final affix in English or French would be found for complex words with multiple affixes, one of which was word-internal, in Russian. Consequently, similar priming effects were obtained for the transparent and pseudo-derived conditions while no priming was found for the form condition. The fact that the priming effect was obtained even when the suffix did not make semantic contribution to the whole word meaning (i.e. as in the case of pseudo-derived condition) advocated early, automatic and semantically blind morpho-orthographic decomposition. Relying on these findings in Russian, Kazanina et al. (2008) suggested that morpho-orthographic segmentation

was not restricted to the decomposition of a single, word-final affix, but lasted till the tiniest possible morpheme-size part was left.

Marslen-Wilson, Bozic, & Randall (2008) investigated the effect of semantic transparency using a similar design. They formed only orthographically related (e.g. *scandal-scan*), only semantically related (e.g. *accuse-blame*), orthographically and morphologically related but semantically unrelated (e.g. *archer-arch*), orthographically, morphologically and semantically related (e.g. *bravely-brave*), orthographically, morphologically and at an intermediate level semantically related (e.g. *barely-bare*), and only semantically related at an intermediate level (e.g. *attach-glue*) conditions. A masked priming lexical decision task was used with various SOAs (36, 48, 72 ms). As a result, a priming effect was found for all the conditions in which there was a decomposable morpheme even if there was no semantic relationship. Moreover, sole form overlap was not found to be adequate for priming, and the priming effect obtained for morphologically related pairs was higher than for only orthographically related ones. Therefore, it was concluded that morpho-orthographic segmentation operated independent of semantic influence. Additionally, it was stated that only form-dependent effects did not change with varying SOAs whereas the effect dependent on only semantic relationship varied (weak at short SOAs and stronger at longer SOAs), but morphological effects were still stronger than purely semantic effects.

Another question deserving attention was whether the purported morpho-orthographic segmentation process would survive when there were orthographic alterations between the prime and the target such as the missing *e* in *adorable-adore*, which prevented the flawless decomposition of the morphologically complex words into their constituents. McCormick, Rastle, & Davis (2008) tested three alterations, missing *e* (e.g. *adorable-adore*), shared *e* (e.g. *lover-love*), and duplicated consonant (e.g. *beginner-begin*) in a masked priming lexical decision task with a 42 ms SOA. They compared priming in a semantically transparent (e.g. *darkness*-dark) condition with opaque morphological (e.g. *writer-write*) condition where the prime and the target

were morphologically, semantically and orthographically related except the orthographic alteration (i.e. shared *e*). The priming in the opaque form (e.g. *shovel-shove*) condition in which the prime and the target did not bear any morphological or semantic relationship and bore only partial orthographic relationship was also added for comparison. As a result, a priming effect was obtained in both the semantically transparent and in the opaque morphological condition, and this effect was significantly greater than the opaque form condition for all three alterations tested. In their last experiment, McCormick et al. (2008) tested whether the observed priming effect could also be obtained for semantically opaque words with the same orthographic alterations (e.g. *badger-badge*) compared to semantically transparent orthographically opaque (e.g. *lover-love*) and form (e.g. *shovel-shove*) items. It was found that the priming effect existed for both semantically transparent and semantically opaque items but not for 'form' items. In summary, based on these findings, the early morpho-orthographic segmentation which was blind to semantic information was advocated, and the idea that this segmentation could tolerate some orthographic alterations was proposed.

The morpho-orthographic segmentation account received further support from research on the processing of Dutch complex words. Diependaele, Sandra, & Grainger (2009) tested the processing of prefixed words in three different conditions, transparent (e.g. *gegil-gil* 'squawk'-'scream'), opaque (e.g. *gebed-bed* 'prayer'-'orison'), and form (e.g. *barok-rok* 'baroque'-'skirt'). The same amount of priming was reported for the transparent and the opaque condition, which was significantly greater than the priming obtained in the form condition. This was exactly in line with what was predicted based on the morpho-orthographic segmentation account and other studies conducted in various languages.

However, there has also been counter-evidence against the morpho-orthographic segmentation account. One piece of counterevidence is the higher amount of priming found for semantically transparent items (e.g. *coolant*-cool) in comparison to semantically opaque items (e.g. *rampant-ramp*) observed in a masked

priming lexical decision task with a 50 ms SOA by Feldman et al. (2009). Feldman et al. (2009) took this finding as clear evidence against the morpho-orthographic segmentation account and proposed the 'morpho-semantic' account, which basically proposed that morphological segmentation is not totally blind to semantic information (see Chapter 2.2 for a detailed discussion). However, Davis & Rastle (2010) discussed the results reported in Feldman et al. (2009) and commented that the lack of a priming effect for semantically opaque items was rather exceptional considering all of the previously conducted studies reported in the literature. Furthermore, Davis & Rastle (2010) suggested that the paucity of priming for the semantically opaque condition in Feldman et al. (2009) might have resulted from the selection of the items showing unsystematic orthographic changes (e.g. missing *p* in *harness-harp*) for the semantically opaque condition whereas more systematic orthographic changes (e.g. replacing *y* with *i* in *burial-bury*) were observed for semantically transparent ones.

As previously mentioned, McCormick et al. (2008) had found that morpho-orthographic segmentation could tolerate some orthographic changes (i.e. duplicated consonant in *beginner-begin*); however, these were systematic changes. They were systematic because these changes were not limited to a specific example, but could be consistently found in a wide range of morpheme combinations instead (e.g. *equipped-equip*, *forgettable-forget*, *splitting-split*). Thus, Davis & Rastle (2010) highlighted that the use of the arbitrary orthographic changes for semantically opaque items in Feldman et al. (2009) may have hindered the appearance of a priming effect for opaque items to occur as previously found. It was lastly claimed that some of the items in Feldman et al. (2009) could have been decomposed in two different ways, and thus ambiguous), which could have been a potential confound. For example, the word *beery* could be decomposed into *bee*, but to decompose it into *beer* was also equally possible. Despite the fact that the meta-analyses by Rastle & Davis (2008) and Feldman et al. (2009) provided some support for the influence of semantic information, significantly higher priming for pseudo-complex items like *brother-broth* than for non-morphological form pairs such as *brothel-broth* was believed to be the main evidence for the morpho-orthographic segmentation account.

Baayen, Milin, Đurdevic, Hendrix, & Marelli (2011) criticized the nature of the opaque items used in Rastle et al. (2004). They claimed that the items used in the pseudo-suffixed condition had actually varying degrees of opacity. For instance, in most of the items, the pseudo-affix still contributed to the whole word meaning either because of etymological origin or syntactic function (e.g. *archer-arch; arcus* 'bow' in Latin). This, in turn, led Baayen et al. (2011) to question the validity of the morpho-orthographic segmentation account because this account was completely dependent on the presence of comparable amounts of priming for opaque and transparent items.

Taking this criticism into consideration, Beyersmann et al. (2016) followed a stricter procedure while forming pseudo-suffixed items. In order to form completely opaque items, they did not include items in which the pseudo-suffix contributed to the whole word meaning remotely (e.g. *butcher-butch*) or etymologically (e.g. *archer-arch*) or in which the so-called pseudo-suffix kept its own meaning (e.g. *gaffer-gaff*). Similar to Rastle et al. (2004), the experiment contained prime-target pairs in three conditions, truly suffixed (e.g. *hunter-hunt*), pseudo-suffixed (e.g. *corner-corn*), and non-suffixed (e.g. *cashew-cash*). A masked priming lexical decision task was used with a 50 ms SOA. Beyersmann et al. (2016) predicted that the priming effect found by Rastle et al. (2004) for pseudo-suffixed items would disappear with more carefully designed opaque items if the effect resulted from the use of transparent-like items in the opaque condition as suggested by Baayen et al. (2011). As a result, the same amount of priming was obtained for both truly suffixed and pseudo-suffixed conditions, while no priming was found in the non-suffixed condition. The results were taken as clear support for the semantically blind morpho-orthographic segmentation procedure, according to which every truly or apparently morphologically complex word is decomposed into its constituent morphemes in the early stages of lexical processing within the masked priming paradigm.

Heyer & Kornishova (2018) tested the effect of semantic information on the morpho-orthographic segmentation by treating semantic transparency as a scalar rather than a categorical measure. Items were designed with various degrees of semantic

transparency. They tested *-ness* and *-ost* nominalizations in English and Russian, respectively, using short (33 and 39 ms) and long (67 and 77 ms) SOAs. At the opaque end of the scale, there were items such as *business-busy* in English and *milost-milyj* 'your highness'-'nice' whereas *paleness-pale* and *gordost-gordyj* 'pride'-'proud' were at the transparent end. For both English and Russian, it was found that semantic transparency had an effect in the long SOAs but not in the short SOAs, which provided additional support for semantically blind morpho-orthographic segmentation at the early stages of processing. When the SOA was short, only morpho-orthographic information contributed to the processing. However, the morpho-semantic information started to make a contribution to the processing at longer SOAs because this provided more time to process the prime. Moreover, the semantic transparency effect gradually appeared at the later stages of processing (i.e. at longer SOAs). Instead of suggesting consecutive processing of structure and meaning, Heyer & Kornishova (2018) proposed that longer SOA could provide a chance to collect more semantic information, which was not the case when the SOA was short. Therefore, the effect of morpho-semantic information could only emerge later.

2.2. The Morpho-Semantic Account

The second account proposed to explain the role of semantic information in the processing of morphologically complex words is called 'morpho-semantic' or 'form-with-meaning' account. Unlike the 'morpho-orthographic' account, in 'morpho-semantic' account, it is claimed that semantically transparent (e.g. *hunter-hunt*) and semantically opaque (e.g. *corner-corn*) words do not induce equal facilitation. The reported effect of semantic transparency is taken as evidence to suggest that the processing of the morphologically complex words is morpho-semantic and not only morpho-orthographic in nature (Feldman et al., 2009). Earlier evidence in support of the 'morpho-semantic' account predominantly relied on the findings obtained from overt or cross-modal priming studies. In the former, the prime words are not masked, but instead presented overtly for conscious perception. In other words, the participants are aware of the existence of the primes. On the other hand, in the latter, the masked

primes are presented visually whereas the targets are in the auditory modality (Rueckl & Aicher, 2008).

For instance, Wilson et al. (1994) tested the effect of semantic information on the processing of morphologically complex English words using the cross-modal priming paradigm in six experiments. In their second experiment, they compared the priming effect for semantically transparent items (e.g. *friendly-friend*) with semantically opaque ones (e.g. *authority-author*) and found that the priming effect for semantically transparent items was significantly greater. The effect for semantically opaque items was not reliable. In other words, opaque items did not induce equally significant priming as in the case of transparent items.

Feldman, Barac-Cikoja, & Kostić (2002) investigated the role of semantic transparency in the processing of Serbian complex words using short (48 ms) and long (250 ms) SOAs. They compared the priming patterns of semantically transparent items (e.g. *zavole-volim*) with semantically opaque ones (e.g. *privole-volim*). The stem was *vol* in both cases whereas *-e* was the third-person plural marker and *-im* was the first-person singular marker. Moreover, while the prefix *za-* was transparently contributing to the whole-word meaning, this was not the case for *pri-*. As a result, significant priming was obtained for the semantically transparent but not for the semantically opaque items when the long SOA was used. However, the priming effect did not significantly differ between the semantically transparent and opaque items with the short SOA. It was concluded that the role of semantic information diminished when the presentation duration of the prime word was limited. Similarly, Feldman, Soltano, Pastizzo, & Francis (2004) tested morphologically complex primes and targets in English in semantically transparent (e.g. *accordingly-accordance*) and semantically opaque (e.g. *accordion-accordance*) conditions against an unrelated baseline (e.g. *dictation-accordance*) under cross-modal priming and unmasked visual priming at 48 ms and 250 ms SOAs. A significant effect of semantic transparency was detected in the cross-modal experiment and the unmasked visual priming experiment only at a 250

ms SOA, which supported the argument that semantic information does not contribute to the morphological processing of complex words at short SOAs.

Meunier & Longtin (2007) tested the potential impact of semantic interpretability and grammaticality on the processing of morphologically complex words by comparing French pseudo-words and existing words in the unmasked cross-modal priming paradigm. In their first experiment, they used semantically non-interpretable pseudo-words (e.g. *sportation-sport*) derived from the ungrammatical combination of a root (e.g. *sport* 'sport') and an incompatible suffix (i.e. -*ation*). No priming was obtained for such pseudo-words. In the second experiment, semantically interpretable pseudo-words (e.g. *rapidifier-rapide* 'quickify'-'fast') combined with a root and a suffix, and the combination was grammatical, produced the same amount of priming as in prime-target pairs based on existing morphologically complex words (e.g. *rapidement* 'rapidly') and their roots (e.g. *rapide* 'fast'). The results of these two experiments showed that the semantic interpretability of the pseudo-words played a role at the processing stage tapped by the cross-modal priming paradigm, similar to the presence of the semantic transparency effect in the processing of existing words. Therefore, a two-stage model was suggested to account for the findings. In this model, there was quite an early stage of semantically blind morpho-orthographic segmentation which decomposed morphologically complex words at the surface level (e.g. *corner*) into the morphemes. Moreover, this stage was followed by another stage where semantic interpretability had an effect. However, it was underlined that the two stages did not act independently. Yet, there was a process involving both decomposition and the contribution of semantic information.

Rueckl & Aicher (2008) tested semantically transparent (e.g. *teacher-teach*), semantically opaque (e.g. *corner-corn*), and form (e.g. *brothel-broth*) items employing the long-term priming paradigm. In this paradigm, the prime is not masked and the lag between the prime and the target word is longer than in masked priming (500 ms for this study). Additionally, there are a number of intervening trials between the prime and the target (7-13 for this study). As a result, significant priming was obtained for

the semantically transparent items whereas no priming was found in the semantically opaque condition. This showed that the morpho-semantic information (i.e. semantic transparency) modulated the processing.

Using the masked cross-modal priming paradigm, Diependaele, Sandra, & Grainger (2005) investigated the effect of semantic transparency on the processing of morphologically complex Dutch and French words. In their first experiment, there were three conditions, semantically transparent (e.g. *domheid-dom* 'stupidity'-'stupid'), orthographic control (e.g. *dominee-dom* 'preacher'-'stupid'), and an unrelated control (e.g. *paprika-dom* 'pepper'-'stupid'). As a result, a significant priming effect was obtained with semantically transparent primes. However, the orthographic control condition in this experiment contained both real derivations and pseudo-derivations, which was not informative for the semantic transparency debate. Thus, in the second experiment, French complex words were tested in three different conditions, semantically transparent (e.g. *clochette-cloche* 'small bell'-'bell'), opaque (e.g. *baguette-bague* 'French bread'-'ring'), and orthographic (e.g. *abricot-abri* 'apricot'-'shelter') using incremental visual priming where the SOA was incrementally increased within the same experiment (13, 40, & 67 ms). Consequently, a priming effect for transparent items was found at 40 and 67 ms SOAs; however, it was apparent for the opaque items only at 67 ms SOA in the visual modality. Furthermore, at 67 ms SOA the effect for transparent items was larger than for the opaque items. The results showing that the opaque items did not cause facilitation at 40 ms SOA whereas the facilitation occurred for transparent items at this SOA could be regarded as in line with the 'morpho-semantic' account. On the other hand, late emergence of facilitation for the opaque items, and the larger effect for transparent items than the opaque ones at a longer SOA (i.e. 67 ms) could be taken as evidence for the two-stage model mentioned above where there was an early semantically blind morpho-orthographic segmentation followed by the contribution of morpho-semantic information.

More recent evidence for the 'morpho-semantic' account has been obtained from masked visual priming experiments because it was claimed that the results obtained from unmasked or long-term priming, where the SOA is long, might be due to the episodic memory or strategy use, which complicated the interpretation of the lexical processing one stage at a time (Feldman et al., 2012). The masked priming ERP (event-related potentials) study of Morris, Frank, Grainger, & Holcomb (2007), for example, used three conditions, semantically transparent (e.g. *hunter-hunt*), opaque (e.g. *corner-corn*), and form (e.g. *scandal-scan*) similarly to the previously cited studies. Both reaction time and ERP data showed that the priming effect only appeared in the transparent condition. More precisely, it was suggested that the priming effect was graded in that the opaque priming was situated between transparent priming (the largest) and form priming (the smallest).

The primary argument for the 'morpho-orthographic' account was that the same amount of priming was obtained in the transparent and the opaque conditions. However, re-evaluating the findings of sixteen previously published studies in the relevant literature, Feldman et al. (2009) highlighted that the priming effect obtained from the transparent condition in most of the studies in the literature was actually numerically greater than the effect for the opaque condition. Moreover, this effect reached significance in the statistical analyses conducted by Feldman et al. (2009). In other words, it was claimed that the priming obtained from the transparent condition was significantly greater than the priming obtained in the opaque condition, which underlined the contribution of semantic information to the early stages of morphological processing.

