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MORPHOLOGICAL PROCESSING IN DEVELOPING READERS: A PSYCHOLINGUISTIC STUDY ON TURKISH PRIMARY SCHOOL CHILDREN

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MORPHOLOGICAL PROCESSING IN DEVELOPING READERS:
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I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Arts.

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ABSTRACT

MORPHOLOGICAL PROCESSING IN DEVELOPING READERS: A PSYCHOLINGUISTIC STUDY ON TURKISH PRIMARY SCHOOL CHILDREN

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The processing of morphologically complex words has been studies in many languages, leading to a variety of theoretical accounts. While dual-route models advocate two distinct mechanisms for word processing, single route models suggest a single mechanism. Contrasting findings as well as the different interpretations of the same results have kept the advocators of both accounts searching for a solid and undisputable justification for their views.

This thesis investigated the early stages of morphological processing in Turkish children. The visual masked priming paradigm was used to investigate the processing of Turkish inflected and derived words by second-grade and fourth-grade primary school children. Furthermore, the spelling skills and vocabulary skills were measured to further investigate how these skills modulate early word processing.

Both the second graders and the fourth graders showed priming effects for affixed words, with no significant differences between derived and inflected primes in the two grade levels. It was further found that the participants with higher vocabulary skills responded faster in all conditions. The results suggest a sensitivity for affixes in the early word processing of Turkish primary school children rather than a sensitivity for pseudo affixes, orthographic overlap, or semantic similarity.

Keywords: masked morphological priming, morphological processing, reading development, visual word processing

ÖZ

GELİŞEN OKURLARDAKİ BİÇİMBİLİMSEL İŞLEMLEME: TÜRK İLKOKUL ÇOCUKLARI ÜZERİNE RUHBİLİMSEL BİR ÇALIŞMA

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Birçok çalışma farklı dilde biçimbilimsel açıdan karmaşık kelimelerin işlemlenmesini incelemiş ve çeşitli teorik görüşlerin oluşmasına öncü olmuşlardır. Çift-yol modelleri sözcük işlemlemede iki ayrı mekanizma olduğunu savunurken, tek-yol modelleri ise tek bir mekanizma olduğunu ileri sürer. Birbiriyle çelişen bulgularla beraber aynı sonuçların farklı yorumları da iki görüşün savunucularını sağlam ve tartışmasız bir ispatı aramaya devam etmelerini sağlamıştır.

Bu tez Türk çocuklarında biçimbilimsel işlemlemenin erken aşamalarını sorgulamıştır. Türkçede çekim eki almış ve yapım eki almış sözcüklerin ilkokul ikinci sınıf ve dördüncü sınıf öğrencileri tarafından işlemlenmesi görsel maskelenmiş hazırlama paradigması kullanılarak incelenmiştir. Ayrıca, sözcük yetenekleri ve imla yetenekleri ölçülerek bu yeteneklerinin sözcük işlemlemenin erken aşamalarındaki etkileri araştırılmıştır.

Hem ikinci sınıflar hem de dördüncü sınıflar ek almış sözcükler için hazırlama etkisi gösterirken, her iki sınıf kademesi için de yapım ekli ve çekim ekli hazırlayıcılar arasında istatiksel bir fark bulunamamıştır. Bu bulgulara ek olarak, daha iyi sözcük yeteneğine sahip olan katılımcılar tüm koşullarda sözcüklere daha hızlı cevaplar vermişlerdir. Sonuçlar Türk ilkokul öğrencilerinin sözcük işlemlemenin erken aşamalarında sahte ekler, yazımsal benzerlik, ya da anlamsal benzerlikten ziyade ek almış sözcüklere karşı duyarlılığı olduğunu ileri sürmektedir.

Anahtar kelimeler: maskelenmiş biçimbilimsel hazırlama, biçimbilimsel işlemleme, okuma gelişimi, görsel sözcük işlemleme

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
AoA	Age of Onset of Acquisition
CV	Consonant-Vowel
CVC	Consonant-Vowel-Consonant
DRC	Dual-Route Cascaded Model of Reading
GPC	Grapheme-Phoneme Correspondences
N	Neighborhood Size
PD	Phonological Difference
PDP	The Parallel-Distributed-Processing Connectionist Model
PSGT	The Psycholinguistic Grain Size Theory
RAN	Rapid Automatized Naming
RT	Reaction Time
SOA	Stimulus Onset Asynchrony
SWRM	Sight Word Reading Model
TL	Transposed Letter
TNC	The Turkish National Corpus
UK	United Kingdom
VSTM	Visual Short-Term Memory

CHAPTER 1

INTRODUCTION

Although the controversy about the origin of language has raged unabated for a long time (Wind, Chiarelli, Bichakjian, Nocentini & Jonker, 2013), it is apparent that people can produce hundreds of words within a single minute and can comprehend a similar amount of words produced by someone else. Similarly, people perform reading at rapid speed. Uncovering the mechanisms and processes involved in this everyday communication way of people is not simple and has given rise to different views, arguments, and contradictions. Word-processing models, for example, have tried to account for how words are processed in the course of reading. As an attempt to contribute to this effort, the aim of this thesis is to investigate word processing phenomena in young readers of Turkish. Two remarkable, yet controversial, views of word processing are the dual-mechanism view and the single mechanism view**.** Although the recent literature has been dominated by the dual-mechanism view, reviewing the essential works from both perspectives will provide a more complete picture.

While different versions with small to medium variations are available, the core point of the dual-mechanism view is that young readers acquire phoneme-grapheme correspondences along with whole word orthographic representations. After some reading exposure, two different routes are developed. One of these routes uses phonological features while the other, faster, route has direct access to meaning through orthographic features. More recently, these two routes are known as the fine-grained and the coarse-grained routes, respectively, in so-called dual-route processing (Grainger & Ziegler, 2011). One of the established assumptions in the dual-mechanism view is that the size of early acquired whole-word representations is larger in especially deep or relatively deep orthographic languages due to the inconsistency between phonemes and graphemes.

The theories within the dual-mechanism view state that reading involves two distinct mechanisms. One of these mechanisms recognizes affixes in words and deduces meaning by combining the meanings of a root and an affix attached to it, while the other mechanism parses words as wholes and accesses the relevant meaning in the mental lexicon. These theories commonly argue that affixes are also stored in the mental lexicon, thus claiming that there is no need for storing every affixed word as a whole. Following this line of reasoning, the word *walked*, for example, is decomposed into the root *walk* and the affix *-ed*; the meanings of these morphemes are retrieved from the mental lexicon and are combined to get the cumulative meaning.

It is important to note that there is no consensus even among dual-mechanism proponents that all affixed words are always decomposed. It has been put forward that factors such as frequency play a determinant role for a word to be decomposed or to be recognized as whole (e.g. Xu & Taft, 2015). A common view holds that after sufficient exposure, words can be processed through their orthographic features and their meanings are reached directly through a coarse-grained route. From this perspective, the word *walked*, can either be decomposed as *walk* and *-ed*, or can be recognized as *walked*. Another related theoretical issue that has been debated over the years concerns the division between derivational and inflectional affixes. While the followers of Distributed Morphology reject a clear-cut differentiation between derivation and inflection (e.g. Harley & Noyer, 1999), Realization-based theories (e.g. Spencer, 2016) see derivational processes and inflectional processes as two distinct phenomena. Generally, the advocates of the latter view argue that derivational processes create new lexeme entries while inflectional processes produce different realizations of the same lexeme.