Feldman et al. (2009) tested transparent (e.g. *coolant-cool*) and opaque (e.g. *rampant-ramp*) items against semantically unrelated baselines in a masked priming lexical decision task with a 50 ms SOA. Different from earlier studies, their study took into account the combinatorial productivity of the affixes in both transparent and opaque conditions, viz., *-er* could be combined with more stems than *-ile*. Furthermore, identical prime-target pairs (e.g. *artist-artist*) were added into the materials as fillers

in order to increase the degree of semantic and morphological relatedness in the experiment. The results indicated that the priming was significant for transparent items, but not reliable for opaque items. These findings were suggested to be not exceptional when the trend in the data of the previous studies was considered.

Similar to the conditions in the many past studies (Feldman et al., 2002; Rastle et al., 2004; Rueckl & Aicher, 2008), Diependaele, Andoni, Morris, & Keuleers (2011) also used semantically transparent (e.g. *viewer-view*), opaque (e.g. *corner-corn*), and form (e.g. *freeze-free*) conditions in a masked priming experiment with a 53 ms SOA. The priming effect was found to be greater in the transparent condition than in the opaque one. Moreover, the results replicated the graded nature of semantic transparency reported earlier by Morris et al. (2007). Namely, the priming effect was the smallest in the form condition. It gradually increased in the opaque condition, and it was the largest for the transparent condition.

The results of Feldman et al. (2009) for English were replicated by Feldman et al. (2012) for Serbian. Feldman et al. (2012) tested Serbian complex words using a masked priming lexical decision task with a 50 ms SOA. Unlike English, Serbian has a shallow orthography in which there is a one-to-one correspondence between sounds and letters. This nature of the language enabled Feldman et al. (2012) eliminate the criticism of Davis & Rastle (2010) in terms of the orthographic alterations in the semantically transparent and opaque items of Feldman et al. (2009).

Davis & Rastle (2010) claimed that there were systematic orthographic alterations in the semantically transparent items but not in the opaque items of Feldman et al. (2009). Serbian, in this regard, did not contain any orthographic or phonological alterations between the primes and the targets. Feldman et al. (2012) used semantically similar (e.g. *gladan-glad* 'hungry'-'hunger'), semantically dissimilar (e.g. *gladak-glad* 'smooth'-'hunger'), and semantically unrelated (e.g. *stablo-glad* 'tree'-'hunger') conditions. The semantically similar and dissimilar primes were combined with the same targets so as to eliminate any confound resulting from the use of different targets. Furthermore, Serbian had two different alphabets, Roman and Cyrillic. The effect of

the use of the same alphabet or different alphabets between prime-targets pairs was also examined. The presence of a priming effect when the primes and targets were presented in two different alphabets, and this effect's being comparable in magnitude to the effect obtained from the same-alphabet primes and targets eliminated the possibility of attributing the morphological facilitation to the orthographic similarity. The orthographic similarity could not be regarded as the source of facilitation because equal priming occurred even when there was no orthographic similarity between the prime and the target due to the use of different alphabets. As a result, a significantly greater priming effect was obtained for the semantically similar items compared to dissimilar ones. Moreover, there was no effect of alphabet similarity or difference. In other words, if the priming resulted from the orthographic overlap, more facilitation should have been obtained when the prime and the target were shown in the same alphabet; however, this was not the case. Based on these findings, Feldman et al. (2012) denied the independent and successive nature of morpho-orthographic and morpho-semantic processing. Instead, they suggested that morpho-semantic information affected the early processing of morphologically complex words, and this effect showed itself before the end of the morpho-orthographic segmentation procedure.

Marelli, Amenta, Morone, & Crepaldi (2013) found significant priming only for semantically transparent items in Italian (e.g. *artista-arte* 'artist'-'art') but not for opaque (e.g. *retaggio-rete* 'legacy'-'net') or form (e.g. *corallo-coro* 'coral'-'choir') items in a masked priming experiment (35 ms SOA) integrated into the eye-tracking paradigm. This was also regarded as evidence for the 'morpho-semantic' account (Heyer & Kornishova, 2018).

Andrews & Lo (2013), on the other hand, took individual differences in terms of spelling and vocabulary into account while investigating the effect of semantic transparency on the morphological processing of complex words. Using test batteries to measure the knowledge of spelling (dictation and spelling recognition test) and vocabulary (vocabulary test) of the participants, two participant profiles were formed.

The orthographic profile group was made up of individuals having higher spelling scores than vocabulary scores whereas the members of the semantic profile group had higher vocabulary scores than spelling scores. There were three different conditions, which were semantically transparent (e.g. *worker-work*), opaque (e.g. *corner-corn*), and form (e.g. *turnip-turn*). The task was a masked priming lexical decision task with a 50 ms SOA. As a result, greater priming was obtained for transparent items compared to opaque and form items. Moreover, individual differences were found to play a significant role in the manifestation of the priming effect. The same amount of facilitation was obtained for the transparent and opaque items in the orthographic profile group whereas the semantic profile group showed reliable priming only for transparent items, and for longer reaction times, with little priming for the opaque or form items. In a way, reconciling the 'morpho-orthographic' and 'morpho-semantic' accounts, this study underlined the need to consider individual differences while theorizing on the contribution of orthography or semantics to morphological processing instead of mere reliance on the average data.

In order to specify the time-course of the effect of semantic transparency on morphological processing, Feldman et al. (2015) tested semantically similar (e.g. *sneaky-sneak*), dissimilar (e.g. *sneaker-sneak*), and semantically unrelated (e.g. *chalky-sneak*) items across various SOAs (34, 48, 67, 84, & 100 ms). The proposal they supported was the simultaneous and interdependent effect of both form and meaning, and the gradual increase of the effect of meaning as the SOA increased. Similar to earlier studies of the same authors, the same targets were used both in the semantically similar and dissimilar conditions to eliminate the influence of target difference as a confound. Firstly, 34, 67, and 84 ms SOAs were tested together in an experiment (Experiment 1A) while 48 and 100 ms SOAs were tested in a separate experiment (Experiment 1B). As a result, it was found that the semantically similar items were processed significantly faster than the dissimilar ones at all SOAs, and the effect of semantic similarity increased with increasing SOA. The priming effect for semantically dissimilar items was also found to emerge later.

In the second experiment, 48 ms SOA, which was frequently used to investigate the effect of semantic transparency in the literature, was the only SOA tested. This was done to ensure that the effect of semantic transparency obtained with the 48 ms SOA in the Experiment 1A did not result from the use of various SOAs within the same experiment, some of which was long enough for conscious perception. Consequently, the priming effect was obtained for the semantically similar items compared to the dissimilar ones when a single SOA (48ms) was used throughout the experiment. This was the exact replication of what was found when different and multiple SOAs (i.e. 34, 67, 84 ms SOA) within the same experiment as in Experiment 1A.

In the first experiment, the difference between the semantically similar and dissimilar conditions at a 34 ms SOA was found to be significant. The difference was small, though. Moreover, running a separate analysis only for the 34 ms SOA in the first experiment was not sufficiently informative due to the small sample size and reduced power. Thus, the same SOA was tested on its own in the last experiment. Similar to Andrews & Lo (2013), individual differences in terms of spelling and vocabulary knowledge were also added into the study design. At a 34 ms SOA, the significant effect of semantic transparency remained. There was no systematic effect of individual differences. Additionally, when the 34 ms and 48 ms SOAs were analyzed together, the effect of semantic similarity was found in both. More precisely, the effect was marginally greater at 48 ms SOA than the one at 34 ms SOA, which lent additional support to the graded emergence of the semantic transparency effect depending on the increasing SOA. It was concluded that the semantic information interacted with morpho-orthographic form at the early stages of processing as opposed to the claims of semantically blind morpho-orthographic account.

2.3. The Intermediate Level of Representation

One of the major questions in the lexical processing literature is to explain how the mapping between the form and meaning of a word is taking place. The form of a word entails the orthographic (written) or phonological (spoken) appearance of the

word whereas the meaning involves its semantic make-up. As the same form repetitively occurs in similar contexts, the processor learns to associate this specific form with a specific meaning (Taft, 2003). For instance, the word form ‘l-i-o-n’, whose phonological appearance is /laɪ.ən/, is learnt to be associated with a big wild animal having a fur and a mane as it constantly appears in the same context.

There are different models trying to explain the mapping between form and meaning. At core, all of these models depend on representing the correlation between form and meaning, and the need for an intermediate level to capture morphological relationships is underlined. For example, the distributed connectionist account suggests that connections exist between the form and the meaning levels, and weightings on these connections get stronger as these levels correlate. It is called ‘distributed’ due to the fact that each unit at different levels makes a contribution to a pattern of activation (Plaut & Gonnerman, 2000). Moreover, this pattern of activation enables the lexical processing system to capture the relationship among words sharing the same stem (e.g. *write* has similar meaning in *writing*, *writer*, *written*).

As a localist connectionist account, on the other hand, another model was suggested by Taft & Nguyen-Hoan (2010). This model is made up of three levels, and each level forms a separate and entire identity in order to present a comprehensible model of an abstract lexical processing system (Taft, 2003). In the model of Taft & Nguyen-Hoan (2010) in addition to the orthographic and semantic levels, there is an intermediary level called the ‘concept’ or ‘lemma’ level, which is responsible for capturing the correlation between these two levels. The lemma level was firstly suggested by Levelt (1999) in the field of speech production, and this level was claimed to build a link between the syntax & semantics of the word and the form of the word. The activation for the word that was going to be produced moved from the levels of syntax & semantics to the lemma level. From this intermediary level, it moved to the pronunciation (i.e. form) level. In visual word recognition, on the other hand, the activation obtained from the form of the word (i.e. orthography) moves to the

lemma level, and then to the meaning (i.e. semantics) level (Taft & Nguyen-Hoan, 2010).

The correlation between the form (i.e. orthography) and the meaning (i.e. semantics) develops based on how consistently the processor sees the same form with the same meaning in varying contexts. When a consistency is achieved between the form and the meaning, the lemma develops. For example, for the word *apple*, the correlation between the form (e.g. *apple*) and the meaning (e.g. fruit) will be consistent, and the lemma for this word will develop because the same form is used all the time in various contexts to refer to a fruit (Taft, 2003). Therefore, all morphologically simple words such as *apple* are claimed to have their own lemmas, and these lemmas could be regarded as the lexical entry of these words (Taft & Nguyen-Hoan, 2010).

Moreover, lemmas are claimed to exist not only for morphologically simple free morphemes such as *apple* but also for bound morphemes like *vir-* because there is also a correlation between the form and the meaning of bound morphemes. Namely, *vir-* could consistently be used in disease-related meanings in different contexts (e.g. *virus* or *viral*) (Taft & Kougious, 2004). Additionally, morphologically complex words (e.g. *hunter*) also have their own whole-word lemmas (see Figure 1) because these lemmas bear the particular information that cannot be derived simply from the constituent lemmas (i.e. *hunt* and *-er*). Therefore, after the activation of individual lemmas (i.e. *hunt* and *-er*), the whole-word lemma for *hunter* is also activated. In the lemma model, for words having more than one meaning (i.e. ambiguous words) such as *stick*, there is only one orthographic unit for the two meanings; however, there are two separate lemmas (see Figure 2) linking these units to related semantic features (Taft & Nguyen-Hoan, 2010).

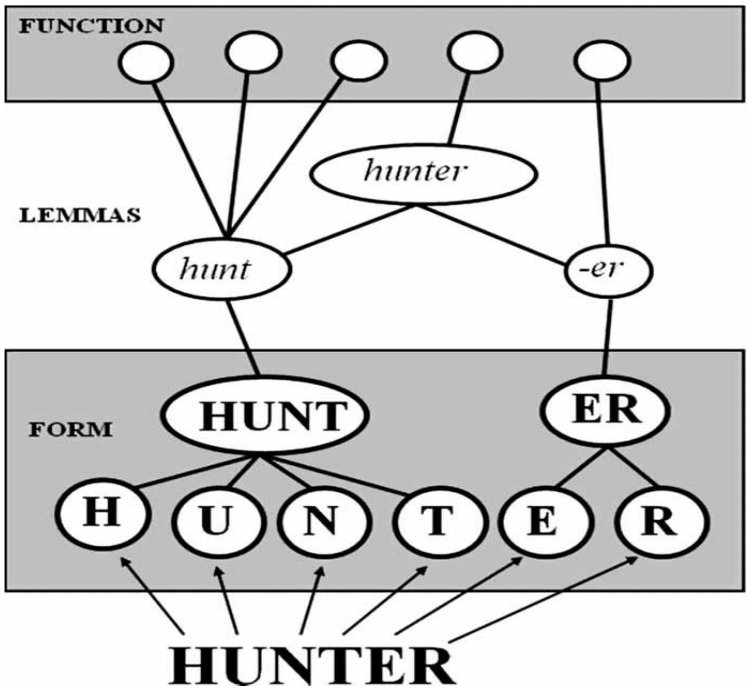

Figure 1. The representation of a lemma level for morphologically simple and complex words (Taft & Nguyen-Hoan, 2010)

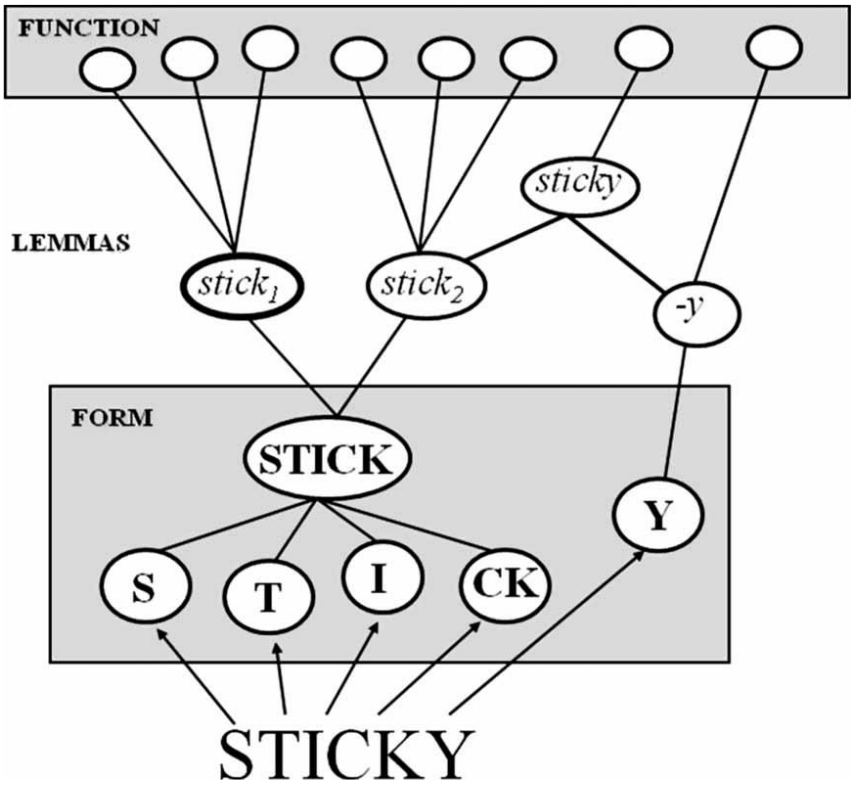

Figure 2. The representation of a lemma level for ambiguous words (Taft & Nguyen-Hoan, 2010)

The evidence for the existence of such a level comes from various studies. For instance, Taft & Kougious (2004) studied how morpheme-like units were processed by using the masked-priming paradigm. They compared the processing of prime-target pairs which were orthographically, phonologically and semantically related such as *virus* and *viral* with prime-target pairs having orthographic and phonological but no semantic relatedness like *future* and *futile*. The argument was that if *virus* facilitated the processing of *viral* when *future* failed to facilitate *futile*, then there should be a level where these two pairs differed although the same string of letters, *vir* and *fut* respectively, was shared in primes and targets in both cases. Similar to the 'lemma' level suggested by Taft (2003), connectionist accounts of morphology (Gonnerman, Seidenberg, & Andersen, 2007; Plaut & Gonnerman, 2000) also supported the existence of an intermediate level which captured the repeated occurrence of a specific form (i.e. *vir*) in a specific context (i.e. meaning referring to diseases). Moreover, whether this specific form could be regarded as a morpheme or not was reliant on the strength of the correlation between form and meaning. Taft & Kougious (2004) also tested prime-target pairs that shared only orthography (e.g. *saliva-salad*) or only semantics (e.g. *pursue-follow*) to ensure that if there was any priming effect, this did not result from orthographic or semantic overlap alone. As a result, they found that items sharing orthography, phonology, and semantics showed priming, unlike the ones sharing orthography and phonology but lacking semantic relatedness. Additionally, only meaning overlap (as in *pursue-follow*) did not induce a priming effect, which supported the existence of an intermediate-level that mediated the combined input coming from form and meaning levels. This could also be regarded as the level where the processor distinguished two lexical items having the same form. Both prime-target pairs shared the same number of letters and the orthographic structure. However, only *virus* and *viral*, which shared the same lemma level representation, led to priming. Therefore, the lemma model claimed that since the lemma of the prime was the same

as the lemma of the target, and because it was activated before the appearance of the target, the priming effect occurred.

Furthermore, Taft (2003) suggested that the emergence of the correlation between form and meaning could be dependent on the systematicity of the orthographic structure. In other words, this correlation could only occur if the orthographic input was the initial CVC unit, or the Basic Orthographic Syllabic Structure (BOSS). This structuring enabled the maximization of the coda of the first sub-lexical unit, which in turn increased the informativeness of that unit. For example, this unit was *vir-* for *virus* and *viral*. It was the initial CVC unit repeatedly occurring in disease-related contexts; thus, the sub-lexical lemma. Additionally, both *virus* and *viral* had their own separate whole-word lemmas because their repeated occurrence in different contexts might lead to the development of different lemmas for different meanings (i.e. *virus* in health vs. in computer science) (Taft & Kougious, 2004).

In addition to the processing of morpheme-like units, support for the lemma level came from ambiguous morphemes, which have the same orthographic or phonological appearance but more than one meaning. Taft & Nguyen-Hoan (2010) used monomorphemic ambiguous words as targets (e.g. *train* 'a vehicle' or 'to prepare someone for something') and polymorphemic words, which could be derived from only one of the possible meanings of the ambiguous words (e.g. *trainer* 'a person who prepares someone for something'), as primes in order to investigate where the morphological representation was situated in the models of lexical processing. They tested whether seeing the masked morphologically related prime (e.g. *trainer*) before the target (e.g. *train*) would lead the participants to report 'a person who prepares someone for something' as the first meaning that comes to their minds more often than the 'vehicle' meaning. Moreover, only semantically related primes (e.g. *tutor*) were also used to determine whether the effect resulted from mere semantic relatedness. The participants were expected to report the meaning by defining it, using it in a sentence or providing a semantically related word. The results showed that the participants who saw the morphologically related primes (e.g. *trainer*) were biased

towards reporting semantically related meanings (e.g. to prepare someone for something); however, seeing only semantically related primes (e.g. *pursue*) did not create any bias under masked priming conditions, where the prime display duration was very short (i.e. *50 ms*). Thus, it was concluded that there would be no chance to distinguish the two meanings of an ambiguous word from one another if the orthographic level was directly linked to the semantic level considering the sameness of the orthography and the absence of semantic priming (Taft, 2003).

Trying to explain the priming effect found for *corner-corn* by Rastle et al. (2004) (see Section 2.1), it was suggested in the lemma model that when the processor saw *corner*, it decomposed the word into pieces that existed in the given language as morphemes. Then, the lemmas for *corn*, *-er*, and *corner* were activated separately. However, there were no constituent lemmas (e.g. *corn* and *-er*) coming together to activate the whole-word lemma (e.g. *corner*) as in the case of *trainer-train*. Although the activated lemmas for *corn* and *corner* competed with one another, and *corner* reached the activation threshold, the priming occurred because of the fact that the competing lemma *corn* could not be fully inhibited within the short prime display duration. Additionally, in an attempt to explain the lack of priming for *brothel-broth* compared to the presence of priming for *corner-corn*, Taft & Nguyen-Hoan (2010) suggested that the BOSS would be the same for *corner* and *brothel*, which were *corn* and *broth* respectively. The point where they differed could be that *-er* had a lemma level representation whereas *-el* did not, which prevented the priming of *broth* by *brothel*.

Another piece of evidence supporting the existence of a lemma level was based on the findings of a study conducted by Crepaldi, Rastle, Coltheart, & Nickels (2010). In this study, Crepaldi et al. (2010) examined whether the morpho-orthographic segmentation account claimed to be void of semantic effects could explain the processing of irregular past tense inflection in English using the masked priming paradigm. They compared the reaction time for prime-target pairs that were genuine irregulars such as *fell* and *fall* with an orthographic, *full* and *fall*, and an unrelated

baseline, and found that genuine irregulars were processed significantly faster than the others. This result was in sharp contrast with the morpho-orthographic segmentation account. The morpho-orthographic segmentation account relied on the idea that the processor decomposed everything that looked like an affix into parts in early processing as in the case of *corn* and *-er*. This decomposition in turn facilitated *corn* as the repeated part in the prime and the target. On the contrary, irregular pairs did not share their orthography, and did not have decomposable parts (e.g. *fell-fall*), but showed priming.

It was claimed that this finding could have stemmed from the orthographic sub-regularities found in irregular pairs. Thus, Crepaldi et al. (2010) conducted additional experiments, where they compared genuine irregulars and pseudo-irregulars, which displayed the same orthographic sub-regularity as in the genuine ones like *tell* and *tall*, against orthographic and unrelated baselines. The authors found a priming effect for genuine irregulars but no priming for pseudo-irregulars. This finding confirmed that the priming observed for genuine irregulars was not due to the orthographic sub-regularities and suggested that there was a need for a level higher than the form level to explain the findings at hand.

While discussing their results, Crepaldi et al. (2010) referred to the lemma model proposed by Taft (2003), which claimed that there was no lemma for inflected forms and no whole-word lemma was found for inflected words. Thus, it was suggested that different form representations as in the case of irregular past tense inflection *fell vs. fall* activated the same lemma *fall* provided that they were various inflected versions of the same stem. Even though this model was claimed to be successful in accounting for the existence of priming effects for genuine irregulars but not for pseudo-irregulars, it was not sufficiently explanatory in explaining the smaller priming observed for *brothel-broth* in comparison with *brother-broth*. In order to fix this, Crepaldi et al. (2010) suggested that a morpho-orthographic segmentation procedure, which decomposed everything that resembled a morpheme into pieces, was incorporated into the form level.

Another part that needed a more successful explanation was the similar amount of priming found for *darkness-dark* and *corner-corn* pairs. Therefore, it was stated that a different conception of the lemma was required than previously proposed by Levelt (1999). In Levelt's understanding of the lemma (as discussed earlier in this section), the lemma level was mainly responsible for capturing the correlation between the form and meaning. In the new understanding of the lemma as suggested by Crepaldi et al. (2010), on the other hand, it was a kind of storage space for lexical items bearing a certain meaning together with a bunch of lexical and syntactic features such as grammatical category. Dwelling on this idea, words with a derivational relationship (e.g. *darkness* or *darkly*) possessed separate lemmas because the grammatical category of these words were different. On the other hand, words with inflectional relationship (e.g. *fell* or *fall*) shared the same lemma since there was a meaning overlap between them, and they were from the same grammatical category. From this perspective, a similar amount of priming was obtained for *darkness-dark* and *corner-corn* due to the fact that derivationally related words (e.g. *darkness-dark*) and semantically unrelated words (e.g. *corner-corn*) had separate lemmas.

Lastly, in the new understanding of the lemma, an orthographic lexicon higher than the morpho-orthographic segmentation procedure was proposed as a mechanism to distinguish words from non-words. For instance, both *falls* and *falled* would be decomposed into their morphemes by the morpho-orthographic segmentation procedure; however, thanks to this mechanism *falls* could be found in the orthographic lexicon and accepted as a legitimate form while *falled* could not (Crepaldi et al., 2010).

Another set of research supporting the lemma model focused on the inhibitory priming obtained from stem-homographs in the unmasked priming paradigm and the facilitatory effect observed in the masked priming paradigm. For example, Allen & Badecker (1999, 2002) presented the word *cerrar* in Spanish, which was the inflected form of one meaning (Eng., to close) of a stem-homograph (*cerr-*), as the prime and another word *cerro,* which was the inflected form of the other competing meaning 'hill' of that stem-homograph as the target. They also used an unrelated (e.g. *pasear*

‘to walk’) and an orthographic (e.g. *cerdo* ‘pig’ and bearing only orthographic similarity to *cerro*) control condition in order to see how the effect for stem-homographs would unfold compared to these conditions. It was found that stem-homographs were processed slower than the unrelated and orthographic conditions. This result could not be attributed to the formal overlap alone since even the allomorphs (e.g. *cierra* ‘opens’) inflected from the one meaning of a stem-homograph, which bore different formal appearance compared to the inflected word of the competing meaning, produced the same inhibitory priming effect. Furthermore, only semantic relatedness could not account for the inhibitory priming because when the inflected form of the stem-homograph (e.g. *cerrar*) was replaced with a semantically related word (e.g. *puerto*) and used as the prime of *cerro*, the inhibitory effect disappeared. Thus, the source of this effect was attributed to the competition between the two meanings of a stem-homograph at the lemma level in which the lemma losing the lexical competition needed to be actively suppressed so that the winning lemma achieved the recognition, and this suppression process slowed down the recognition of the winner (Allen & Badecker, 2002).

On the other hand, Badecker & Allen (2002) tested the same stem-homographs compared to an unrelated and an orthographic baseline in the masked priming paradigm with a brief stimulus onset asynchrony (67 ms). They found that masked stem-homographs were processed significantly faster than the unrelated and orthographic conditions. The presence of inhibition in the unmasked paradigm in contrast to the facilitation observed in the masked priming experiment was attributed to the fact that the inhibition mechanism should be at work, and one lemma or one meaning of an ambiguous word should be chosen in unmasked priming experiment for conscious processing, though no such selection was required in masked priming which was claimed to tap into early stages of processing (Jacob, 2018). Therefore, a word derived from one meaning of an ambiguous word might facilitate the recognition of another word derived from different meaning of the same ambiguous word in masked priming (Badecker & Allen, 2002).

In the study of Allen & Badecker (2002), the orthographic similarity was decided merely based on the number of letters shared in the prime and the target. However, this was regarded as a potential confound by Xu & Taft (2014). Thus, Xu & Taft (2014) tested English homographs in an unmasked priming experiment by taking into consideration the neighboring letters shared in the prime and the target while designing the orthographic control condition. Similar to the design of Allen & Badecker (2002), Xu & Taft (2014) used the words derived from the different meanings of homographs as primes and targets (e.g. *solely* as the prime produced from the 'alone' meaning of the stem *sole* and *soles* as the target from the 'shoe' meaning). Moreover, they designed a compatible condition where the prime and the target came from the same meaning (e.g. *slipped* as the prime and *slipping* as the target), and an orthographic condition in which the prime and the target shared their orthography (e.g. *campus* as the prime and *camping* as the target). The results showed that there was facilitatory priming when the prime and the target were derived from the same meaning and, importantly, no inhibitory priming was observed for the condition where the primes and targets came from the different meanings of a homograph or for the orthographic condition. This was in sharp contrast with the inhibitory effect found by Allen & Badecker (2002) with stem-homographs in Spanish. Xu & Taft (2014) claimed that this might have resulted from the fact that the orthographic overlap between the prime-target pairs in the stem-homograph condition was greater than the overlap in the orthographic condition in Allen & Badecker (2002). Furthermore, not considering the meaning frequency (i.e. relative frequency of different meanings of a stem-homograph) of the primes and targets might have caused the absence of an inhibitory effect. Therefore, according to these researchers, the most plausible scenario where the presence of inhibitory priming was expected would be one in which the prime was coming from the subordinate meaning of the homograph whereas the target was from the dominant meaning. In this case, the processor needed to suppress the readily available dominant meaning. Indeed, the materials in the first experiment of Xu & Taft (2014) was the opposite. Namely, most of the primes were derived from the dominant meaning, which was not the ideal context for the emergence of the inhibition. Yet, in their second experiment, an inhibitory effect was obtained with subordinate

primes and dominant targets with a careful design incorporating meaning frequency. On the other hand, when they used dominant primes and subordinate targets in their last experiment, the inhibition disappeared because no strong suppression was needed for the dominant meaning. In summary, the facilitatory effect for the primes and targets sharing the same meaning and the inhibitory effect for different meanings of the homographs unfolding based on the meaning frequency supported the existence of lemma level representations, lemma level competition and inhibition mechanism (Xu & Taft, 2014).

On the other hand, Tsang & Chen (2013) tested Chinese ambiguous morphemes using compounds and manipulating the meaning frequency effect under the masked priming paradigm. In their first experiment, the target ambiguous morpheme, which was a Chinese character meaning either 'moon' or 'month' in English was primed by compounds formed for four different conditions: dominant, subordinate, opaque and unrelated. The dominant prime was a Chinese character meaning 'lunar eclipse' in English, which was derived from the dominant meaning 'moon' of the ambiguous morpheme, whereas the subordinate prime could be translated as 'monthly salary' derived from the subordinate meaning 'month' of this ambiguous Chinese character. Moreover, the opaque word contained the same ambiguous character but this character did not contribute to the meaning of the whole compound that meant 'railway platform'. The participants were expected to generate the first meaning that came to their minds when they saw the target word. Consequently, they reported the dominant meaning more frequently, which was taken as the replication of the findings of Taft & Nguyen-Hoan (2010).

For the second experiment, Tsang & Chen (2013) designed a masked priming lexical decision task using a very short SOA (40 ms) with the same four prime types and two target types, which were compounds derived from either the dominant or the subordinate meaning of the relevant ambiguous morphemes. As a result, the dominant targets were processed faster than the subordinate ones, which supported the idea that the meaning frequency played a role in the processing of ambiguous morphemes in

Chinese. Furthermore, there was a facilitatory priming effect for dominant targets when the primes were in dominant, subordinate, and opaque conditions. However, this facilitation existed for subordinate targets only when the primes were in the subordinate condition. Accordingly, Tsang & Chen (2013) claimed that morpho-orthographic segmentation could be explanatory enough when the results for the dominant targets were separately considered since even opaque primes, which bore only orthographic resemblance to the dominant targets, could induce facilitation. Yet, the distinct pattern for subordinate targets underlined the need for a different explanation.

The authors based their explanation on the lemma model with slight modifications to accommodate the effect of the meaning frequency in the course of processing ambiguous morphemes. First, they suggested that as individual lemmas needed to come together to send activation to the whole-word lemma as proposed by Taft (2003) and Taft & Kougious (2004), the whole-word lemma should also send contextual feedback to the individual lemmas to help the selection of the appropriate lemma. In other words, this contextual feedback involved seeing the rest of the compound word other than the ambiguous part which provided the information to choose the relevant lemma and to solve the ambiguity. Moreover, due to the meaning frequency, the dominant lemma was highly active even when the prime was subordinate or opaque. On the contrary, so as to activate the subordinate lemma, the context, namely the prime word, needed to support the subordinate meaning to take control over the meaning frequency effect.

The authors also commented on how the priming for opaque items could be explained by the lemma model. They highlighted that after *corner* was segmented into *corn* and *-er*, which was claimed to take place via morpho-orthographic segmentation procedure before the lemma level in Crepaldi et al. (2010), the readily available dominant meaning for *corn* was the lemma connected to the 'cereal' meaning, and the same lemma was activated twice causing the facilitation since the target was also *corn*. In summary, it was stated that the priming obtained could not be accounted for

referring to the orthographic overlap because this did not differ from the dominant meaning to the subordinate meaning. Additionally, the different pattern of priming in the dominant and subordinate conditions eliminated the possibility of attributing this effect to the semantic sharing as the compounds used were unambiguous in their whole-word forms, but instead ambiguous at the morphemic level. Therefore, the presence of a lemma-level representation between the orthographic and semantic levels was advocated once again without disregarding the influence of the meaning frequency.

2.4. Ambiguity and The Effect of Meaning Frequency

2.4.1. The Lexical Ambiguity

Psycholinguistic research into ambiguity has to date mostly dealt with lexical ambiguity. In this regard, homonymous and polysemous lexical items could be regarded as the most frequently tested ambiguous word types in experimental psycholinguistic studies. For these items, the ambiguity is often claimed to come from the fact that these have than one meaning, each of which is either related (polysemy) or unrelated (homonymy). More precisely, both homonymous and polysemous words have the same orthographic and/or phonological make-up (as in the case of *bank* or *paper*, respectively); however, the two or more meanings that could be derived from these words are completely unrelated as in the case of homonymy (e.g. *bank* 'financial institution' or 'a land along the side of a river') while they are related in the case of polysemy (e.g. *paper* 'writing material', 'newspaper' or 'essay') (Shen & Li, 2016).