From the single mechanism perspective, a single mechanism is responsible for word processing which ties visual symbol combinations to the lexical representations in the mental lexicon and thus arrives at the intended meaning. Graphemes have different numbers of phoneme representations depending on the orthographic depth of a language; for shallow orthographic languages, each grapheme has a single or comparatively few phoneme representations tied to it with limited conversion rules. In deep orthographies, on the other hand, more phoneme representations for each grapheme are available, and more grapheme-phoneme conversion rules are needed to achieve adult-like reading proficiency. For the same word *walked,* some of the theories within this camp would claim that there is no separation into morphemes at the beginning and the meaning is retrieved from the mental lexicon as a whole. Although this may seem similar to the coarse-grained route, strict advocators of this view do not acknowledge another mechanism and reject the idea that affixes are recognized by some other system. It is, however, important to underline that some single mechanism views include an affix separation mechanism in their models (see Section 2.2.1.2).

Even within the single mechanism and dual-mechanism views, there are varying roles for morphemes in word processing. Readers start with a letter-to-letter coding strategy and go through a phonological recoding stage in most of the reading acquisition theories available (Ehri, 1992; Share, 1995; Grainger & Ziegler, 2011; Ziegler & Goswami, 2005). Nevertheless, the controversy regarding the next step is not resolved. How do readers perceive morphemes? Are they salient units in reading? If yes, then are they salient throughout the entire process of reading development? Are inflected and derived words treated any different in word processing and in the mental lexicon? Does semantic transparency facilitate word processing? These and related questions have been of major interest in word processing research for many years.

The studies investigating the role of morphemes in word processing have generally indicated cross-linguistic effects, an expected result considering that it would be unusual to expect exactly the same acquisition and reading process for the 7,099 recognized languages in the world (Lewis, Simons, & Fennig, 2009). Quémart, Casalis and Colé (2011) argued that orthographic consistency, derivational consistency, and morphological productivity are likely to affect the role of orthographic and semantic influences in word processing. Similarly, the size of salient units used in reading has been attributed to cross-linguistics differences (Marcolini, Traficante, Zoccolotti, & Burani, 2011; Ziegler & Goswami, 2005). Therefore, an important task in revealing the role of these constituents is to carry out cross-linguistic research and investigate typologically different languages.

Turkish is a good candidate for providing important insights to the current literature; it has an extremely shallow orthography and a remarkably productive morphology. However, far too little attention has been paid to the Turkish language in such studies. A technique to investigate the early stages of word processing, the masked priming paradigm, has offered different interpretations about morphological processing in Turkish adults and children. Unfortunately, studies on Turkish using this paradigm with adult participants are to date limited (Gacan, 2014; Kırkıcı & Clahsen, 2013; Şafak, 2015), and even more unfortunately, studies investigating the processing of morphologically complex words in young readers of Turkish are entirely non-existent. The broad aim of this thesis is therefore to contribute to the cross-linguistic efforts to better understand lexical / morphological processing by investigating the role of morphemes in Turkish developing readers in the early stages of word processing.

As most of the studies in the literature focusing on the role of morphemes in the early stages of word processing in children included participants in second to fifth grades (see Sections 2.2.4, 2.3.6), the current study focuses on second and fourth graders. Alphabetic knowledge is necessary in reading so that beginning readers can start reading words by decoding single letters. Turkish children are reported to reach high levels of word reading proficiency at the end of the first grade (Babayiğit & Stainthorp, 2007; Durgunoğlu & Öney, 1999; Öney & Durgunoğlu, 1997). It will therefore be assumed in this thesis that the dominance of this letter-to-letter strategy will lose its ground to larger linguistic units quickly; children are likely to use syllables and morphemes in their reading by the first grade and thereafter. Second graders will provide good information about whether children start using larger linguistic units in the early word processing right after abandoning the initial letter-to-letter coding strategy. Considering the highly consistent orthography of Turkish, second graders are expected to use morphemes as salient units instead. It is important to remember, however, that the thesis focuses on the very early processing stages of words. Even if second graders do use morphemes as salient units, it would not necessarily mean that these are also active in these very early stages of processing. Thus, morphological decomposition might not be observed within the second grade data. The second group of participants, fourth graders, might provide important insights regarding developmental changes since they have 2 more years of reading experience. As already stated, while observing second grade readers to decompose morphemes in the early stages of word processing might be a little difficult even for a highly shallow language, it is expected that fourth graders will show morphological decomposition effects.

Since this thesis focuses on young readers, some of the well-known reading acquisition theories will be examined in Section 2.1. This section will also offer insights into how different theories explain reading acquisition processes and how cross-linguistic differences can affect reading acquisition and skilled reading. The next section (Section 2.2) will focus on word processing and will summarize several word processing models for both single-mechanism views and dual-mechanism views. Finally, the focus will be on one of the most controversial areas of word processing (and the main focus of this thesis): the early stages of word processing (Section 2.3).

CHAPTER 2

LITERATURE REVIEW

Although the debates surrounding the processes involved in reading still go on, there is no doubt that reading is a human invention and is considered as the most important sign system our species has ever created (Coulmas, 1989). While this invention is generally accepted as first being used in Mesopotamia (Powell, 1981), there is another view that Mesopotamians based their writing system on some older writing system that had originated in Western Asia around 11.000 years ago (Schmandt & Besserat, 1978). What differentiates reading acquisition from language acquisition is not related to the purposes of these phenomena but to the nature of their emergence; both gave the human kind better survival abilities, yet language emerged as a natural result of evolution, while reading was consciously created as the next step of complex social organization and enhanced cognitive abilities that the language itself had made possible (Dunbar, 2003; Johnson, 2015). This difference has led to fundamentally distinct acquisition processes; while human beings without language disorders can acquire a language naturally and with relative ease through adequate input without any instructions, this principle does not apply to reading acquisition.

It is true that there are self-teaching hypotheses (Grainger & Ziegler, 2011; Share, 1995); however, even these require at least some alphabetic knowledge to begin with. An eighty-year-old illiterate man who has been exposed to some language for that long can easily be outperformed in reading by a six-year-old child in the first grade. Unlike first language acquisition, reading acquisition is not merely based on cognitive abilities (and perhaps innate abilities for some theorists) of the human brain to create new knowledge. Since we already have a spoken language, reading acquisition involves establishing connections between the symbols and the acquired sounds. By doing so, we can access our spoken lexicon and use it in reading and writing rather than creating a whole new lexicon for such tasks. The process of creating connections between symbols and sounds is called *phonological recoding* and is regarded as a crucial step in reading acquisition since it provides a tool for beginning reading that consequently leads to skilled reading (e.g. Ehri, 1992; Grainger & Ziegler, 2011; Share, 1995; Ziegler & Goswami, 2005).

Then the question is: How do we go through this phonological recoding process and finally acquire reading? This next section will outline some well-known reading acquisition theories. Since the present study focuses on developing readers, the relationship between reading development and word processing shall not be overlooked.

2.1. Reading Acquisition

2.1.1. The Sight Word Reading Model

One of the established models in reading, Ehri's (1991, 2005) Sight Word Reading Model (henceforth, SWRM) proposes that words are rapidly recalled from memory through the orthographic recognition of written symbols. The model also tries to account for reading acquisition and emphasizes the role of phonological recoding during this process. The term *Sight Word* refers to a word that is read very rapidly on *sight.* In the framework of the SWRM, reading acquisition is explained in four phases: the pre-alphabetic phase, the partial-alphabetic phase, the full alphabetic phase, and the consolidated phase.