One of the earlier research questions being asked was whether homonymous and polysemous words were represented and processed similarly or differently in the lexicon. The results of studies trying to tackle these questions are still far from conclusive. Whereas the results of some studies have been in line with the idea that homonymous and polysemous words are represented and processed similarly, others have pointed to major differences. For instance, using different memory or sense judgment tasks, Klein & Murphy (2001) found that the different senses (meanings) of

a polysemous word had different representations.. In other words, the previous presentation of a phrase derived from one sense of a polysemous word (e.g. *shredded paper*) before seeing another phrase coming from the same sense (e.g. *wrapping paper*) facilitated recognition. However, when the sense between the firstly presented (e.g. *wrapping paper*) and the secondly presented phrases (e.g. *liberal paper*) was different, this caused inhibition. Similarly, when the meaning of a homonymous word (i.e. financial institution) overlapped between the first (e.g. *commercial bank*) and the second (e.g. *savings bank*) phrases, the effect was facilitatory. Yet, it was inhibitory in case of a meaning mismatch between the first (e.g. *creek bank*) and the second (e.g. *savings bank*). Depending on these findings, it was claimed that homonymous and polysemous words were represented similarly in the lexicon.

Shen & Li (2016) also found a similar pattern for both homonymous and polysemous words in Chinese using a sentence reading task in the eye-tracking paradigm. They manipulated the context (i.e. *When the astronaut saw*) prior to the homonymous/polysemous word (e.g. 火星, Eng., Mars or fire sparks) in the sentence and the disambiguating region (i.e. *he felt amazed at the beauty of the universe*) following the homonymous/polysemous word. If the prior context (i.e. *when the fireman saw*) and the disambiguating region (i.e. *he was worried about the danger of fire*) supported the same meaning (e.g. fire sparks) of the homonymous/polysemous word, this condition was called 'consistent'. On the contrary, if there was a mismatch between the prior context (i.e. *when the fireman saw*) and the disambiguating region (i.e. *he felt amazed at the beauty of the universe*), it was called an 'inconsistent' condition. As a result, less total reading time and fewer regressions (i.e. looking back to the previous parts of the sentence to solve the ambiguity) were observed in the consistent condition in comparison to the inconsistent condition for both homonymous and polysemous words. It was concluded that the homonymous and polysemous words were represented similarly if the context was supportive enough to specify a meaning entirely.

On the other hand, Rodd, Gaskell, & Marslen-Wilson (2002) used various lexical decision tasks to test whether the presentation of a polysemous word (e.g. *twist*) could facilitate recognition compared to unambiguous words (e.g. *belt*). Faster responses were obtained for polysemous words. Homonymous words (e.g. *bark*) were also tested against unambiguous words, and it was found that the effect turned into inhibition for homonyms. Namely, while the different senses in the case of polysemy caused facilitation in recognition, the different meanings of homonymous words led to inhibition. The results also indicated that polysemous words with more senses (e.g. *clip*) caused a greater facilitation compared to polysemous words with fewer senses (e.g. *novel*) since the words with more senses were accepted to be semantically richer. Similar to the findings of Rodd et al. (2002), Klepousniotou & Baum (2007) also found that polysemous words (e.g. *lip*) facilitated processing in comparison to unambiguous control words (e.g. *seven*) whose frequencies were matched whereas no such effect was obtained for homonyms (e.g. *panel)*. This result was explained referring to the competition between the unrelated meanings of a homonymous word and the lack of this competition for polysemous words because they had one underspecified core meaning with related senses.

Moreover, another prominent debate following the nature of the representation of homonymy vs. polysemy in the mental lexicon was whether homonyms caused a processing advantage compared to unrelated words or not. If homonyms were processed faster than unambiguous words, this effect was dubbed the 'ambiguity advantage'. For example, Lin & Ahrens (2010) investigated the effect of lexical ambiguity using Chinese homonymous (e.g. *huoguo* 'a pot' or 'a blocked shot in basketball') and unambiguous nouns in a lexical decision task. The results showed that the homonymous words were processed faster than the unambiguous words, which supported the ambiguity advantage effect in Chinese. It was postulated that the different meanings of a homonym cooperated with one another instead of competing in order to inhibit other lexical competitors, which led to a processing advantage for ambiguous words (i.e. homonyms) in comparison with unambiguous words (Klepousniotou & Baum, 2007).

In addition to some studies showing the ambiguity advantage effect (e.g. Lin & Ahrens, 2010), other studies have indicated a processing disadvantage for homonymous words (e.g. Rodd et al., 2002) That is, homonymous words were processed slower than unambiguous words. It was claimed that homonymous words had different and unrelated meanings which were stored separately in the lexicon. Therefore, upon seeing a homonymous word, a competition emerged between the different meanings for selection, and this, in turn, caused the slower processing (Klepousniotou & Baum, 2007). It was also postulated that this controversy concerning the ambiguity advantage or disadvantage might have been dependent on task differences. For example, in lexical decision tasks, the participant's only job was to decide whether the presented string was a word or not. In other words, there was no need to select one specific and appropriate meaning of a homonymous word in the lexical decision task in contrast to semantics-related tasks such as semantic categorization or sentence reading tasks in the eye-tracking paradigm. Thus, it was claimed that the ambiguity advantage effect was mostly found in lexical decision tasks because having more than one meaning, even if these meanings were unrelated, led to an advantage in a task where the activation of any meaning of a homonymous word was sufficient (Lin & Ahrens, 2010). However, the ambiguity disadvantage effect found in Rodd et al. (2002) was also dependent on lexical decision data, which was a counter-argument against the effect of task differences.

2.4.2. Morphemic Ambiguity and Meaning Frequency

While a great number of studies in the psycholinguistics literature has focused on lexical ambiguity, the number of studies examining ambiguity at the morphemic level has been rather small. This is actually surprising as morphemic ambiguity is prevalent in many languages. For instance, the morpheme *-in* in English is ambiguous because it could denote negation as in the word *insane,* but this is not the case for the word *inside*. The ambiguity is claimed to be at the morphemic level because the words *insane* or *inside* are not ambiguous at the lexical (i.e. whole-word) level. Instead, only the morpheme *-in* has different, unrelated meanings even if these various meanings are

represented with the same orthographic structure (i.e. homonyms) (Tsang & Chen, 2010). Similarly, the word *sticky* is not ambiguous at the lexical level; however, at the morphemic level *stick* is a homonymous morpheme that could mean 'to adhere' or 'a twig' (Taft & Nguyen-Hoan, 2010). As can be seen in the examples provided, ambiguous morpheme can be stems (e.g. *stick*) as well as affixes (e.g. *-in*).

Morphemic ambiguity studies have predominantly focused on stem-homographs or constituents of compound words (Tsang et al., 2014). Most of the prominent morphemic ambiguity resolution studies were conducted in Chinese because Chinese is regarded as an ideal language in this respect (Tsang & Chen, 2010). In Chinese, the majority of words contain two separate characters (morphemes), and each one of these characters can have up to twenty different meanings (e.g. 打 'beat, fight, make, build' etc.). The morphemic ambiguity is only resolved when the character is combined with another character to form a compound (e.g. 打鼓 'beat the drum') (Shen & Li, 2016).

Earlier research on morphemic ambiguity has frequently dealt with potential factors contributing to morphemic ambiguity resolution. One of these factors is the relative frequency of the different meanings of a homonymous word (Rice, Beekhuizen, Dubrovsky, Stevenson, & Armstrong, 2019). The claim is that all meanings of an ambiguous word are activated based on meaning frequency (Sereno, Pacht, & Rayner, 1992). Considering meaning frequency, some studies have grouped homonymous words as 'balanced' vs. 'unbalanced' homonyms. According to this classification, balanced homonyms (e.g. *compound*) bear at least two different meanings (i.e. mixture or enclosure) that have equal/nearly equal meaning frequencies. In the case of unbalanced homonyms (e.g. *bank),* on the other hand, one of the meanings has a high (i.e. financial institution) meaning frequency (i.e. dominant meaning) and the other meaning has a low (i.e. a land along the side of a river) meaning frequency (i.e. subordinate meaning). (Shen & Li, 2016).

Regarding the processing of balanced vs. unbalanced homonyms, it has been claimed that much more time is needed in order to activate one meaning of a balanced

homonym since the two meanings that could be derived from this homonym have approximately equal meaning frequencies. Because both of the meanings are equally available, it will take more time for one meaning to inhibit the other (i.e. competitor) and win the competition for the activation. On the other hand, the dominant meaning is more readily available than the subordinate meaning for unbalanced homonyms. Thus, it will require less time to activate the dominant meaning in this case (Rice et al., 2019). A small number of studies found no effect of the meaning frequency (e.g. Hino, Lupker, & Sears, 1997). For example, Klepousniotou & Baum (2007) did not find any processing advantage for homonymous words compared to unambiguous controls. They tested both balanced (e.g. *panel*) and unbalanced (e.g. *coach*) homonyms. However, no facilitation was obtained for either balanced or unbalanced homonyms.

On the other hand, there has been an increasing number of studies reporting the effect of meaning frequency. For example, Tsang & Chen (2010) examined the potential factors playing a role in morphemic ambiguity resolution. They tested Chinese bimorphemic compounds (e.g. 風箏 'kite') which were made up of an ambiguous morpheme (e.g. 風 'wind' or 'bee') and a contextual morpheme (e.g. 箏 'zither') using the visual-world paradigm in eye-tracking. Each time, the participants were shown three different objects, a target, a competitor, and a distractor, and the objects they looked at were recorded. The meaning frequency (e.g. 風, dominant meaning: wind; subordinate meaning: bee) and the place of the contextual morpheme (whether it preceded or followed the ambiguous morpheme) were manipulated. When the target came from the dominant meaning of an ambiguous word (e.g. 風箏 'kite'), the competitor came from the subordinate meaning (e.g. 蜂巢 'comb'). It was found that it was easier to access the dominant meaning without any prior context because the visual detection of the targets was more swiftly and correctly done. However, the subordinate meaning was still active in the dominant-biased context whereas the dominant meaning could be inhibited in the subordinate-biased context. Thus, it was concluded that the contextual biases and the meaning frequency made a contribution

to the morphemic ambiguity resolution process (see Rayner & Frazier, 1989; Sereno et al., 1992 for further studies on the contextual influence in sentence processing).

Moreover, Tsang & Chen (2013) also tested the effect of the meaning frequency on morphemic ambiguity resolution using Chinese compounds in a lexical decision task. It was a masked priming task where the meaning frequencies of both the prime and the target were manipulated. The results indicated that the dominant targets were processed faster than the subordinate ones. Furthermore, there was a different response pattern for the subordinate targets compared to the dominant ones. Only subordinate primes could facilitate the recognition of subordinate targets, but there was no such constraint in the facilitation of the dominant targets. These findings were taken as evidence for the role of meaning frequency while resolving morphemic ambiguity (see Section 2.3 for a detailed discussion of this study).

Considering the significant role of meaning frequency in morphemic ambiguity resolution, another issue was how to determine the meaning frequencies of the different meanings of a homonymous morpheme. Some researchers (e.g. Lin & Ahrens, 2010) used the total number of meanings produced by the participants for a homonymous morpheme while others (e.g. Shen & Li, 2016) provided the participants with the two meanings of the homonymous morpheme and asked them to report which meaning first came to their minds. The former method was useful to investigate whether the number of meanings that a homonymous word possessed affected the processing of these words. The latter, on the other hand, was a bit problematic because it created a bias in the participants to choose one of the two provided meanings, which might be detrimental to reflecting the real meaning frequency.

The most frequently cited method to arrive at estimates of meaning frequency is ‘free association’. In this method, the participants are asked to report the first meaning that comes to their mind when they see a homonymous morpheme in isolation. This method is accepted to be useful to determine meaning dominance because the meaning most frequently reported by the participants relative to the other secondary meanings is regarded as the dominant meaning (Gee & Harris, 2010).

Moreover, most of the meaning frequency norms for homonymous words (e.g. Nelson, McEvoy, Walling, & Wheeler, 1980) were obtained via the free association method (Rice et al., 2019). Thus, the majority of studies which examined the morphemic ambiguity and the effect of the meaning frequency on resolving this ambiguity in English and Chinese (i.e. Taft & Nguyen-Hoan, 2010; Tsang & Chen, 2010, 2013; Tsang et al., 2014) used 'free association' to estimate the relative meaning frequency of homonymous words.

In addition to the free association method, some innovative methods such as obtaining the meaning frequency estimates from movie and television subtitles were also proposed because these texts could reflect the natural language use more successfully. The meaning frequency estimates collected through this innovative method and analyzed by human raters have been claimed to be in line with the ones obtained from free association tasks and previous norming studies (Rice et al., 2019). Additionally, as opposed to the evaluation of human raters, Gee & Harris (2010) suggested asking a group of participants instead of researchers to categorize the reported first meanings of homonymous morphemes.

CHAPTER 3

METHOD

3.1. Materials and Procedure

As the first step of the material preparation procedure, 49 homonymous Turkish words were selected consulting the dictionary of the Turkish Language Association. The main criterion was to find words that have the same orthographic shape but at least two distinct meanings. For example, the word *al* could mean either 'red color' or 'to get'. Moreover, these two meanings were distinct enough not to be considered as related senses of the same word as in polysemy (Klein & Murphy, 2001; Klepousniotou & Baum, 2007). The meaning frequencies of these homonymous morphemes were determined as either dominant or subordinate. In order to decide on the dominant and the subordinate meanings of the ambiguous morphemes, a pilot task was run with 42 participants. In this task, participants were presented with the ambiguous morphemes in isolation and were asked to provide the first meaning of that morpheme which comes to their mind or the most dominant meaning. As a result, if 55 percent or more of the participants opted for a certain meaning, this meaning was regarded as the dominant meaning of the ambiguous morpheme. Based on this criterion, 3 words were excluded since different meanings of the ambiguous morpheme were nearly equally preferred. Then, two bimorphemic words for each meaning were derived from these ambiguous morphemes. One further word was excluded because the pilot task participants could not distinguish its two meanings. After the derivation process, 2 words were excluded since a sufficient number of words could not be derived from their dominant meanings. In addition to the words derived from the dominant and subordinate meanings of the ambiguous words, an opaque word combining the ambiguous morpheme with a possible pseudo-suffix and an orthographically/phonologically and semantically unrelated word were used as

baselines for each ambiguous word. For example, the word *gül* can either mean ‘rose’ or ‘to laugh’. Based on the dominance piloting results, while the former meaning was identified as the dominant one, the latter was the subordinate one. The opaque word for this ambiguous morpheme was *gülle*, which means ‘cannonball’, and it was formed with the ambiguous morpheme itself and the pseudo-suffix *-lE*. In this context, it was called a pseudo-suffix because it could not be considered as a real suffix contributing to the whole meaning of this word even though it is normally a legal suffix in Turkish. In the course of forming opaque words, 2 ambiguous words had to be excluded since no opaque words were found. Additionally, one word was excluded because its opaque form had too high a word frequency compared to the others.

Table 1. Sample Primes

Ambiguous morpheme	**Dominant Prime**	**Subordinate Prime**	**Opaque Prime**	**Unrelated Prime**
sür	sürüş	süreç	sürgü	darlık
‘to drive’ or ‘to last’	‘driving’	‘process’	‘bolt’	‘narrowness’

The remaining 40 words underwent word frequency and word length matching procedure. Word frequency measures were taken from Turkish National Corpus, Version 3.0.63. This corpus is composed of 50 million words (Aksan, Mersinli, Yaldır, & Demirhan, 2012). In this corpus, 5 experimental words of the current study had zero frequency. Since Turkish native speakers reported that these words existed in Turkish, their frequency were regarded as ‘1’ (Brysbaert & Diependaele, 2013). Then, a significant difference was found between dominant and opaque items because dominant items were long and rare whereas opaque items were short and

comparatively more frequent. Therefore, one word was eliminated each time until there was no significant difference between dominant and opaque items in terms of frequency and length. The criteria for elimination was to be short in length (4/5 letters) and less frequent in opaque list while its dominant counterpart was long (6/7 letters) and more frequent. When 8 words were eliminated, there was no significant frequency ($F(3,124)=1.421$, $p>.05$) or length difference ($F(3, 124)= 1.570$, $p>.05$) across 4 (dominant, subordinate, opaque, and unrelated) lists. These 4 lists were used as primes (see Table 1). As a result, there were 32 prime words in total in each of the four lists. Then, 32 dominant and 32 subordinate targets were formed (See Table 2). There was also no significant frequency ($t(62)=.341$, $p>.05$) or length difference ($t(62)=.842$, $p>.05$) between these 2 lists (see Table 3).

Table 2. Sample Targets

Ambiguous Morpheme	**Dominant Target**	**Subordinate Target**
sür	sürücü	süre
'to drive' or 'to last'	'driver'	'period'

There were 4 types of primes (dominant, subordinate, opaque and unrelated) and 2 types of targets (dominant and subordinate). So as to exhaust all prime and target types, 8 experimental lists with 8 conditions (DD: dominant prime-dominant target, DS: dominant prime-subordinate target, SD: subordinate prime-dominant target, SS: subordinate prime-subordinate target, OD: opaque prime-dominant target, OS: opaque prime-subordinate target, UD: unrelated prime-dominant target US: unrelated prime-subordinate target) were prepared. In each list, there were 8 primes from each prime

type and 16 targets from each target type. Each participant saw each target only once, and each target was preceded by each prime only once. Each participant saw each prime-target pair (e.g., yansız 'unbiased'-YANIK 'burnt') in each condition (e.g., DS) only once. In each list, there were 24 related prime-target pairs, and 8 unrelated prime-target pairs. Thus, 16 fillers bearing orthographically/phonologically and semantically unrelated prime-target relationship were added to have a balance between semantically related and unrelated pairs. Filler primes were 16 legal words formed with different inflectional suffixes whereas filler targets were 16 legal words formed with derivational suffixes that were not used before in any other list. Because there were 48 word trials, 48 non-word trials were added to keep the number of required 'yes' and 'no' responses equal. Non-word primes were 48 legal words formed with derivational suffixes that were not used before as in the case of filler targets. For the 48 non-word targets, first non-words were generated by using the Wuggy Turkish Plugin (Erten, Bozsahin, & Zeyrek, 2014) compatible with the phonotactic constraints of Turkish. Then, legal derivational suffixes that were not used before were added to these non-words in order to form non-word targets. These suffixes were added because all of the word targets in the experiment were bimorphemic. In half of the non-word trials, primes and targets shared 3 or 4 letters because the half of the prime-target pairs shared their stems, which are also between 3-4 letters long, in word trials. Both fillers and non-words were close to other lists in terms of length.

Prime-target pairs were placed into the 8 lists by using Latin Square design. The order of the items was not random to avoid repeated appearance of the same type of items. In each list, there were 96 items (see Appendix A for full item list) and 12 practice trials. In the practice part, 6 items were words while the rest was non-words to familiarize the participants with the procedure. The stimulus onset asynchrony was 50 milliseconds. The task was an online masked priming lexical decision task in which participants were instructed to decide whether the letter groups they saw on the computer screen was a word in Turkish or not as fast and accurate as possible.

Table 3. Mean Frequency & Length Values for Each List

List	Mean Frequency (N=32)	Mean Length (N=32)
Dominant Prime	4,82	5,19
Subordinate Prime	11,05	5
Opaque Prime	11,15	4,88
Unrelated Prime	6,79	5,19
Dominant Target	18,05	5,06
Subordinate Target	33,90	5,13

**Frequency counts are out of 1 million.*

For presenting the stimuli and gathering accuracy and reaction time measures, E-prime 2.0.10.356 was used (Schneider, Eschman, & Zuccolotto, 2012). The experiment started with a blank screen for 500 ms. This blank screen was replaced with the mask that contained the same number of hashtags as the length of each prime for 500 ms. After the mask, the prime was presented for 50 ms. Finally, the target was presented and the participants were expected to indicate their decisions by pressing the specified buttons on a Logitech gamepad. The target remained on the screen until a response was made or for a maximum of 2000 ms. While the primes were in lowercase, the targets were in uppercase. All the items were in white on a black background.

The participants were tested in a quiet room. First, they signed an informed consent form and filled in a background questionnaire (see Appendix B). Then, they participated in the online masked priming lexical decision task, which took approximately 8-10 minutes. After the experiment, they were provided with an off-line form in which they were given a list of words and asked which ones they saw in the online experiment. The lists were composed of both words having appeared in the experiment and ones that had not. This was to ensure that they were not consciously aware of the primes.

Before the main experiment started, 8 participants different from the ones of dominance piloting task and the main experiment participated in the study for piloting in order to detect potential problems in advance. After ensuring that no problem was detected, the data collection for the main experiment began.

3.2. Participants

56 native speakers of Turkish (41 females), all students at Middle East Technical University in Ankara, participated in this study on a voluntary basis. The mean age of the participants was 22,14 (SD: 3,47). All had normal or corrected-to-normal vision. They were naïve with regard to the aim of the experiment. All participants used their dominant hand to respond to the stimuli. The participants who took part in the main experiment were different from the ones in the dominance piloting task and the pilot version of the main experiment. This thesis was approved by Human Subjects Ethics Committee of METU (see Appendix C).

3.3. Data Analysis

The dependent variables in this study were *accuracy* and *response time* (RT), whereas there were 2 independent variables which were *prime type* and *target type*. There were 4 levels (dominant, subordinate, opaque, and unrelated) of prime type while target type was measured at 2 levels (dominant and subordinate). Before the data analysis, incorrect responses and skipped trials were excluded. Since the RT data was negatively skewed, a log-transformation was used to normalize the data. Moreover, extreme RTs, which were defined as values of 2 standard deviations above a participant's mean RT per condition, were excluded. The total data loss was 9 %. 1 participant were not included in the eventual analysis because of the extremely slow RTs, with a mean RT ranging from 926 ms to 1207 ms across eight conditions (compared to the overall mean RT ranging from 639 ms to 675 ms). Similarly, five items (*dallı, mali, malca, oydaş, salgı*) were excluded since they were found to show deviant RTs (i.e. 1004 ms, 957 ms, 1165 ms, 1012 ms, 487 ms respectively) considering the rest of the sample (i.e. overall mean RTs for the relevant conditions

respectively: 650 ms, 655 ms, 644 ms, 661 ms, 631 ms). Three items (*dalış, oyuntu, salcı*) also had to be excluded because they shared the same stem with the previously discarded items.

For the F_1 (i.e. by participants) analysis, there were two within-subject variables, prime type (4 levels) and target type (2 levels). For the F_2 (i.e. by items) analysis, there was one within-subject, prime type (4 levels) and one between-subjects variable, target type. Both RT and accuracy data were submitted to repeated measures analyses of variance (i.e. ANOVA).

CHAPTER 4

RESULTS

4.1. RT Analysis

The descriptive statistics are presented in Table 4. Table 4 shows that in the case of dominant targets, dominant, subordinate and opaque primes induced comparable RTs. However, these RTs were shorter than the unrelated prime. For subordinate targets, on the other hand, the mean RT in the subordinate prime condition was shorter than in the dominant, opaque and unrelated primes.

Table 4. Mean Reaction Times (in ms), Standard Deviations (in parentheses) & Error Rates (in %)

	Dominant Prime		**Subordinate Prime**		**Opaque Prime**		**Unrelated Prime**	
	RT	Error	RT	Error	RT	Error	RT	Error
Dominant Target	637 (104)	5,4	639 (107)	2,7	630 (92)	4	653 (113)	6,7
Subordinate Target	628 (101)	4,5	623 (106)	3,1	632 (109)	3,6	630 (106)	2,7

Repeated measures ANOVAs on the response time data with the factors prime type (dominant, subordinate, opaque, unrelated) and target type (dominant, subordinate) did not reveal a significant main effect of prime type (F_1 (1, 162) = .716, p=.544; F_2 (1, 162) = .271, p=.846) or target type (F_1 (1, 54) = 3.082, p=.085; F_2 (1,

54) = 2.247, p=.140). Moreover, there was no significant interaction between the prime type and target type (F_1 (1, 162) = .758, p=.519; F_2 (1, 162) = .710, p=.547).

4.2. Error Analysis

Error rates (in percent) are presented in Table 4. Repeated measures ANOVAs on the accuracy data with the factors prime type (dominant, subordinate, opaque, unrelated) and target type (dominant, subordinate) were conducted. There was no significant main effect of prime type (F_1 (1, 165) = .735, p=.533; F_2 (3, 186) = 1.258, p=.290) or target type (F_1 (1, 55) = 3.060, p=.086; F_2 (1, 62) = .390, p=.534). Furthermore, no significant interaction between the prime type and target type was found (F_1 (1, 165) = 1.219, p=.305; F_2 (3, 186) = 1.409, p=.242).

CHAPTER 5

DISCUSSION AND CONCLUSION

The present study investigated the processing of ambiguous morphemes in Turkish using homonymous words ambiguous at the morphemic level in a masked priming experiment. One of the aims was to test whether the lemma model, which was claimed to be able to account for the processing of ambiguous morphemes in English and Chinese (Taft & Nguyen-Hoan, 2010; Tsang & Chen, 2013), could explain the processing of such morphemes in Turkish. The other aim was to test whether the under-studied meaning frequency effect, shown to affect morphemic ambiguity resolution in earlier studies (Taft & Nguyen-Hoan, 2010; Tsang & Chen, 2010, 2013; Tsang, Wong, Huang, & Chen, 2014), would modulate the processing of ambiguous morphemes in Turkish. The meaning frequencies of both the primes and the targets were therefore taken into account in the study.

The results of the present study did not show morpho-semantic priming. Namely, conditions where the prime and the target shared the same meaning (i.e. dominant prime-dominant target and subordinate prime-subordinate target conditions) did not induce a stronger facilitation. Moreover, there was no significant effect of the meaning frequency on the morphemic ambiguity either. In other words, there was no significant processing difference between the dominant and subordinate targets.

5.1. The Contribution of Morpho-Orthographic vs. Morpho-Semantic Information

In the literature, the contribution of morpho-orthographic and morpho-semantic information to morphological processing has been hotly debated. In both ‘morpho-orthographic’ and ‘morpho-semantic’ accounts, the question has been

whether equal facilitation could be obtained from semantically transparent (*worker-work*) and semantically opaque (*brother-broth*) pairs, and whether this facilitation is higher than the form (*brothel-broth*) pairs. Studies supporting the morpho-orthographic account have been conducted in various languages such as English (Beyersmann et al., 2016; Marslen-Wilson et al., 2008; Rastle et al., 2004), French (Longtin et al., 2003), Russian (Kazanina et al., 2008), and Dutch (Diependaele et al., 2009).

All of these studies have indicated an equal facilitation for semantically transparent and opaque pairs, and this facilitation has been found to be stronger than form pairs. In the present study, on the other hand, there were two semantically transparent conditions, one of which was dominant prime while the other was the subordinate prime condition. There was also an opaque prime condition. The RT difference between the transparent conditions (dominant and subordinate prime) and the unrelated baseline was not statistically significant. Similarly, the RT difference between the opaque condition and the unrelated baseline did not turn out to be significant. Namely, neither the semantically transparent nor the opaque pairs induced priming. However, when the descriptive results for the dominant target condition were scrutinized, the priming effect for the transparent prime conditions was approximately 15 ms whereas it was 23 ms for the opaque prime condition. The existence of a similar amount of priming effect both for the transparent and opaque pairs and the absence of a significant difference between these two priming effects advocated what was found in different previously tested languages. In fact, it might be regarded as support for morpho-orthographic segmentation for dominant targets in Turkish. However, it is crucial to keep in mind that in all of the previous studies a form condition was used to ensure that the priming obtained was not an end-result of only orthographic overlap (*brothel-broth*) but instead a morpho-orthographic phenomenon (*brother-broth* or *worker-work*). In the present study, on the other hand, there was no form condition, which does not enable a direct comparison between the former studies focusing on the contribution of morpho-orthographic information and the present study.

Moreover, when the findings obtained for the dominant and subordinate targets in the present study were evaluated together, it in a way provided support for the claim of Heyer & Kornishova (2018). Heyer & Kornishova (2018) suggested that at short SOAs (33-39 ms) only the contribution of morpho-orthographic information could be detected, but the contribution of morpho-semantic information emerged at longer SOAs (67-77 ms). In the subordinate target condition of the present study, the transparent and opaque distinction was not apparent as in the case of dominant targets, but instead only the subordinate prime condition caused a small (7 ms) non-significant priming effect. This processing difference between the dominant and subordinate targets may be interpreted as the emergence of the contribution of morpho-semantic information. This difference might be an indication of the onset of accessing morphemic meaning because the SOA used in the present study was 50 ms, which was longer than the short SOAs and shorter than the long SOAs tested in the study of Heyer & Kornishova (2018).

The contribution of morpho-semantic information is regarded as intact if the amount of facilitation obtained for transparent and opaque pairs is not equal, but instead transparent pairs induced more facilitation than the opaque and form pairs (Diependaele et al., 2011; Feldman et al., 2009; Morris et al., 2007 among others). In contrast to the findings of earlier studies, only the morpho-orthographic information seems to contribute to the processing of the dominant targets in the present study. Even though the results did not reach statistical significance, transparent (dominant and subordinate prime conditions) and opaque conditions showed similar amounts of priming, which might be taken as counter-evidence against the contribution of morpho-semantics. On the other hand, the situation changes when the pattern for subordinate targets is considered. The different processing pattern for the subordinate targets compared to the dominant ones may indicate that the processor decomposes a lexically unambiguous word into its constituent morphemes and the morphemic ambiguity (namely the fact that the stem morpheme has two meanings) affects the processing based on meaning frequency (dominant vs. subordinate). This pattern

might provide a way to reconcile the present findings with the ones found regarding morpho-semantic contribution.

5.2. Lemma Level Representation and The Effect of Meaning Frequency

Taft & Nguyen-Hoan (2010) showed that presenting a word derived from one meaning of an ambiguous word as the prime could cause the participants to report the meaning related to the prime when they see the ambiguous word itself as the target. A direct comparison with the present study was not possible because of task differences. Moreover, another difference preventing such a direct comparison is the fact that Taft & Nguyen-Hoan (2010)did not manipulate the meaning frequency of the ambiguous morphemes as the present study did. However, the previous study provided support for the lemma level in English, which could be used to compare English with other languages.

The results of the present study might be considered as comparable to was found by Badecker & Allen (2002). Badecker & Allen (2002) found that stem homographs were processed faster than an unrelated and orthographic baseline. Even though this was statistically not the case in the present study, for the dominant targets, the dominant and subordinate prime conditions were processed nearly 15 ms faster than the unrelated baseline. However, it may be plausible to keep in mind that there was no orthographic baseline in the present study.

Additionally, Xu & Taft (2014) suggested that facilitation would occur when the prime and target were derived from the same meaning. This is similar to the present findings. When the descriptive statistics were scrutinized, the facilitation for the dominant prime-dominant target condition was 16 ms whereas it was 7 ms for the subordinate prime-subordinate target condition. Moreover, Xu & Taft (2014) obtained inhibition in the subordinate prime-dominant target condition because it was hard to suppress the dominant meaning. However, no inhibition was obtained in the present study for this condition. In contrast to the subordinate prime-dominant target condition, Xu & Taft (2014) found no inhibition for the dominant prime-subordinate

target condition as no need for suppression remained. Likewise, there was no inhibition in the present study for the dominant prime-subordinate target condition.

There were two predictions formulated in the present study based on the lemma model suggested by Taft & Nguyen-Hoan (2010) and the slightly changed lemma model proposed by Tsang & Chen (2013). First, morpho-semantic priming was predicted to occur. In other words, significantly greater priming was expected when the prime and the target were derived from the same meaning irrespective of meaning dominance. Secondly, due to the effect of meaning frequency, dominant, subordinate and opaque primes were all predicted to facilitate the processing of the dominant target. However, the recognition of the subordinate targets was only expected to be facilitated by the subordinate primes because it would be hard for other prime types to override the effect of the dominant meaning and facilitate the recognition of the subordinate target.

In the present study, no morpho-semantic priming was found, and there was no significant effect of meaning frequency. These findings are in contrast with the results of studies on Chinese (e.g. Tsang & Chen, 2013; Tsang et al., 2014), In which a morpho-semantic priming effect and an effect of meaning frequency were reported. Moreover, the presence of these effects led the researchers to seek an intermediate level of representation (i.e. the lemma level) because the other two levels (i.e. form and meaning levels) of representation were not sufficiently explanatory. It was claimed that the processing difference between the dominant and subordinate targets could not be due to the form level as these targets had the same form. Moreover, this difference could not be attributed to the meaning level either since both the dominant and the subordinate targets were unambiguous at the whole-word level. Thus, an intermediate level where the morphemic meanings were accessed and the frequency of these meanings mattered was required. However, the absence of morpho-semantic priming and meaning frequency effect in Turkish cast doubt on the need for such an intermediate level of representation.