The first phase, the pre-alphabetic phase, involves recognizing words through visual features since alphabetic knowledge is nonexistent or extremely limited at the beginning. The word *fly*, for example, might be remembered by thinking of the letter *y* as having two wings. In the next phase, the partial alphabetic phase, children acquire the sounds of the alphabet letters (or, at least, some of them) or names. The ability to perform all necessary mappings between graphemes and phonemes leads developing readers to read words rapidly and to advance to the next phase, the full alphabetic phase. In this phase, readers can recognize phonemes in a word and match them to the graphemes of that word (Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh, & Shanahan, 2001). Ehri (2005) argues that alphabetic schemata function as background knowledge and are activated to map graphemes to phonemes. After several exposures to spellings, they are tied to the pronunciations of words. This phase allows readers to become very accurate in reading, and the rather rare mistakes that appear in this phase usually involve words that are orthographically similar. Furthermore, an improved word memory and decoding ability are also observed in this phase. The last phase, the consolidated phase, is reached by acquiring a good number of sight words. Small grapheme-phoneme correspondences evolve into larger units (rimes, syllables, morphemes, and words) as readers are exposed to more and more different words with the same letter patterns.

Ehri (2005) explicitly underlines that the theory is not a stage theory. A stage theory would require latter stages to be based on prior stages; in this *phase* theory, reading words via visual cues during the pre-alphabetic phase does not help with the latter stages. Another distinction from a stage theory is that readers do not necessarily abandon their mapping processes after moving to the next phase. In fact, they can benefit from mapping processes from prior phases in different situations. Long words, for example, may require a partial mapping process even if the reader is in the full alphabetic phase.

In an attempt to answer how readers store sight words in memory via alphabetic knowledge, Ehri (2005) points to schema theory (Anderson, Reynolds, Schallert, & Goetz, 1977). Grapheme-sound correspondences are internalized within alphabetic knowledge, and this knowledge leads readers to make assumptions about a word's pronunciation or spelling. This is not to say that each grapheme would correspond to a single phoneme; it is apparent that in some orthographies a grapheme corresponds to multiple phonemes. What is unlikely is to expect a reader to make assumptions about the pronunciation or spelling of a word without having been exposed to the graphemes and the letter patterns in that word before.

2.1.2. The Psycholinguistic Grain Size Theory

Another notable theory for reading acquisition is the Psycholinguistic Grain Size Theory (Ziegler & Goswami, 2005; henceforth, PGST). Similar to the SWRM, in this theory too, reading acquisition necessitates establishing connections between symbols and sounds. Therefore, the PGST also takes phonological recoding as one of the crucial initial steps in reading acquisition (Ehri, 1992; Share, 1995; Grainger & Ziegler, 2011). For children to use phonological recoding, it is necessary to discover shared grain sizes in orthography and phonology, which will allow genuine and clear connections between these domains. Ziegler and Goswami (2005) define three problems in reading acquisition that need to be overcome for successful reading acquisition: availability, consistency, and granularity.

The first problem, availability, refers to the consciously inaccessible phonological units before reading. A beginning reader should be able to overcome this cognitive challenge of accessing small phonological units to advance in reading. It is well-proven that to access and manipulate especially small phonological units like phonemes, people need at least some degree of reading skill (e.g. Liberman, 1970); therefore, an illiterate adult would have problems with phoneme manipulation (e.g. Adrián, Alegria & Morais, 1995). The second problem, consistency, is related to the multiple representations a single unit can have. For example, a letter or a grapheme can represent multiple phonemes. Or phonemes can have several allophones, like in

English. These two problems are strong factors in slow reading acquisition. Granularity, the final problem, is related to the orthography of a language. A phonological system based on bigger grain sizes demands learners to learn more orthographic units, such as more words, syllables, rimes, and graphemes. Smaller grain sizes (e.g. phonemes), on the other hand, are usually limited in number in a language, and a language system largely based on them is easier to acquire. Referring to Rayner, Foorman, Perfetti, Pesetsky, and Seidenberg (2001), Ziegler and Goswami (2005) claim that solving these three problems is at the heart of reading acquisition.

The PGST suggests that beginning readers more easily access larger units such as words, syllables, and onsets. Readers develop their phonological awareness depending on the phonological similarity of words. The characteristics of a language play a crucial role in this development. For some languages like Dutch, French, and English, salient grain sizes are based on rimes while for other languages like Korean, they are likely to be based on syllable or onset-vowel.

As language develops, more phonological relations are established between words and inserted in fine-grained phonological information. Ziegler and Goswami (2005) state that the structural consistency of words is a key factor in the incidental learning of phonology. The Lexical Restructuring Hypothesis (Metsala, 1998) argues that words are represented in a holistic manner first, while the vocabulary size is not too large. As vocabulary size grows, word representations also increase their details. This is not a general process that happens for all words at the same time. Instead, words that have more phonologically similar neighbors in the lexicon tend to be detailed first since having many phonological neighbors is likely to cause confusion, and the enhanced details of word representations can avoid this confusion. The theory does not say that segmental presentations overtake coarser presentations in the process of lexical restructuring. Rather, these presentations are enhanced through phonological detail, no matter what their grain size levels are (large or small).

For the PSGT, three types of pressure are the determinant factors in the development of salient units for both small and large grain size units in reading development. Orthographically less complex smaller units cause functional pressure towards them to be developed first. Phonological accessibility is another factor; phonologically more accessible larger units create linguistic pressure on them. Finally, consistency creates statistical pressure, as more consistent units are easier to be developed. The overall consistency characteristic of a language is referred to as orthography, which will be investigated further in Section 2.1.5.1.

Despite the common ground that the PGST and the SWRM share, it is important not to overlook an essential difference: the PGST emphasized how different grain sizes and strategies for decoding are developed and used along with how the orthography of a language influences these (Ziegler & Goswami, 2005), while the SWRM allocates a smaller role to the effect of orthography. The SWRM suggests that although orthography might affect the development of grapheme-phoneme correspondences and the pace of developing phases, all readers follow the same phases and reach the final phase of rapid word recognition regardless of orthographic depth. In the last phase, the orthography is even less important since readers process most of the words *at sight*. The claims of both theories about orthography will be discussed in more detail in Section 2.1.5.1.

2.1.3. Grainger and Ziegler's Dual-route Approach

A more recent model of reading acquisition and word processing has been proposed by Grainger and Ziegler (2011). The model bases its core assumptions on two routes: a fine-grained route and a coarse-grained route. Until these two routes are developed, a letter-by-letter reading strategy is adopted by beginner readers. Phonological recoding is again an inseparable part of reading acquisition like in previous models (Ehri, 1992; Share, 1995; Ziegler & Goswami, 2005). Similar to Share

(1995), who argued that successful decoding attempts allow a beginning reader to establish correspondences between a written word and its meaning, Grainger and Ziegler (2011) also base the foundations of their two routes on these correspondences. Beginning readers use their eyes and attention shifts to identify letters in a word; they benefit from alphabetic knowledge and the spoken lexicon to learn corresponding sounds. In the course of establishing the correspondences, location-specific letter codes are acquired. These codes initiate the development of location-invariant and sub-lexical codes, which are orthographic codes that constitute the very foundations of the model.

The coarse-grained route depends on location-coded letter combinations. Beginning learners develop some detectors of letter combinations which restrict word identity as much as possible. Consecutiveness for these combinations is not necessary as long as they are restrictive. It is assumed that this coarse-grained route has direct access to meaning through orthography alone. The second route, the fine-grained processing route, has indirect access to meaning, which is through phonological and morphological representations. The key aspect of this route is recognizing highly frequent letter combinations since it is based on mapping letters onto pre-existing sub-lexical representations used in spoken language. The aim of this route is transforming orthographic codes easier into linguistic codes for creating correspondences with meaning. Developing orthographic representations carry essential value since they facilitate this mapping process. Phonemes and morphemes form the majority of these orthographic representations since they are highly frequent letter groups.

Another point discussed by Grainger and Ziegler (2011) is the advantages of parallel orthographic processing. First, the coarse-grained route allows rapid access to meaning. Also, the fine-grained route increases the efficiency of the process in which orthographic representations are transformed into phonological transformations. Finally, as a result of combining fine-grained and coarse-grained processes, morpho-orthographic and morpho-semantic representations are likely to develop.

The indicators of a developing parallel orthographic processing are also underlined by Grainger and Ziegler (2011) by referring to some previous empirical findings; it is argued that achieving skilled reading is likely to decrease word length effects and phonological recoding related phonological effects, while it would increase the sensitivity for orthographic priming and morphological structure. Table 1 presents an overview of these indicators.

Table 1. The indicators of a developing orthographic word processing (based on Grainger & Ziegler, 2011)

- Word lengths effects will be reduced (e.g., Acha & Perea, 2008).
- Phonological effects from phonological recoding will be reduced (e.g., Sprenger-Charolles et al., 2003).
- Orthographic priming sensitivity will increase (e.g., Castles et al., 2007).
- Morphological structure sensitivity will increase (e.g., Colé et al., 2011).

2.1.4. Skilled Reading

After moving beyond novice-level reading, it is open to discussion what processes exactly are involved in skilled reading. Although Ehri (1991) proposes that sight word reading dominates skilled reading, there are three other ways in which words can be processed. The first way is phonological decoding. Being the essential strategy for beginning readers, phonological recoding can also be used in skilled reading, especially with larger chunks of letters. Another way is analogizing. This strategy is simply using the words known to guess the pronunciation of novel words. And the last way is to predict how to read a word via context clues and letters.

Other than the rare situations in which the aforementioned three strategies are used, sight word reading allows rapid reading regardless of orthographic consistency and frequency; the SWRM rejects the idea that only irregularly spelled words and highly-frequent words are read as whole. Furthermore, sight word reading is not regarded as a strategy since strategies involve conscious control over them; however, procedures are not controlled by readers in sight word reading (Ehri, 2005). Even though it is accepted that readers can use other ways to read words in skilled reading, since these ways require external focus identifying words and involve a conscious process rather than the unconscious process of sight word reading, comprehension is delayed. Therefore, it is concluded that sight word reading is the most efficient way to read.

The PSGT does not set an end-point for skilled reading. The theory holds that lexical structuring and the other processes are likely to affect skilled reading even in adulthood. This is not to say that the developmental constraints in novice reading are not important. They change depending on the orthography of a language and influence the characteristics of the strategies used for lexical organization and processing. Therefore, processes involved in initial reading development constitute the basis for skilled reading.

This part of the thesis covered the basics on how the reading acquisition models of interest explain skilled reading. The phenomenon will be more thoroughly discussed in a later section together with the models specifically designed for word processing (Section 2.2). Grain and Ziegler's Dual-route Approach (2011) wills also explained in more detail in this upcoming section since it extensively focuses on word processing (Section 2.2.2.5).

2.1.5. Cross-linguistic Differences

As there are notable differences between languages, it is important to examine these and how they are likely to contribute to the nature of language acquisition and language processing. This section examines the effects of language orthography and phonological awareness on reading acquisition.

2.1.5.1. Orthographic Effects in Reading Acquisition

Although Section 2.1.4 briefly covered orthographic effects in language acquisition, the present section is devoted to the investigation of orthographic effects in reading acquisition since the phenomenon is crucial especially in explaining the differences in reading acquisition among different languages. Orthography refers to the rules and norms in writing a language that include what letter sequences are legal and what are the rules behind grapheme-phoneme correspondences (Scheerer, 1986). A language that has little to no inconsistency between grapheme and phoneme correspondences is regarded as a shallow orthographic language while a language with considerable inconsistency between graphemes and phonemes is called a deep orthographic language. Before referring to specific studies that have investigated this phenomenon, it would be helpful to examine what the reading acquisition theories of interest have claimed about the role of orthography in reading acquisition.

Since Ehri (1992, 2005) puts the establishment of grapheme-sound correspondences in the center of reading acquisition, it is crucial to dwell on the role of orthography in SWRM. In shallow orthographic languages, a decoding strategy might be enough to read words, and this can lead to the conclusion that sight words are not necessary. Ehri (2005) disagrees with such an assumption and underlines the difference between reading words and storing them. Although the partial alphabetic phase may last shorter in shallow orthographic languages due to early emerging decoding skills, it is explicitly underlined that decoding alone is not enough for readers to advance to the full alphabetic phase. If a reader uses decoding merely for pronouncing the letters in words without storing sight words in the memory, then it would not single-handedly carry the learner to the full alphabetic phase.

Figure 1. The connections between graphemes and sounds in the SWRM (based on Ehri, 2005)

One major issue in reading acquisition research concerns irregular words, which are especially abundant in deep orthographic languages. Reading words is the ultimate way to store them, and successful reading attempts of the same word lead a word to become a sight word. This process seems straightforward for regular words; however, the processing of irregular words needs further explanation. Ehri (2005) advocated that even in irregular words, most of the graphemes correspond to a phoneme. Through a decoding strategy, they can be regarded as exceptional words while sight word reading regards them as regular words except for some unsettled letters (see Figure 1). The importance of a good alphabetic knowledge to establish accurate correspondences carries essential value, just like it is for regular words.

The PGST (Ziegler & Goswami, 2005) argues that phonological recoding and reading strategies are the major reasons behind the accuracy and speed differences observed in reading across languages. These two reasons are developed differently according to the orthography of a language. In other words, orthographic characteristics determine phonological recoding and reading strategy characteristics.

Reading in shallow orthographies heavily depends on grapheme-phoneme correspondences; phonemic awareness develops at a rapid rate due to the facilitating effect of orthography. Such orthographies might disregard the development of multiple grain size units, thus leading to easier reading acquisition. For languages that lack such consistent correspondences (e.g. English), or lack them altogether (e.g. Chinese), larger orthographic units necessitate the learning of more correspondences since they cannot rely on consistent smaller grain size correspondences. This leads to a dramatic increase in grain sizes to learn; "for instance, to decode the most frequent 3,000 monosyllabic English words at the level of the rime, a child needs to learn mappings between approximately 600 different orthographic patterns and 400 phonological rimes" (Ziegler & Goswami, 2005, p.19).

The PGST has an interesting assumption for so-called multiple routes in reading. For orthographies that lack orthographic-phonological consistency like, for example, English, readers may develop a complex processing system (e.g. a dual-mechanism) for pronunciation. This is even more interesting when we consider the dominance of English studies in reading acquisition modelling. It is underlined that English children also develop strategies regarding grapheme-phoneme correspondences along with multiple grain size strategies. The latter is developed due to the characteristics of English orthography.

Studies showing cross-linguistic differences in reading acquisition are abundant in number and well-reported in the literature. Goswami, Gombert, and de Barrera (1998), for example, examined English, French, and Spanish children at 7-9 years of age. The Spanish participants performed significantly better on a monosyllabic non-word decoding task than the other two groups across all age groups, while the English participants showed the worst performance. Note that Spanish has the shallowest orthography as opposed to English, which has the deepest orthography among the languages investigated in the study. In a later study, Ellis and Hooper (2001) compared two groups of students instructed in a deep orthographic language (English) and a shallow orthographic language (Welsh). The Welsh-instructed group significantly outperformed the English-instructed children in a frequency-matched reading aloud test. In the pioneering work of Seymour, Aro, and Erskine (2003), language acquisition differences are again well-documented. The acquisition of 14 European languages was examined at the end of the first grade, and it was concluded that the orthography of a language influenced the speed of its acquisition.