The absence of the morpho-semantic priming could be attributed to the cross-linguistic differences between Chinese and Turkish. For instance, Tsang & Chen (2013) underlined the fact that the character-based nature and the use of spaces between morpheme boundaries in Chinese might ease morphological segmentation and accelerate form level processing. This, in turn, might have caused the initiation of the morpho-semantic processing quite rapidly (i.e. in 40 ms) for Chinese. Turkish, on the other hand, has agglutinative morphology, and morpheme boundaries are not marked by spaces. Instead, a more thorough morpho-orthographic segmentation procedure is required to determine the morpheme boundaries. Therefore, the onset of morpho-semantic processing in Turkish might not be as quick as in Chinese. A 50 ms SOA was used in the present study, and this SOA may be the time period in which the contribution of the morpho-semantics was not fully in effect but just started to unfold. There is also cross-modal priming evidence for the late start of morpho-semantic processing coming from studies with long SOAs (i.e. 100 ms) in purely morphological languages such as Arabic (e.g. Boudelaa & Marslen-Wilson, 2001). Moreover, Zargar & Witzel (2017) similarly claimed that rich morphology of Basque language could bring more cognitive burden on the speakers for morpho-orthographic segmentation. Thus, the later start of the morpho-semantic processing in Turkish compared to Chinese might not be a far-fetched idea.

Furthermore, the lack of morpho-semantic priming in Turkish might be explained by referring to Andrews & Lo (2013), who pointed out that for participants in their 'semantic profile' group (i.e. participants with greater vocabulary scores), the start of morpho-semantic processing was quicker than for participants in the 'orthographic profile' (i.e. greater spelling scores). Depending on the empirical evidence showing that individual differences among speakers of a certain language can modulate the way of processing, these individual differences could be valid for the speakers of different languages. For example, Chinese speakers may predominantly be closer to the semantic profile and morpho-semantic processing might emerge more swiftly since no intricate morpho-orthographic processing is required in Chinese. On the other hand, Turkish speakers might be closer to the orthographic profile because a

more intricate morpho-orthographic processing may slow down the initiation of the morpho-semantic processing.

In addition to the lack of the morpho-semantic priming, no significant effect of meaning frequency was observed in the present study. In spite of the non-significance, the reaction times nevertheless showed a trend similar to what was reported by Tsang & Chen (2013). In the case of dominant targets, the reaction times obtained from the dominant, subordinate and opaque primes were quite similar to one another, and approximately 15 ms faster than the unrelated primes (Table 4). For the subordinate targets, on the other hand, the reaction times for the dominant and opaque primes were similar to the unrelated primes; however, the subordinate primes were 7 ms faster than the unrelated primes. Hence, the trend seems to be in the expected direction in terms of the meaning frequency effect. Based on this trend, when separately considered, the pattern found for the dominant targets seemed to support morpho-orthographic segmentation because all morpheme-sharing conditions (i.e. dominant, subordinate, opaque prime) were processed faster than the unrelated prime condition. The fact that the opaque prime condition induced similar RTs to the ones in the dominant and subordinate prime conditions indicated that the processor decomposed everything that looked like an affix (i.e. *yanak*, *yan*, *-ak*) into its constituents. However, this pattern was different for the subordinate targets because subordinate primes were the fastest. Therefore, considering the trend in the data, the lemma level of representation still seems to have the potential to explain the processing difference between the dominant and the subordinate targets because this level could be accepted as the level where dominant and subordinate meanings activate separate lemmas and where the effect of the meaning frequency matters.

Additionally, the non-significant facilitation for opaque items could also be explained with the slightly changed lemma model suggested by Tsang & Chen (2013). In this model, the priming for '*corner-corn*' pairs was claimed to come from the activation of the same lemma twice. With the help of morpho-orthographic segmentation, the processor decomposed the *corner* into its morphemes. As a result of

the meaning frequency, the dominant meaning for *corn,* which is cereal, was activated. Since the target was also *corn*, it was activated twice. The findings of the present study may support this claim. When the orthographic prime such as *yanak* was presented, it might be decomposed into its constituent morphemes, and the lemma for 'side' meaning of *yan* was activated since it was the dominant meaning. Furthermore, when this prime was presented with a dominant target such as *yanlı*, the same lemma was activated twice causing a 23 ms facilitation compared to the unrelated baseline. However, when the same orthographic prime was presented with a subordinate target such as *yanık*, different lemmas ('side' lemma for the orthographic prime but 'burn' lemma for the subordinate target) were activated, which in turn caused 2 ms inhibition against the unrelated baseline.

At this point, one of the key issues that needs to be highlighted is the power of the statistical findings in the present study. Statistical power is defined as a test's ability to detect an effect. The power of a test entails the probability of a test's reaching an effect if there is one. .8 or 80% power is frequently what is desired because this per cent indicates that the chance of reaching an effect is 80% if there is one (Field, 2013). In the present study, the statistical power of the main effect of the prime and target types and the interaction between these factors in the participant analysis was 20%, 40%, and 21%, respectively. In other words, the likelihood of obtaining a significant effect was 20 to 40% at most with the number of participants tested in the present study. This likelihood was even lower (i.e. 10-30%) in the item analysis. Since statistical power was low, the probability of committing a Type II error (i.e. claiming that there is no effect when there is one) was actually high. Therefore, the absence of morpho-semantic priming and of the meaning frequency effect could be attributed to low statistical power. This lack in statistical power should be taken into account when analyzing the results, which means that the trend in the RT data may not be trivial; on the contrary, the trend looks promising since it could have reached significance if the sample size for items and participants had been larger. Furthermore, in the literature, it has been stated that the lack of significance should not be regarded as a strong evidence for the null hypotheses. Thus, the power calculations and effect sizes should

also be reported for the correct interpretation of the null results (Aczel et al., 2018; Schumm, 2012). In addition to the low power values in the present study, the effect sizes were even lower than 0.2, which is a small effect size. In other words, neither power calculations nor effect sizes provided compelling support for the null result. Therefore, it would be more plausible to attribute the null result in the present study to the lack of statistical power and insufficient effect size.

Despite the existence of a non-trivial trend, the findings of the present study constitute a 'null result' as they stand. In other words, the null hypotheses claiming the non-existence of the morpho-semantic priming and the meaning frequency effect could not be refuted. In the relevant literature, null results are claimed to face publication bias (i.e. they are less preferred for publication compared to significant results) (Shields, 2000), and this bias results from the nature of null hypothesis significance testing practices, which makes hard to interpret such null results (Lakens, Mclatchie, Isager, Scheel, & Dienes, 2018). Moreover, the bias against null results has been reported to lead to questionable research practices such as manipulations regarding the data or the analyses fostering the attainment of the 'desired' results. The aversion to the null results is claimed to be more frequent in fields where a small community of researchers has a strong faith in a specific model or theory and does not want any findings to prove the contrary (Nikiforakis & Slonim, 2015).

However, the publishers' unwillingness to publish null results does not seem to be the only cause of not seeing null results in any journal. Instead, individual researchers have been reported to be unwilling to send out the null results that they found to journals for publication because they either believe that the chances of publishing are low, and there is no need for doing additional analyses, elaborating on the study etc. or they are hesitant about contradicting with the existing models or theories(Ferguson & Heene, 2012; Franco, Malhotra, & Simonovits, 2014). For example, the results of a study investigating 221 published and unpublished studies presented that the likelihood of publication for significant results was 40% more than for null results. This definitely creates a disadvantage for null results. However, there

is another statistics showing that 65% of the null results were never attempted by the researchers to be turned into any publication (Franco et al., 2014).

Due to the unwillingness to report null results, Rosenthal (1979) claims that most of the journals are comprised of 5% of the studies indicating Type I error (claiming that there is an effect when there is none). The rest 95% of the studies that reached at a non-significant result, on the other hand, are kept in file drawers. This is called the 'file drawer problem'. It underlines the fact that published significant results might be indicating a selective reporting practice (reporting only significant results) instead of capturing a true effect. The null results that could be informative, on the other hand, are not publicly shared unlike the significant results. Other than not reporting null results, another problem might be to put not the whole study but some parts of it showing the null result in the file drawer (Simonsohn, Nelson, & Simmons, 2014). The aversion to the null results may also cause another questionable practice, which is 'HARKing'. This term is used to describe a situation in which the researchers introduce a post-hoc explanation that they attained after analyzing the data as if this was their previously suggested hypothesis at the beginning of their study (Kerr, 1998).

The file drawer problem together with HARKing and the failures to replicate previously conducted studies or their results caused many questions and concerns in terms of the reliability, reproducibility, and transparency of scientific inquiries. These questions and concerns led to the development of open science methods. These methods aim to provide some ways for the researchers in order to conduct open, reproducible and transparent research practices. In this regard, pre-registration of studies and analysis plans, transparently sharing the research methodology and research materials, promoting replications, and changing the publishing formats using preprints, open publishing, and registered reports can be listed among many others. All of these methods have a potential to encourage the reporting of null results. Presenting null results on a specific phenomenon as well as significant results could cause a more accurate assessment of the evidence for this phenomenon. Indeed, it is stated that null results might be informative as long as the study has a meticulous

design and sufficient statistical power. Considering the fact that the per cent of the studies showing a null result and kept in file drawers is 95, null results bear the potential to reflect the scientific practice more truly (Allen & Mehler, 2019; Button et al., 2013; Nosek et al., 2015). All in all, not hiding null results in file drawers but reporting them instead could promote open, transparent, and reproducible science (Franco et al., 2014). Against this background, in the present study the null results were reported 'as is' together with power calculations and effect size estimates.

The results of the present study are in their present form conducive to further questions (meaning frequency as a dichotomous vs. scalar construct and methods to determine meaning frequency), which would probably never be asked if significant findings had been obtained. Landis, James, Lance, Pierce, & Rogelberg (2014) suggested that although null results are usually easily discarded by researchers, they could be a trigger to think about questions worthy of attention. Moreover, they could provide some space for a more thorough evaluation of the theory based on which the research hypotheses were formulated, and in this way, a null result might turn into something meaningful that informs science in general.

In this regard, the first point to be questioned in the present study is the understanding of 'meaning frequency' as a dichotomous phenomenon (i.e. dominant vs. subordinate). Nearly all earlier studies focusing on meaning frequency, including the present study, classified their experimental items as derived from the dominant meaning or the subordinate meaning, disregarding the amount of dominance as long as a certain percentage of the participants (e.g. 60%) reported a specific meaning. However, evaluating meaning frequency as a *scalar* construct would be more natural. A similar point has recently been made for another variable frequently manipulated in the literature to test the contribution of morpho-semantic information, semantic transparency. Semantic transparency is also regarded as a dichotomous variable (transparent vs. opaque) in the majority of relevant studies. However, Heyer & Kornishova (2018) have underlined the fact that this dichotomy does not reflect the true nature of transparency, but constitutes instead an artificial grouping, which could

potentially turn into a confound. Heyer & Kornishova (2018) therefore used items with varying degrees of transparency, and regarded transparency as a scale (ranging from more transparent to more opaque). In the end, the obtained effects for more transparent or more opaque items presented a more accurate picture of the effect of semantic transparency without any confounds. Likewise, applying the same logic to meaning frequency, placing the different meanings of an ambiguous morpheme on a meaning frequency scale which ranges from more dominant to more subordinate meanings bears the potential to solve the inconsistency between the significant results in Chinese and the null result in Turkish.

The second question which emerged from the obtained null result related to the methods used to determine the relative meaning frequencies. The method that has been repeatedly used in the literature and in the present study is 'free association'. In free association, the participants are asked to report the first meaning that comes to their mind when they see an ambiguous word. Then, a meaning is regarded as the dominant meaning when a certain percentage (i.e. 55%) of participants reported it as the first meaning that comes to mind. This method is useful to create a dichotomy (i.e. dominant or subordinate) for meaning frequency, but it comes with its limitations. In this method, any meaning other than the first meaning that comes to mind is grouped as a subordinate meaning. Yet, how frequent this meaning is, how this frequency varies or whether there was more than one subordinate meaning is not taken into account. These factors, in turn, might have contributed to the absence of a meaning frequency effect in Turkish.

In conclusion, focusing on morphemic ambiguity in derived homonymous words in Turkish, the present study investigated whether the processing of these words could be explained by the lemma model as done in earlier studies for English and Chinese, and whether meaning frequency effect modulated the processing of such words. No significant morpho-semantic priming effect was observed, and the effect of the meaning frequency was non-significant. This could be interpreted as the lack of a need for the lemma level representation. However, the observed trends in the data were

promising. The different pattern of processing for the dominant (i.e. dominant, subordinate, and opaque primes faster than the unrelated prime) and subordinate targets (i.e. only subordinate prime was faster than the unrelated prime) underlined the need for a lemma level where different meanings of an ambiguous morpheme were activated and the meaning frequency played a role. Although this was a null result, it was indicated that this could be attributed to the low observed power and small effect size. Therefore, the trend in the data should not be underestimated. Additionally, obtaining a null result led to some crucial questions that would probably not have emerged otherwise, such as problems related to the dichotomous understanding of meaning frequency or the ways in which meaning frequency was determined, which could provide valuable contribution to the way morphemic ambiguity resolution is approached.

CHAPTER 6

LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

The present study has some limitations that could be informative for the future studies on morphemic ambiguity. First, one specific SOA (i.e. 50 ms) was used in this study, and the discussion on whether the initiation of the morpho-semantic processing was slower in Turkish compared to Chinese had to be confined to a certain SOA. Thus, using different SOAs, especially SOAs above 50 ms, will be meaningful to understand exactly in which time window morpho-semantic processing begins to show its effect in Turkish. Moreover, the present study focused on derived words whereas the Chinese studies were based on compounding. Whether this difference could have an effect remains to be examined by future studies. Furthermore, considering the low power and the non-trivial trend in the RT data, increasing the sample size both for participants and items will increase the statistical power and help to draw more firm conclusions from the data. Additionally, meaning frequency was regarded as a dichotomous variable in this study. Yet, it might be understood and used as a scale to reflect its true nature as in the case of semantic transparency. In this regard, ambiguous items having various degrees of the meaning frequency (i.e. more dominant, less dominant etc.) may be tested. Lastly, the method of 'free association' was used in the present study; however, a method focusing on the frequency of the subordinate meaning or how many subordinate meanings exist might be used in combination with a meaning frequency scale in the future studies.

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APPENDICES

A. FULL ITEM LIST

Dominant Target	Subordinate Target	Dominant Prime	Subordinate Prime	Opaque Prime	Unrelated Prime
bağlık	bağlı	bağcı	bağcık	bağış	kaygan
salcı	salgı	sallı	salma	salça	kısık
geçkin	geçiş	geçik	geçit	geçim	hisli
sağcı	sağma	sağlı	sağım	sağır	gergin
allık	alım	allı	algı	alim	kopuş
kırsal	kırgın	kırlık	kırıcı	kırat	söylem
yanlı	yanık	yansız	yanıcı	yanak	sergi
sürücü	süre	sürüş	süreç	sürgü	darlık
tezli	tezlik	tezsiz	tezce	tezek	bulgu
mali	malca	malen	mallık	malul	küskün
anlık	anma	ani	anıt	antik	kuşçu
yüzlü	yüzgeç	yüzsüz	yüzücü	yüzük	dolgu
güllü	gülüş	gülcü	güleç	gülle	eskici
ekli	ekici	eksiz	ekin	eksi	sezgi
diklik	dikiş	dikey	dikit	dikiz	muzlu
yenik	yensiz	yenme	yenli	yengeç	otçul
dallı	dalış	dalsı	dalgıç	dalak	suskun
eşli	eşlik	eşsiz	eşit	eşik	askı
dini	dingin	dinsel	dinme	dingil	yapıcı
düşsel	düşkün	düşsüz	düşey	düşman	silik
katlı	katık	katsız	katkı	katır	uysal
yaylı	yayıcı	yaylan	yayık	yayla	sorgu
soylu	soyma	soysuz	soygun	soyut	dişçi
aşçı	aşım	aşlı	aşama	aşık	sövgü
oydaş	oyuntu	oyla	oyuk	oya	acısız
akça	akıcı	aklık	akış	akut	ipli
kızlık	kızma	kızsal	kızış	kızak	üçlü
atlı	atık	atçı	atış	atik	esin
kanlı	kanıt	kansız	kanış	kancık	sütçü
taşlık	taşma	taşlı	taşım	taşıt	vurgun
saçlı	saçık	saçsız	saçış	saçak	balcı
düzlük	düzenek	düzce	düzme	düzey	falcı

B. LANGUAGE BACKGROUND QUESTIONNAIRE

Kişisel Bilgiler		**Kod:**	
Adı:	Soyadı:		Bugünün Tarihi:
Doğum Tarihi/Yeri:		Kadın ( )	Erkek ( )
Bölüm:		E-posta:	
Mezun olduğunuz lise türü nedir? (*Örn: Anadolu Öğretmen Lisesi*)			

Hangi dil(ler)i, hangi sırayla öğrendiniz? (ana diliniz dahil)

Dil	Hangi yaştan itibaren?	Ne kadar süreyle?	Öğrendiğiniz yer? (evde, okulda vb.) (lütfen belirtiniz)
1.			
2.			
3.			

Türkiye dışında bir ülkede yaşadınız mı?	Hangi yaştan itibaren?	Ne kadar süreyle?	Hangi sebeplerden dolayı? (okul, çalışma vb.)
1.			
2.			