Overall, reading acquisition studies have highlighted clear cross-linguistic differences, much of which are attributed to the properties of the orthography of the language(s) under investigation. Another important language aspect, which is again affected by orthography, is phonological awareness. The development of phonological awareness coincides with crucial steps in language acquisition. As phonological awareness development is often reported to be interacting with language orthography, it is likely to be affected by cross-linguistic effects. Therefore, the next section will focus on phonological awareness.

2.1.5.2. Phonological Awareness

The issue of phonological awareness and its development has been a controversial and much disputed subject within the field of reading acquisition. Phonological awareness is actually an umbrella term for phoneme awareness, rime awareness, onset awareness, and syllable awareness. Ehri and Nunes (2002) underlined that it is important not to misconceive the letters or letter patterns presenting phonemes as phonemes themselves. Despite their common correspondence, a single letter or letter combination might correspond to more than a single phoneme (e.g. the letter *c* or the letter combination *th* in English). These letters or letter combinations representing phonemes are called graphemes. Again, it is crucial to differentiate phonemes and phones. While a phoneme is the abstract representation of the smallest phonological unit in a language, a phone is the pronunciation of this representation; a single phoneme representation can be pronounced as different phones among words. These varied pronunciations of a single phoneme are called allophones.

The emergence of phonological awareness in the human mind is a controversial issue. According to Liberman (1970), children are born with a special decoding device to perceive speech sounds, which is different from perceiving other, non-speech, sounds. Although these decoded units include phonemic structures, children become aware of them only after reading acquisition. An alternative view argues that as children learn more and more spoken vocabulary items during the language acquisition process, phonological information emerges as a result of this growing spoken lexicon to make a distinction between words (Metsala & Walley, 1998).

Ehri (1991) also puts a special emphasis on phonemic awareness in reading acquisition. Decoding, to start with, requires a leaner to combine phonemes. As stated before, grapheme-phoneme correspondences are at the heart of word storage and sight word reading (Ehri 1992, 2005). For Ehri (2001, 2005), phonemic awareness is not an easy skill to develop and for many people, explicit learning is required to achieve this skill. The PGST has common ground with the view that increasing vocabulary leads to phonological awareness, although it rejects the idea of naturally developing phoneme awareness. Despite the fact that the orthography of a language can affect the relative ease of phoneme awareness development, explicit training is needed to advance (e.g. Bertelson, Morais, Cary, and Alegria, 1987). This is not to say that phonological awareness is always dependent on direct instruction; the PGST agrees that an increase in vocabulary items can lead to the phonological awareness development of larger grain size units. However, for phoneme-size awareness, direct teaching is a necessity, and alphabetic instruction is a must for a good alphabetic knowledge.

Another point of dispute is related to the acquisitional sequence in phonological development. While some argue that small phonological units are acquired first (e.g. Ehri, 2005; Hulme, 2002), others (e.g. Ziegler & Goswami, 2005) reject such a simplification and argue instead that the orthography, the phonological accessibility, and the consistency of units determine which units develop first and to what extent. Pointing to the famous study of Liberman, Shankweiler, Fischer, and Carter (1974), Ziegler and Goswami (2005) argue that as the phonological unit size decreases, the ability to manipulate it gets harder; thus, while syllable manipulation is relatively easier, phonemes are the most difficult phonological units to manipulate. Of course, this does not falsify the previous claim about the cross-linguistic effects on the initial development of phonological unit sizes.

The above subsections presented an overview of cross-linguistic effects in reading acquisition. As the present study will focus on Turkish, it is also important to gain an understanding of earlier studies conducted on Turkish. The next subsection will therefore focus on reading acquisition studies in Turkish.

2.1.6. Studies on Turkish

In one of the earliest Turkish reading acquisition studies, Öney and Durgunoğlu (1997) examined 30 Turkish-speaking first-grade children during their first year of formal education. Unlike English children, at the end of the term the participants did not display any decoding difficulties. Furthermore, it was found that phonological awareness and decoding for Turkish were poor predictors of Turkish reading comprehension in the first grade, while listening comprehension was a significant predictor. These findings were attributed to the shallow orthography of Turkish. In a later study, Öney and Durgunoğlu (1999) investigated Turkish-speaking and English-speaking kindergarteners and first graders. The study confirmed earlier empirical findings that pointed at the relationship between decoding and phonological awareness. Furthermore, although both Turkish-speaking first graders and American-speaking first graders outperformed their lower age groups, Turkish children did significantly better in syllable tapping and syllable deletion tasks than American-speaking children in the same grade. These findings were attributed to the consistent and relatively small number of Turkish syllable structures.

In another study, Babayiğit and Stainthorp (2007) investigated early literacy skills and preliterate awareness of 56 Turkish-speaking children in Cyprus. In this longitudinal study, the same participants were first examined in kindergarten, then in the first-grade, and finally in the second grade. As expected, the children had nearly perfect reading accuracy at the end of the first grade (94%). The results also showed that preschool phonological awareness was an important predictor of early spelling performance. Contradictory to expectations, however, the participants showed poor performance with initial and final phoneme deletion tasks. Babayiğit and Stainthorp (2007) argued that the reason behind poor phoneme deletion tasks could be the task difficulty and education policy; children in Northern Cyprus do not receive alphabetic instruction unlike children in Turkey. Phonological awareness was not a strong predictor of later reading skills. This was again related to the shallow orthography of Turkish along with possible methodological and task-related factors; it was argued the high transparency in shallow orthographies could allocate a rather redundant role for phonological awareness in reading. In a more recent study, Babayiğit and Stainthorp (2010) investigated early reading, spelling, and narrative writing skills with fifty-seven Turkish children. The participants were first tested in the spring term of their first grade and then once more eleven months later in the second grade. The first finding of the study was the stability of reading speed and spelling skills after 11 months. Students who had been good at reading in the 1st grade were also good readers in the 2nd grade. Although it was not as strong as reading speed, spelling performance also remained stable after a year. Students with slower reading speeds and worse spelling performance were again relatively worse than their peers in the second grade. Reading speed and rapid automatized naming (RAN) were found to be significantly related. Word complexity and context (giving the word in a context or in isolation) did not interfere with this relationship. Also, phonological awareness was found to be an unimportant predictor of reading speed when RAN was controlled. In yet another longitudinal study, Babayiğit and Stainthorp (2014) examined 56 kindergartners through the second grade; the participants were tested three times, once in each year. Listening comprehension, vocabulary skill, grammar skill and VSTM (Visual Short Term Memory) before reading instruction were found to be reliable indicators of early reading comprehension skills. Babayiğit and Stainthorp (2014) underlined that as word-reading skills reached ceiling-level speed in shallow orthographies, listening comprehension was a better indicator of early reading comprehension skills.

In a more recent study, Güldenoglu (2016) tested 90 second-grade students using three lexical decision tasks including Turkish words and non-words. The aim of the study was to assess syllable awareness. The participants were divided into two groups: a poor syllable-awareness skill group and a proficient syllable-awareness skill group. The results showed that students with high syllable-awareness proficiencies were faster and more accurate in processing real words compared to their peers with low syllable awareness proficiencies. Güldenoglu (2016) took this finding as an indicator of the decoding strategy students used. The significant difference between the two groups was taken as evidence for the dominance of the phonological route, since the groups differed significantly on syllable-awareness skills. Considering the Turkish orthography in which syllable awareness was an important predictor for phonological decoding due to transparent orthography, and further considering the deduction that the participants were using the phonological route, the essential role of syllable awareness in real-word reading was underlined. The assumption that reading non-words should involve the phonological decoding strategy (due to lack of orthographic representations) was supported since the participants with higher syllable awareness again outperformed their peers with lower syllable awareness in the non-word tasks. All in all, both the real word and the non-word tasks suggested that the participants used the phonological decoding strategy since syllable awareness proficiency played a differentiating role in word processing.

Overall, there is solid evidence that Turkish readers reach ceiling-level reading accuracy very quickly, which is not a surprising result given the shallow orthography of Turkish (Babayiğit & Stainthorp, 2007; Durgunoğlu & Öney, 1999; Öney & Durgunoğlu, 1997). This highly accurate reading performance observed in first graders minimizes the predicting power of phonological awareness, which is a significant predictor in kindergarten for later reading skills. Listening comprehension (Babayiğit & Stainthorp, 2014; Öney & Durgunoğlu, 1997), vocabulary skills, grammar skills, and VSTM (Babayiğit & Stainthorp, 2014) have been singled out as indicators of good reading comprehension skills in Turkish. Güldenoglu (2016) argued a phonological decoding strategy was adopted by Turkish young readers since the students with higher syllable awareness outperformed their peers with relatively poorer syllable awareness. The claims of this study can be criticized due to a number of reasons. First, there was a good possibility for the students with higher syllable awareness to outperform their peers in other reading-related skills, such as reading speed and morphological awareness. A second problem relates to the assumption that using an orthographic strategy would result in similar reaction times; the quality of lexical representations, as well as other factors, might have changed from participant to participant (see Sections 2.2.3 and 2.3.3) Thus, such a strong claim would need further empirical evidence.

Before investigating early word processing in more detail, it is necessary to review some major theories of word processing. One may wonder why Ehri’s model (1995) and the PSG Theory (Ziegler & Goswami, 2005) are not included in the upcoming section since they also have claims on word processing. The reason is the different foci of the theories; while some theories take reading acquisition as their center of investigation, others are richer in explaining word processing. Grainger and Ziegler's model (2011) is an exception and is discussed in both sections due to its recency and direct relevance to both issues.

2.2. Word Processing

Reading involves the processing of words. This apparent relationship is even more essential in developing readers; developmental changes in word processing is likely to affect reading in general. The aforementioned reading acquisition theories offered contrasting views on how illiteracy is replaced with literacy in individuals. The following sections will examine word processing theories, which also present different views. Gaining an understanding of these views on reading acquisition and word processing, and how they contradict each other will help to interpret the results of the present study in more detail.

2.2.1. Single Mechanism Views

Although there are many variants available, the core assumption of a single mechanism view is the availability of a single mechanism for the processing of each and every word. This view can be divided into two broad categories: associative single mechanism views and rule-based single mechanism views. The next two sub-sections will briefly outline some of the models representing both types.

2.2.1.1. Associative Accounts

One of the first advocators of a single mechanism view, Glushko (1979) challenged dual- systems by proposing a kind of analogy process for reading non-words and thus advocating the lack of necessity for a non-lexical mechanism. The system does not require readers to recall a fixed pronunciation from memory or to apply abstract spelling-to-sound conversion rules; rather, orthographic similarity and grapheme-sound patterns are the bases for the pronunciation of words and non-words. These rules are derived each time they are needed rather than simply being stored. This rejection of rule storage is explained in terms of a principle of economy, since full storage requires a large number of specific rules for letters and letter combinations. Glushko (1979) describes this system as an activation system. The system processes regular words and exceptions via the same path. The only difference of exception words is their high probability of activating contradictory information. Such an explanation refutes the idea that exception words are explicitly marked and left out from rule application (Coltheart, 1978). Coltheart, Curtis, Atkins, and Haller (1993) argue that one serious weakness of these arguments is the lack of a formulated model supporting them.

Some other researchers defend a similar analogy process that precludes a non-lexical mechanism (Rumelhart & McClelland,1985; Seidenberg & McClelland, 1989); however, unlike Glushko (1979), they support their criticism by an explicit single-route model of reading: The Parallel-Distributed-Processing (PDP) Connectionist Model. The innate system advocated by Rumelhart and McClelland (1985) is different from the innate system of Chomsky and his followers; while Chomsky supports the existence of an explicit and inaccessible rule system, Rumelhart and McClelland (1985) do not agree on the explicitness of rules. The Rumelhart-McClelland model attempted to explain the acquisition of the English past tense, which subsequently turned into one of the most popular phenomena in the field. At a descriptive level, the acquisition of the English past tense reflects three stages: accurate but limited use of irregular past tense verbs, inaccurate use of irregular verbs largely due to generalization errors, and finally mostly accurate use of regular and irregular past tense verbs (also known as the U-shaped developmental pattern). It is argued that in the first stage children possess a limited number of verbs and use them accurately most of the time. In the second stage, the observation that children add the *-ed* suffix to even irregular past tense verbs is taken as an indicator of an *-ed* adding tendency, which leads to a less accurate use of irregular past tense verbs but denotes a more advanced stage. In the last stage, children generally use both regular and irregular past tense verbs accurately. Rumelhart and McClelland (1985) underline that it is often disregarded that a correctly used irregular verb may coexist with its incorrectly regularized base form + -ed and with its incorrectly regularized past form + -ed (e.g. *wented*). Such a pattern is taken as support for the argument that generalizations based on statistical relationships among similar forms are the reasons behind the aforementioned language behaviors rather than explicit rule application.

As an attempt to model human-like English past tense acquisition, Rumelhart and McClelland (1985) used a simple pattern associator and a decoding network. The pattern associator was assigned to learn the relationships between verbs and their past tense forms. It had both input and output units. The input units served as verbs while output units were devoted to the model's outputs that were the past form unit generations based on the input units. These generations were not always correct. At the beginning, input units and output units had no connections between them. As the model generated guesses for the output forms, or the past tense forms, the pattern associator connected input and output units. Afterwards, the input and the output connections were compared with the verb and the correct past form. The matching connections were left untouched, while the mismatched connections were adjusted. The decoding network, on the other hand, merely converted the featural representations of the output units into phonemic forms that complied with the phonotactics of the language.

Rumelhart and McClelland (1985) argued that the model managed to learn 460 verbs through inputs including regular past tense verbs and irregular past tense verbs with a certain pattern. Not only did the model reflect the typically observed U-shaped learning pattern for irregular verbs, but over-regularized verbs and the correct irregular forms of these verbs coexisted in some stages, similar to transitional stages in children. The authors accepted that the model was not ceiling-level accurate with rule application; however, it was argued that children were also not perfect with rules. Rumelhart and McClelland (1985) hence rejected the idea of explicit rule learning; accordingly, children do not deduce the rules from the input and do not have any idea about what rules are. Rather, they store the associations between verbs and their past forms. The statistical relationship is at the heart of the theory and even the responses for novel verbs are explained with this relationship; persistent patterns emerge from statistical relationships and these patterns are used for interpreting the past forms of novel verbs.

However, the poor performance of the Rumelhart and McClelland model with regular verbs in particular led Pinker and Prince (1988) to argue that the model did not reflect the processes involved in child past tense acquisition. It was underlined that the model could not learn some rules that it should have learned while it came up with rules that existed in no human language. For Pinker and Prince (1988), explicit rule phenomena in language acquisition and production cannot be eschewed.

Creating a more extensive version of the Rumelhart and McClelland model, Seidenberg and McClelland (1989) also tried to explain language acquisition and processing. Like dual-mechanism models, their model also opposed the idea that the processing of phonological information is always necessary in word processing; however, it was not completely identical with dual-mechanism models either. As dual-mechanism models separated two routes by sharp distinctions like irregular words using the indirect route only, the model took the weight connections differences for different processing for words; statistical information such as word frequency was used to determine the weight of the connections between orthographic units and phonological units. The grain size of these connections differed from single letters to multiple letter clusters based on the statistical values related to the words used in the model's training (Seidenberg, 2012). Thus, there was a single mechanism handling two routes. The weight between these units determined the route to be used: a direct route or an indirect route. There were also hidden units that sent feedback to orthographic units to help with word perception. Furthermore, hidden units were also used to activate phonological units, without any feedback. The two-way relationship between hidden units and orthographic units, and hidden units and phonological units can be seen in Figure 2.