İngilizce Yeterlik Öz Değerlendirmesi

Lütfen aşağıdaki soruları cevaplayınız:

1) Nasıl değerlendirirsin…	**çok zayıf**								**çok iyi**
… genel İngilizce yeterliğini?	1	2	3	4	5	6	7	8	9
… İngilizce konuşma becerini?	1	2	3	4	5	6	7	8	9
… İngilizce dinlediğini anlama becerini?	1	2	3	4	5	6	7	8	9
… İngilizce yazma becerini?	1	2	3	4	5	6	7	8	9
… İngilizce okuma becerini?	1	2	3	4	5	6	7	8	9
	oldukça rahatsız								**oldukça rahat**
2) İngilizceyi anlama ve kullanmada kendinizi ne kadar rahat hissediyorsunuz?	1	2	3	4	5	6	7	8	9
3) Hangi yaştan itibaren kendinizi İngilizceyi kullanmada rahat hissetmeye başladınız?									

C. APPROVAL OF METU HUMAN SUBJECTS ETHICS COMMITTEE

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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08 OCAK 2019

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Doç.Dr. Bilal KIRKICI

Danışmanlığını yaptığınız Esra ATAMAN'ın **"'Türkçede Anlam Belirsizliği Barındıran Biçimbirimlerin İşlemlenmesi'"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2018-EGT-170** protokol numarası ile araştırma yapması onaylanmıştır.

Saygılarımla bilgilerinize sunarım.

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D. TURKISH SUMMARY/ TÜRKÇE ÖZET

Çalışmanın Arka Planı

Zihinsel sözlüğün ne şekilde organize edildiği ve sözlüksel erişim için hangi tür mekanizmalar kullanıldığı ruh dilbilim alanında temel sorulardır. Bu bağlamda, biçimbilimsel açıdan karmaşık yapıdaki sözcükler ilgi odağı olmuştur. Bu sözcükler birden fazla biçimbirim içerdiğinden zihinsel sözlükte bütünsel olarak mı yoksa ayrıştırılarak mı tutuldukları ya da zihinsel sözlükten hangi şekilde çağrıldıklarını araştırmak için uygun materyal olarak kabul görmektedir (Kazanina et al., 2008).

Bazı çalışmalar biçimbilimsel olarak karmaşık yapıdaki sözcüklerin bütünsel olarak saklandığını desteklerken (Bybee, 1995), diğer çalışmalar biçimbilimsel ayrıştırmayı savunmuştur (Taft, 1979; Taft & Forster, 1975). Bütünsel saklama görüşü karmaşık sözcüklerin biçimbirimlerine ayrıştırılmaksızın bütün olarak işlemlendiğini öne sürerken (Wilson et al., 1994), biçimbilimsel ayrıştırma görüşü ise karmaşık sözcüklerin farklı biçimbirim parçaları halinde depolandığını iddia eder (Kazanina vd., 2008). Örneğin, işlemleyen İngilizcede karmaşık yapıdaki *worker* (çalışan) sözcüğüne erişebilmek için bu sözcüğü *work* ve *-er* şeklinde biçimbirimlerine ayırmak durumundadır. Bu sebeple bu görüşte biçimbirim (morfem) en küçük işlevsel birim olarak tanımlanmakta ve karmaşık sözcüklerin anlamına ulaşmada temel yapı taşı olarak görülmektedir (Rastle et al., 2004). Biçimbilimsel ayrıştırma görüşünü destekleyen kanıtlar sözcük sıklığı çalışmalarının ve hazırlama deneylerinin sonuçlarına dayanmaktadır. Örneğin, karmaşık sözcüğün türetildiği kökün sıklığının bu sözcüklerin işlemlenmesini etkileyebildiği bulunmuştur (Bertram et al., 2000).

Biçimbilimsel hazırlama deneylerinde katılımcılara iki sözcük art arda sunulmaktadır. İlk sözcük hazırlayıcı iken ikinci sözcük hedef sözcük olarak gösterilir.

Hazırlayıcı sözcük hedef sözcük ile biçimbilimsel olarak ilişkilidir (türetilmiş sözcük ve bu sözcüğün kökü gibi) ve hazırlayıcı sözcüğün hedef sözcüğün işlemlenmesi üzerinde bir etkisi olup olmadığı biçimbilimsel olarak ilintisiz bir temel çizgisi (İng., baseline) durumuyla karşılaştırılarak incelenir. Bu bağlamda, karmaşık yapıda bir sözcüğün (*employer*, iş veren) hazırlayıcı sözcük, aynı sözcüğün kökünün (*employ*, iş vermek) ise hedef sözcük olarak kullanıldığı deneylerde hazırlayıcı sözcüğün hedef sözcüğün işlemlenmesini biçimbilimsel olarak ilintisiz (*addition*, ekleme) duruma oranla hızlandırdığı sonucuna ulaşılmıştır (Rastle vd., 2004). Bu sonuç da karmaşık sözcüklerin işlemlenmesi esnasında bu sözcüklerin biçimbirimlerine ayrıştırıldıkları savını desteklemiştir (Taft, 1979; Taft & Forster, 1975).

Fakat hala cevap bekleyen bir diğer soru biçimbilimsel ayrıştırmanın yalnızca anlamsal olarak şeffaf (İng., semantically transparent) sözcükler (*worker*, çalışan) için mi geçerli olduğu yoksa aynı zamanda anlamsal olarak geçirimsiz (opaque) sözcüklere (*corner*, köşe) de genellenip genellenemeyeceğidir. Anlamsal olarak şeffaf karmaşık sözcüklerin anlamları kendilerini oluşturan biçimbirimlerin (*work* ve *-er*) anlamından çıkarılabilirken, geçirimsiz yapıdaki sözcüklerin anlamları parçalarından (*corn* ve *-er*) çıkarılamamaktadır (Davis & Rastle, 2010).

Bazı çalışmalar zorunlu biçimbilimsel ayrıştırma sürecinin geçirimsiz sözcükler için de geçerli olmasının ya da bir diğer deyişle geçirimsiz sözcüklerin de şeffaf sözcükler gibi hazırlama etkisine sebep olmasının biçim-yazımsal parçalara ayırma (İng., morpho-orthographic segmentation) olarak yorumlanabileceğini göstermiştir. Yazımsal olarak adlandırılmasının sebebi geçirimsiz hazırlayıcı-hedef sözcük ikililerinin (*corner-corn*) yalnızca yazımsal örtüşme göstermesidir. Biçim-yazımsal olarak adlandırılmasının sebebi ise şeffaf ve geçirimsiz ikililer için bulunan hazırlama etkisinin *brothel-broth* gibi bir ikili için ortaya çıkmamasıdır. Bu durumda, hazırlama etkisinin bu ikili için bulunamamasının *-el*'in *corner* (köşe) sözcüğündeki *-er*'ın aksine İngilizcede geçerli bir biçimbirim yahut ek olmamasından kaynaklandığı savunulmuştur. Bu nedenle, biçimbilimsel ayrıştırma sürecine var olan biçim-yazımsal bilginin katkı sağladığı iddia edilmiştir (Rastle vd., 2004).

Öte yandan diğer bazı çalışmalar, biçimbilimsel ayrıştırmanın geçirimsiz sözcüklere de genellenebileceği görüşüne karşı çıkmış ve anlamsal olarak şeffaf sözcüklerden (*worker*-work, çalışan-çalışmak) elde edilen kolaylaştırıcı etkinin eşit şekilde geçirimsiz sözcükler (*department,* depart, bölüm-yola çıkmak) için de geçerli olmadığını öne sürmüştür (Feldman et al., 2009). Bu sebeple, anlamsal şeffaflık etkisi biçim-anlamsal (İng., morpho-semantic) bilginin de karmaşık sözcüklerin tanınmasına katkı sağladığı iddiasına yol açmıştır (Feldman, Kostić, Gvozdenović, O'Connor, & Moscoso del Prado Martín, 2012; Feldman, Milin, Moscoso del Prado Martín, O'Connor, & Cho, 2015; Feldman vd., 2009).

Biçim-yazımsal yahut biçim-anlamsal bilginin karmaşık sözcüklerin işlemlenmesine katkısıyla ilgili tartışmaya ek olarak, bir başka grup araştırma, yazım (İng., orthography) ve anlam (İng., semantic) seviyeleri arasında yer alan ve bu iki seviye arasındaki korelasyonu yansıtan orta bir biçimbilim seviyesinin (İng., lemma) de karmaşık sözcüklerin işlemlenmesini açıklamada kullanılabileceğini iddia etmiştir (Taft, 2003). Bu iddiayı destekleyen çalışmalar genel olarak maskelenmiş hazırlama paradigmasını kullanmıştır. Bu paradigmanın normal hazırlama deneylerinden farkı, katılımcılara hazırlayıcı sözcükten önce bu sözcüğü maskeleyecek bir maske sunulması (Örn., # karakteri) ve hazırlayıcı sözcüğün çok kısa süreyle (50 ms) gösterilmesidir. Kısa süreyle gösterilen hazırlayıcı sözcük bilinçli bir algılamayı önlemekte ve sözcük tanımanın çok erken safhalarında neler olduğu konusuna ışık tutmaktadır.

Örneğin, yazım ve anlam seviyeleri arasında yer alan orta bir seviyenin varlığına dair erken kanıtlar maskelenmiş hazırlama deneylerinden gelmektedir. Bu çalışmalarda, yalnızca yazımsal olarak bağlantılı (*future-fut*), yalnızca anlamsal olarak bağlantılı (*pursue-follow,* takip etmek) ve hem yazımsal, hem de biçim ve anlambilimsel olarak bağlantılı (*virus-viral*, virüs-virüsle ilgili) biçimbirim benzeri yapılar (*fut* ve *vir* gibi) test edilmiştir. Sonuç olarak hazırlama etkisi yalnızca yazım, biçim ve anlambilimsel olarak bağlantılı sözcükler için bulunmuştur. Sadece yazımsal yahut sadece anlamsal örtüşme herhangi bir hazırlama etkisine sebep olmadığı için

işlemleyenin bu tür bağlantıya sahip sözcükleri ayırt ettiği bir orta seviyenin var olması gerektiği sonucuna ulaşılmıştır.

Baş sözcük (İng., lemma) seviyesi gibi orta bir seviyenin varlığına ekstra delil ise anlam belirsizliği barındıran biçimbirimlerin işlemlenmesini araştıran çalışmalardan gelmektedir. Bu biçimbirimler (Örn., *train*- tren ya da birini bir şey için eğitmek) farklı anlamlara sahip olsalar da bu farklı anlamlar aynı yazıldığından uygun materyal olarak kabul görmektedir. Mesela, *trainer-train* (eğitmen- tren ya da birini bir şey için eğitmek) ikilisinde *trainer* sözcüğü *train* sözcüğünün yalnızca bir anlamından (birini bir şey için eğitmek) türetilmiştir ve bu ikili sırasıyla hazırlayıcı sözcük ve hedef sözcük olarak maskelenmiş hazırlama deneyinde sunulduğunda katılımcılar hedef sözcüğü gördüklerinde akıllarına gelen ilk anlam olarak 'birini bir şey için eğitmek' anlamını rapor etmiştir. Fakat sadece anlamsal olarak bağlantılı *tutor-train* gibi ikililer için *trainer-train* ikilisinde saptanan ilgili anlamı rapor etme yanlılığı gözlemlenmemiştir. Anlam belirsizliği barındıran biçimbirimlerin yazımsal seviyede aynı oldukları ve sadece anlamsal örtüşmenin hazırlayıcı sözcüğün çok kısa süre gösterildiği maskelenmiş hazırlama deneyi sonucu herhangi bir hazırlama etkisine yol açmadığı düşünüldüğünde, anlam belirsizliği barındıran biçimbirimin farklı anlamlarının işlemleyen tarafından ayırt edilmesi için baş sözcük gibi orta bir seviyenin gerekliliği desteklenmiştir (Taft & Nguyen-Hoan, 2010).

Anlam belirsizliğinin işlemlenmesini araştıran çoğu çalışma sözcük bazında anlam belirsizliğine odaklanmıştır. Öte yandan, birçok farklı dilde (Örn., İngilizce, Flemenkçe, Çince) varlığı sıklıkla rapor edilse de biçimbirim bazında anlam belirsizliği alan yazında yeterince dikkati çekmemiştir. Biçimbirimsel anlam belirsizliği etkisi biçimbilimsel ayrıştırmanın var oluşuna dayanmaktadır çünkü biçimbirimsel anlam belirsizliği barındıran sözcükler yalnızca biçimbirim seviyesinde (*sticky* sözcüğündeki *stick* kökü; ince dal ya da yapıştırmak) belirsizliğe sahip iken bütün sözcük seviyesinde (*sticky*- yapışkan) herhangi bir belirsizlik söz konusu değildir. Diğer bir deyişle, biçimbirimsel anlam belirsizliği etkisinin ortaya çıkabilmesi yalnızca işlemleyenin bütün sözcüğü biçimbirimlerine ayrıştırmasıyla mümkündür. Bu etkinin var olduğuna dair desteğin çoğu İngilizce (Taft & Nguyen-

Hoan, 2010) ve Çincede (Tsang & Chen, 2010, 2013; Tsang, Wong, Huang, & Chen, 2014) yapılan çalışmalardan elde edilmiştir.

Anlam belirsizliği barındıran bir sözcüğün farklı anlamlarının göreceli sıklığı 'anlam sıklığı' olarak bilinmektedir (Tsang & Chen, 2010). Anlam sıklığının biçimbilimsel işlemlemeye etki ettiği iddia edilmiştir. Diğer bir deyişle, karmaşık yapıda bir sözcüğün (Örn., Çincede ay tutulması) anlam belirsizliği barındıran sözcüğün baskın (Dünya'nın uydusu) mı yoksa ikincil (yılın 12 bölümünden biri) anlamından mı türetildiği karmaşık yapıdaki sözcüğün işlemleme örüntüsünü değiştirmektedir. Örneğin, Çincede karmaşık sözcük baskın anlamdan türetildiğinde ikincil anlamdan türetilen sözcüklere oranla daha hızlı işlemlenmiştir. Ayrıca, baskın anlamdan türetilmiş sözcük hedef sözcük (月餅, ay keki-Çin'e özgü bir pasta) olarak kullanıldığında hazırlayıcı sözcüğün baskın (月蝕, ay tutulması), ikincil (月薪, aylık takvim) ve geçirimsiz (月台, demir yolu platformu) olduğu tüm durumlarda hazırlama etkisi gözlenmiştir. Fakat, ikincil anlamdan türetilmiş sözcükler hedef sözcük (月曆, takvim) olarak kullanıldığında baskın anlam hali hazırda hep etkin olduğundan hazırlama etkisi yalnızca hazırlayıcı sözcük de ikincil anlamdan (月薪, aylık takvim) türetildiğinde ortaya çıkmıştır. Bu sonuçlar biçimbirim seviyesinde anlam belirsizliğinin çözümlenmesinde anlam sıklığının etkisini vurgulamıştır (Tsang & Chen, 2013). Fakat, anlam sıklığının biçimbirim seviyesinde anlam belirsizliği üzerindeki etkisini Çince dışında farklı dillerde de ortaya koymak için daha fazla çalışmaya ihtiyaç duyulmaktadır.

Çalışmanın Önemi

Bir önceki bölümde de tartışıldığı gibi, anlam belirsizliği barındıran biçimbirimlerin (eş sesli) farklı anlamları yazımsal ve sesbilimsel olarak (taraf ya da tutuşmak anlamına gelen *yan*) aynı görünüşe sahiptir, ki bu durum bu iki anlamı ayırt etmede pek bir fayda sağlamamaktadır. Ayrıca, yalnızca anlamsal örtüşmenin (*tutor-train*, eğitmen-eğitmek) hazırlayıcı sözcüğün çok kısa süre (50 ms) sunulduğu durumlarda herhangi bir hazırlama etkisine yol açmadığı Taft & Nguyen-Hoan (2010) tarafından bulunduğundan biçimbirim bazında anlam belirsizliği barındıran

sözcüklerin farklı anlamlarının biçimbilimsel işlemlemenin erken safhalarında doğrudan anlam seviyesinde ayırt edilmesi ihtimali ortadan kalkmıştır. Bu sebeple, sözcük işlemleme sisteminin anlam belirsizliği barındıran biçimbirimlerin farklı anlamlarını tam olarak hangi noktada ayırt ettiği hala geçerliliğini koruyan bir sorudur. Ancak alan yazında anlam belirsizliğini biçimbirim bazında çalışan çalışma sayısı oldukça azdır. Anlam belirsizliği barındıran biçimbirimlerin çeşitli dillerdeki yaygınlığı göz önünde bulundurulduğunda, biçimbilimsel işlemlemenin nasıl gerçekleştiğiyle ilgili bütün bir resim oluşturmak bu biçimbirimlerin nasıl işlemlendiği bilinmeden mümkün olmayacaktır (Tsang vd., 2014).