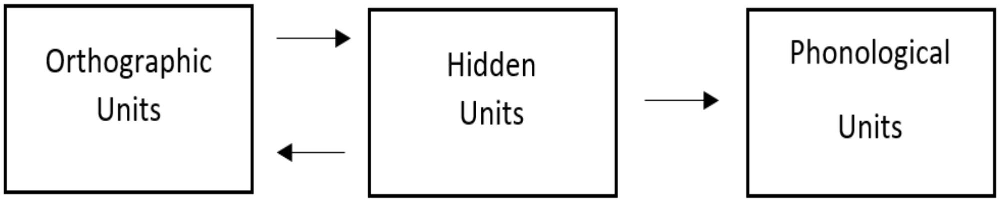

Figure 2. The implemented model structure based on Seidenberg and McClelland (1989)

The validity of this model has also been questioned by many researchers. Besner, Twilley, McCann, and Seergobin (1990) pointed out the model's relatively low performance on reading non-words compared to reading regular and exception words. In response, Seidenberg and McClelland (1990) defended their model by arguing the low performance of their model in non-word reading was due to its low vocabulary size (2,897) compared to humans. In another criticism against the model, Besner et al. (1990) displayed the relatively low lexical task performance of the PDP model (Seidenberg & McClelland, 1989) compared to human participants. Seidenberg and McClelland (1989) acknowledged this deficiency and argued that human participants could benefit from phonological features in lexical tasks, while the model did not have this advantage; thus, the model needed to be improved to handle similar tactics. Coltheart et al. (1993) also found the PDP model unsatisfactory. Despite acknowledging the two superior features of the PDP model (being computational and being able to learn), Coltheart et al. (1993) harshly criticized Seidenberg and McClelland's (1989) model since they tried to reduce the units in their model's output system by an unjustified reduction method, which resulted in the exclusion of some phonotactically legal units as well as the inclusion of some phonotactically illegal units. After an extensive analysis of the model, Coltheart et al. (1993) concluded that the PDP could account for neither developmental nor acquired dyslexia while the dual-mechanism model could explain them satisfactorily.

2.2.1.2. Rule-based Accounts

Rule-based accounts make up another broad category of single mechanism views. In one of the pioneering studies of the account, Taft and Forster (1975) advocated the idea that words are not always stored as wholes; derived and inflected words are likely to be decomposed at the time of language input. The question of whether this morphological decomposition is applied even if the stem of a word is not a real word (e.g. unremittingly *-mit*) was investigated. Taft and Forster (1975) ran three experiments using lexical decision tasks with words and non-words to investigate this argument. The items in the first experiment consisted of real stems stripped off their prefixes (*rejuvenate – juvenate*) and pseudo-stems seemingly stripped off their pseudo-prefixes (*repertoire – pertoire*). The results showed that real stems were harder to reject as they required significantly longer response times to reject; furthermore, more errors were produced with real stems. Another argument was the existence of bound morphemes as separate entries in the lexicon. Some words (e.g. *vent*) functioned both as separate words and as bound morphemes (e.g. *advent*). Taft and Forster (1975) argued that since the functions of these words were distinct from each other, it was likely for them to occupy two different lexical entries. Their second experiment investigated this phenomenon. The results showed that words like *vent* with a higher bound morpheme frequency resulted in significantly slower reaction times than both the words with a higher word frequency than their bound morpheme frequency and the control words which only existed as words and had similar frequency with test words. The third experiment used the same items that as in the first experiment. This time, real stems (e.g. *juvenate*) and pseudo-stems (e.g. *pertoire*) were added inappropriate prefixes (e.g. *dejuvenate*, *depertoire*). The experiment was an attempt to support the findings from the first experiment since some of the items were arguable; for example, the real stem *whelm* used in the first experiment, which had been a standalone word a few dozen years back, might have confused the participants whether it could be used as a stand-alone word. The results of the third experiment supported the results of the first one; the participants reacted significantly slower to the real stem non-words than pseudo-stem non-words. Also, the error rates were significantly higher for the real stem non-words just like they were in the first experiment.

Taft and Forster (1975) interpreted the results as supportive of the idea that morphological decomposition was applied before searching for a word in the mental lexicon and proposed a model to explain the process (Figure 3). Overall, it was argued that the evidence ruled out the possibility of an initial whole-word search paradigm for derived words before morphological decomposition; however, the evidence obtained did not allow to make an assumption about whether a simultaneous whole-word search process accompanied morphological decomposition. was interpreted as a whole word search paradigm did not happen before morphological decomposition; however, the assumption that the whole word search and morphological decomposition happened simultaneously was not within the range of the evidence obtained.

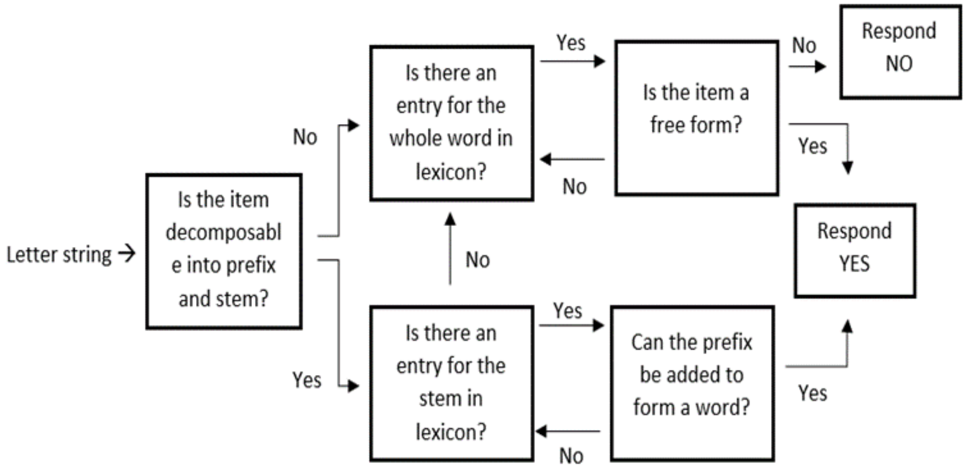

Figure 3. Taft and Forster's (1975) model of word recognition

Although the model advocated that words with real stems (e.g. *juvenate*) were stored separately as a stem and an affix, and the words with pseudo-stems (*repertoire*) were stored as wholes, Taft and Forster (1975) acknowledged another possibility that words like *rejuvenate* were stored with a certain structure like re(juvenate), while the words without any real affixes were stored as wholes. If this assumption was to be true, then a pseudo-stem like *juvenate* would share a structural element with the word *rejuvenate*, while a pseudo-stem like *pertoire* would not since the word repertoire did not possess a real affix. Such a view would contradict with the model at hand in that the model assumed that real stems stored in the lexicon were used in other entries (e.g. the words *admit*, *remit*, and *submit* share the same lexical entry *mit*), while this other view would take each word as having its own lexical entry. The results lacked the conclusive evidence to decide which view was more accurate. Another possible factor that could explain the results was individual differences. It was quite possible for some people to decompose the word *embezzle* as *em* + *bezzle* while other could not recognize these separate morphemes. Therefore, it was argued that the same experiments with less literate participants could yield different results.