Biçimbilimsel işlemlemeyle ilgili alan yazında, biçim-anlamsal bilginin katkısı sıklıkla anlamsal şeffaflık kullanılarak test edilmiştir. İlgili çalışmalarda karşılaştırma hep anlamsal olarak şeffaf ve geçirimsiz sözcükler arasında yapılmıştır. Fakat çoğunlukla aynı kökten (*depart*, yola çıkmak) türetilebilecek anlamsal olarak şeffaf (*departing, departed, departure*; yola çıkma, yola çıkmış, kalkış) sözcüklerin sayısı geçirimsiz (*department*, bölüm) sözcüklerden fazladır. Diğer yandan, biçim-anlamsal bilginin katkısını test etmede kullanılabilecek bir diğer değişken anlam sıklığıdır ve Türkçede eş sesli bir biçimbirimin farklı anlamlarından (*yan*, taraf ya da tutuşmak) eşit sayıda sözcük (baskın anlam: taraf, yanlı ve yansız; ikincil anlam: tutuşmak, yanıcı ve yanık) türetilebilmektedir. Bu sebeple anlam belirsizliği barındıran biçimbirimlerin bu özelliği, biçim-anlamsal bilginin biçimbilimsel işlemlemeye katkısı hakkında daha açık sonuçlar elde edilmesine katkı sağlama potansiyeline sahiptir (Tsang vd., 2014).

Anlam belirsizliği barındıran biçimbirimi çözümlemede anlam sıklığının etkisi ise tamamıyla eksik çalışılmış bir konudur. Ayrıca, yakın tarihte bu konuda elde edilmiş verilerin hepsi Türkçeden büsbütün farklı olan tek bir dilden, Çinceden gelmektedir. Bu nedenle, anlam sıklığının etkisi biçimbirim bazında anlam belirsizliğini çözümleme noktasında diller arası var olan çalışmaların sonuçlarını destekleyici ya da onlara karşıt bilgi sağlayabilme potansiyeline sahip olduğundan dikkate ve çalışmaya değer bir konudur. Bilgimiz dahilinde de Türkçede biçimbirim bazında anlam belirsizliğini ve bu biçimbirimlerin işlemlenmesinde anlam sıklığının

etkisini aynı çalışma içerisinde inceleyen bir araştırma yoktur. Bu bağlamda, bu çalışma alan yazındaki bu başlığı doldurmayı amaçlamıştır.

Araştırma Soruları ve Öngörüler

Bu tez Türkçede anlam belirsizliği barındıran biçimbirimlerin işlemlenmesine odaklanmaktadır. Anlam belirsizliği tüm tez boyunca eş sesli sözcükleri belirtmek amacıyla kullanılmıştır. Eş sesli sözcükler yazımsal ve sesbilimsel özellikleri aynı olan fakat birden fazla farklı anlama sahip sözcükler olarak tanımlanabilir (Lin & Ahrens, 2010; Shen & Li, 2016). Türkçe saydam yazımsal yapıya (İng., shallow-orthography) sahip bir dildir. Diğer bir deyişle, bir sözcük içerisindeki harf ve sesler arasında birebir bir örtüşme söz konusudur (Miller et al., 2014). Bu nedenle İngilizcede yer alan eş sesli ve eş yazımlı ayrımı Türkçede söz konusu değildir. Aksine Türkçede tüm eş sesli sözcükler aynı zamanda eş yazımlıdır. Bu tezde çalışılan anlam belirsizliği biçimbirim bazındadır. Bunun dışında deneyde kullanılan tüm sözcükler tüm sözcük seviyesinde anlam belirsizliği barındırmamaktadır. Başka bir deyişle, türetilmiş bir sözcük olan *yanık* anlam belirsizliği barındırmazken bu sözcüğün türetildiği *yan* biçimbirimi (kökü) anlam belirsizliği göstermektedir. Bu tezin cevaplamayı amaçladığı sorular:

1. Yazım ve anlam seviyeleri arasında yer alan baş sözcük seviyesinde orta bir temsil Türkçede anlam belirsizliği barındıran biçimbirimlerin işlemlenmesini açıklamada kullanılabilir mi?
2. Anlam sıklığı Türkçede anlam belirsizliği barındıran biçimbirimlerin işlemlenmesinde bir rol oynayacak mıdır?

Taft & Nguyen-Hoan (2010) tarafından öne sürülen hiyerarşik modele göre bu çalışmada anlam belirsizliği barındıran hedef sözcüklerin anlamının yorumlanmasının hazırlayıcı sözcüğün türetildiği anlamın etkisi altında kalacağı öngörülmüştür. Ayrıca, hazırlayıcı ve hedef sözcükler aynı anlamdan türetilen sözcükler olduğunda hazırlama etkisinin daha güçlü ortaya çıkması beklenmektedir. Bu nedenle hazırlayıcı ve hedef sözcüklerin her ikisinin de baskın yahut her ikisinin de ikincil anlamdan türetildiği durumlarda diğer durumlara oranla daha güçlü bir hazırlama etkisi olacağı tahmin edilmiştir. Tsang & Chen (2013) tarafından önerilen anlam sıklığı etkisine dayanarak,

hedef sözcüğün baskın anlamdan türetilmiş olduğu durumlarda hazırlama etkisinin baskın, ikincil ve geçirimsiz hazırlayıcı sözcük durumlarının hepsinde ortaya çıkması beklenmektedir çünkü üç hazırlayıcı sözcük türünde de hedef sözcükle hazırlayıcı sözcükler aynı kökü paylaşmaktadır. Öte yandan, hedef sözcüğün ikincil anlamdan türetildiği durumda hazırlama etkisinin yalnızca hazırlayıcı sözcüğün de ikincil anlamdan türetildiği durumda ortaya çıkması beklenmektedir çünkü ikincil anlamın sıklık sebebiyle baskın anlamı aşıp etkinleştirilmesi ancak hazırlayıcı sözcüğün de bu anlamı desteklemesi ile mümkündür.

Katılımcılar

Ana deney uygulanmadan önce bu deneyde kullanılacak materyallerin anlam sıklığını belirlemek amacıyla uygulanan 'Anlam Baskınlığını Belirleme' görevine 42 kişi katılmıştır.

Ana deney için ise ana dili Türkçe olan ve tümü Orta Doğu Teknik Üniversitesi'nde öğrenci olan 56 kişi çalışmaya gönüllü olarak katılmıştır (41'i kadın). Katılımcıların yaş ortalaması 22,14'tür (SS: 3,47). Katılımcıların herhangi bir göz kusuru yoktur ve katılımcılar deneyin amacı hakkında ön bilgiye sahip değildir. Tüm katılımcılar sunulan harf topluluklarının Türkçede bir sözcük olup olmadığına karar verirken baskın ellerini kullanmıştır. Bu çalışmaya katılan kişiler daha önce yapılan 'Anlam Baskınlığını Belirleme' görevine katılan kişilerden farklıdır. Bu çalışma ODTÜ İnsan Araştırmaları Etik Kurulu tarafından onaylanmıştır.

Materyaller ve Deneysel Yöntem

Materyal seçimi için öncelikle Türk Dil Kurumu Sözlüğü'ne de danışarak okunuşu ve yazılışı aynı fakat birden fazla anlamı olan (eş sesli) sözcükler seçilmiştir. Ayrıca bu birden fazla anlamın birbiriyle bağlantılı anlamlar olmamasına dikkat edilmiştir. Mesela, *al* biçimbirimi hem 'kırmızı renk' hem de 'almak' eylemi olarak kullanılabilir ve bu anlamlar birbiriyle bağlantılı değildir. Daha sonra bu eş sesli sözcüklerin farklı anlamlarının sıklığını belirlemek için bu sözcükler yukarıda belirtilen 42 kişilik gruba 'Anlam Baskınlığını Belirleme' görevinde sunulmuştur. Bu görevde sözcükler herhangi bir bağlamda değil tek başlarına katılımcılara sunulmuş

ve onlardan bu sözcükleri gördüklerinde akıllarına ilk gelen anlamı yazmaları istenmiştir. Alan yazındaki sınır noktaları dikkate alınarak ve görsel/istatistiksel incelemeler sonucu bu çalışma için sınır noktası %55 olarak belirlenmiştir. Bir başka deyişle eğer bir sözcük için bir anlam katılımcıların %55'i tarafından rapor edilmişse bu anlam bu sözcük için baskın anlam olarak kabul edilmiştir.

Daha sonra her bir anlamdan baskın, ikincil, geçirimsiz ve ilintisiz hazırlayıcı sözcükler türetilmiştir. Geçirimsiz sözcükler oluşturulurken anlam belirsizliği barındıran biçimbirim (*yan*) ile Türkçede var olan (*-ak*, *durak*) fakat türetilen geçirimsiz sözcük içinde gerçek bir ek olmayan (*yanak*), yani sözcüğün bütünsel anlamına katkı sağlamayan, sözde ek bir araya getirilmiştir. İlintisiz sözcükler ise diğer durumlarda yer alan sözcüklerden yazımsal, sesbilimsel ve anlamsal olarak bağlantısız temel çizgisi (İng., baseline) durumu olarak kullanılmıştır. Örneğin, *gül* sözcüğü için 'Anlam Baskınlığı Belirleme' görevi sonuçlarına göre baskın anlam 'çiçek' olarak rapor edilmiştir. Bu sebeple baskın hazırlayıcı sözcük *gülcü*, ikincil sözcük *güleç*, geçirimsiz sözcük *gülle* ve ilintisiz sözcük *eskici* olmuştur. Hedef sözcükler ise baskın ve ikincil anlamdan türetilenler olmak üzere iki türe ayrılmıştır. Örneğin, baskın hedef sözcük *güllü* iken ikincil hedef sözcük *gülüş* olarak belirlenmiştir.

Sıklık verileri Türkçe Ulusal Derlemi'nden (Aksan et al., 2012) alınmıştır. Hazırlayıcı sözcük listeleri ve hedef sözcük listeleri sıklık ve uzunluk bakımından kendi içlerinde eşitlenmiş, listeler arası anlamlı bir sıklık (hazırlayıcı sözcükler için ($F(3,124)=1.421$, $p>.05$); hedef sözcükler için ($t(62)=.341$, $p>.05$)) ya da uzunluk (hazırlayıcı sözcükler için ($F(3, 124)= 1.570$, $p>.05$); hedef sözcükler için ($t(62)=.842$, $p>.05$)) farkı bulunmamıştır. Sıklığı derlemde 'sıfır' olarak belirtilen fakat ana dili Türkçe konuşucular tarafından dilde var olduğu doğrulanan sözcüklerin sıklık değeri 'bir' kabul edilmiştir (Brysbaert & Diependaele, 2013).

Dört farklı hazırlayıcı sözcük türü ve iki farklı hedef sözcük türü kullanılarak sekiz ayrı liste oluşturulmuştur. Her bir listede 32 tanesi deneysel olmak üzere, 16 adet dolgu sözcüğü, 48 adet gerçek olmayan sözcük ve 12 adet de alıştırma sözcüğü kullanılmıştır. Gerçek olmayan sözcükler Türkçe'nin sesbirim dizge yapısına uygun

olarak Wuggy yazılımının Türkçe ara yüzü (Erten et al., 2014) kullanılarak oluşturulmuştur. Hazırlayıcı sözcük kendisinden önce sunulan ve kendi harf sayısı kadar # karakteri içeren bir ekran ile maskelenmiş ve 50 ms boyunca gösterilmiştir. Kullanılan görev çevrimiçi sözcüksel karar testidir. Katılımcılardan ekranda gördükleri harf topluluklarının Türkçede bir sözcük olup olmadığını önceden belirlenen tuşlara olabildiğince hızlı ve doğru basarak belirtmeleri istenmiştir. Deneysel yöntem için E-prime yazılımı (Schneider et al., 2012) kullanılmıştır. Deney 500 ms boyunca ekranda kalan boş ekran ile başlamış, yine 500 ms ekranda kalan maskenin sunumu ile devam etmiştir. Daha sonra hazırlayıcı sözcük 50 ms ekranda kalmış ve hemen ardından sunulan hedef sözcük maksimum 2000 ms ya da katılımcı cevap verene kadar ekranda kalmıştır.

Katılımcılar sessiz bir odada test edilmiştir. Öncelikle gönüllü katılım formu ve dilsel artalan anketi doldurmuşlardır. Ardından başlatılan deney 8 ile 10 dakika arası sürmüştür. Deney sonrasında katılımcıların hazırlayıcı sözcüğün varlığını fark edip etmediklerini anlamak için onlara çevrimdışı bir listede bazı hazırlayıcı sözcükler sunulmuş ve çevrimiçi deney sırasında bu sözcükleri görüp görmedikleri sorulmuştur.

Genel Sonuçlar

Çalışmadan elde edilen sonuçlar, istatistiksel olarak anlamlı herhangi bir biçim-anlamsal hazırlama etkisinin olmadığını göstermiştir. Bir diğer deyişle, hazırlayıcı sözcük ve hedef sözcüğün aynı anlamdan türetildiği baskın hazırlayıcı-baskın hedef ve ikincil hazırlayıcı-ikincil hedef durumlarında diğer durumlara oranla daha güçlü bir hazırlama etkisine ulaşılamamıştır. Buna ek olarak, anlam sıklığının da biçimbirim bazında anlam belirsizliğinin işlemlenmesi üzerine istatistiksel olarak anlamlı bir etkisi ortaya çıkmamıştır. Başka bir deyişle, baskın hedef sözcükler ile ikincil hedef sözcüklerin işlemlenme örüntüleri arasında bir fark bulunamamıştır.

Bu iki hedef sözcük türü arasında işlemleme farkının bulunması alan yazında yazım ve anlam arasında yer alan baş sözcük seviyesinde bir temsil için temel kanıt olarak kabul edilmiştir. Çünkü iki hedef sözcük türü de yazım seviyesinde örtüşme gösterdiğinden bu seviye iki türün işlemlemede farklılaşmasını açıklayamamaktadır.

Benzer şekilde, bütünsel anlam seviyesinde de her iki hedef sözcük türü de anlam belirsizliği barındırmadığından sözcüksel işlemleme sisteminin iki türü anlam seviyesinden önce bir yerlerde ayırt ettiği ve bu seviyenin de baş sözcük seviyesi olduğu iddia edilmiştir. Mevcut çalışmada Türkçede biçim-anlamsal hazırlama etkisinin olmayışı ve iki hedef sözcük türü arasında herhangi bir işlemleme farkı bulunamaması İngilizce ve Çincede bulunan baş sözcük seviyesine olan ihtiyacın Türkçe için geçerli olmadığı şeklinde açıklanabilir.

Öte yandan, elde edilen bulgularda istatistiksel olarak anlamlı olmayan fakat dikkate değer bir eğilim gözlemlenmiştir. Bu eğilim dikkatli bir biçimde incelendiğinde, baskın hedef sözcük durumunda, baskın, ikincil ve geçirimsiz hazırlayıcı sözcük durumları benzer tepki sürelerine yol açmış ve bu tepki süreleri ilintisiz durumdan yaklaşık 15 ms daha kısa olmuştur. Diğer yandan, ikincil hedef sözcük durumunda ise, baskın ve geçirimsiz hazırlayıcı sözcük durumları birbirine ve ilintisiz hedef sözcük durumuna benzer tepki sürelerine yol açarken, ikincil hedef sözcük durumu ilintisiz durumdan yaklaşık 7 ms daha kısa tepki süresine neden olmuştur. Bu eğilim tam olarak Çincede bulunan sonuçların aynısıdır.

Eğilime bakıldığında Türkçede baskın ve ikincil hedef sözcük türleri arasındaki işlemleme farkının yani anlam sıklığının etki göstermesinin (baskın hedef durumunda baskın, ikincil ve geçirimsiz hazırlayıcı sözcükler ilintisizden hızlı işlemlenirken ikincil hedef durumunda yalnızca ikincil hazırlayıcı sözcüğün ilintisizden daha hızlı işlemlenmesi) Çince ve İngilizcede olduğu gibi Türkçede de yazım ve anlam arasında yer alan baş sözcük seviyesinde bir temsille açıklanabileceği düşünülmektedir. Ayrıca, sekiz deneysel liste ve her bir liste için yedi katılımcı olması sebebiyle mevcut çalışmadaki istatiksel gücün düşük, etki boyutunun da küçük olduğu düşünüldüğünde elde edilen eğilimin oldukça anlamlı ve gelecek vaat edici olduğu görülmektedir.

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