As for the reasons underlying morphological decomposition, Taft and Forster (1975) suggested three explanations. The first explanation was related to the economy principle that suggested storing stems separately rather than storing each word individually was more economical. Taft and Forster (1975) found this explanation problematic as they thought the storing capacity of brain was large enough to store each and every simple and complex word without necessitating such an economy principle. The second explanation suggested that units were organized according to their stems which allowed the words with semantic relations to be stored near each other; the words *rejuvenate* and *juvenile* could be stored closely to each other if this assumption was to be true. Their third explanation offered that rather than storing all the words together with the same prefix (e.g. re), stripping prefixes and organizing words in an alphabetical storage would be more efficient when trying to access that word (Knuth, 1973 in Taft & Forster, 1975). In more recent works, Taft (2003, 2004) have updated the model to include a possible dual-mechanism phenomenon (see Section 2.2.2.4).

In another model, Albright and Hayes (2002) created a rule-leaner model with the aim of creating the ability to create output forms rather than merely labeling the given inputs. The basic foundation of the model is based on the deduction of multiple assumptions for a given word and valuing each of these assumption by their well-formedness. The model is also designed in a way to infer both detailed generalizations and broad generalizations. Basically, the model creates a word-specific rule for each given word pair, and as these rules increase, the model combines the ones with the same changes to create generalized rules.

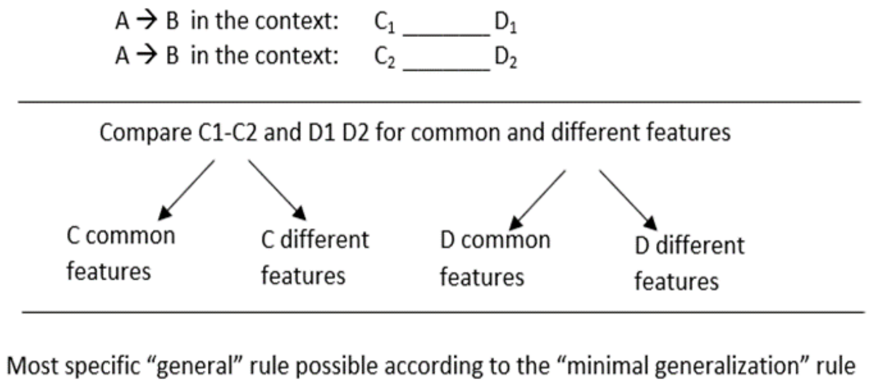

Figure 4. Rule generalization in the model based on Albright and Hayes (2002)

Figure 4 shows the rule generalization procedure of the model. The same structural change rules in different environments are compared. C1 and C2, the environments before the rule application, and D1 and D2, the environments after the rule application, are matched and examined. Between these pairs, common features are combined, and different features are included into a more general rule. The model keeps the rule as specific as possible to cover the given word pairs, which is a principle the researchers called minimal generalization. Then, these rules are compared with the structures in the data. The more matching structures a rule has, the higher reliability the model marks it with. These confidence values are then used in the production for novel inputs. The model is programmed to recognize illegal letter combinations that allow it to infer phonological rules. The aim of these rules is to increase the accuracy of the outputs. In addition, some cross-context rules are added since some phonological rules cannot be derived through ill-formed morphological outputs (e.g. devoicing rule). All in all, the model acquires a number of rules, from the most general rule to word-specific rules that will never be used in deriving words due their low confidence values.

One problem that occurred in the model's test was what was called distributional encroachment. Irregular forms usually possess changes that are restricted to a few words. In some cases, regular rules could change irregular forms in wrong environments rather than the rare rules that were supposed to apply. This would lead to wrong generalizations in the model. For example, the novel verb *pran* would come up as *prant* as a considerable choice, which Albright and Hayes (2002) evaluated as ill-formed. An algorithm named *impugnment* was added to model; this algorithm allowed smaller rules to question the validity of larger rules in all context.

To compare the results with their model, Albright and Hayes (2002) conducted two experiments with adult participants. In the first experiment, the participants were first introduced with a sentence which contained a made-up verb. The next sentence had a blank that clearly required the past-tense form of the made-up word from the previous sentence. In the second experiment, the same participants were given a 7-point scale that consisted of the alternative past-time derivations of the verbs used in the first experiment. The goal was to choose the most appropriate answer between different (regular and irregular) versions of the made-up words. The results of the experiments showed that the model showed similar past-tense deriving patterns with the participant answers; both the model and the participants preferred mostly regularly made-up words and selected irregularly made-up words only when they shared real-irregular word contexts (e.g. *–ing* , *-ung*). Seeing the high ratings for words like *prant* by the participants, Albright and Hayes (2002) decided to turn impugnment algorithm off. Albright and Hayes (2002) concluded that the model captured some valuable patterns of human past-tense preferences.

Pinker and Ullman (2002) criticized single mechanism models for a number of reasons. First, creating specific rules for irregulars necessitates too many rules, which is not economical. Another objection is against the statistical patterns. Referring to the study of Marcus, Brinkmann, Clahsen, Wiese, Pinker (1995), Pinker and Ullman

(2002) underlined that although the German –*s* plural is applied to a limited number of nouns (%7), it reflects the characteristics of the affixes that are applied by regular rules; as one of the examples in the article, German-speaking children make generalization errors with the German -*s* plural like English-speaking children make with English -*s* plural despite the extremely low frequency of the German suffix compared with the English one. Thus, children's over-regularization errors do not reflect the pattern of regular verbs used by adults. Also, some irregular verbs appear as regularized verbs in some specific contexts (e.g. ringed-rang). This is taken as evidence for the existence of additional factors in inflecting words other than sounds alone. Pinker and Ullman (2002) argued that connectionist explanations cannot account for this phenomenon. Finally, neurological disorders and the way in which they affect language functionality are shown as evidence against the single mechanism views since most of the disorders cause some language processing impairments as they leave other functionalities undamaged or relatively less impaired, which is a strong indication for distinct modular systems for language processing. Many researchers with similar claims have argued for the impossibility of a single mechanism view to account for language processing and maintained the view that at least two systems are required to explain such phenomena (e.g. Pinker & Ullman 2002; Ullman, 2001a, 2001b).

2.2.2. Dual-mechanism Views

2.2.2.1. A Brief History

Baron and Strawson (1976) advocate two different mechanisms: one responsible for acquiring and using the patterns between letters and sounds (an orthographic mechanism) and the other using the pronunciations of words or morphemes as wholes (a lexical mechanism). To prove their argument, they conducted two experiments. The first experiment involved a reading aloud task in English with three different types of stimuli: regular words, exception words, and non-words. Although the frequencies of regular and exception words were approximately matched, the participants read regular words much faster than the exception words and non-words. To show that the results of the first experiment was not due to visual or etymological factors, another experiment was run. Baron and Strawson (1976) stated that controlling the confounding factors regarding to visuality and etymology was impossible; therefore, they formed two groups: Phoenicians, who had a relatively better orthographic mechanism and a relatively worse lexical mechanism, and Chinese, who reflected the exact opposite pattern of the other group. Capitalization used as a further variable and the words were organized in the experiment as lower case, upper case, and mixed case. The results suggested that having mixed-case letters affected exception words more than regular words, which was taken as evidence for the vulnerability of lexical mechanism against case manipulation. Remember that the lexical mechanism relied more on letter combinations and whole-word representations. The Chinese group was affected more by the letter-case manipulation, which confirmed the authors' expectation since this group was thought to rely more on their lexical mechanisms. Furthermore, the Phoenician group showed significantly better performances with regular words, again complying with the expectations since they were thought to have better orthographic mechanisms. Baron and Strawson (1976) argue that people have different types of rule knowledge; some extremely rare rules, which should be treated as exceptions rather than rules, are not acquired by all people due their unproductive nature.

So far as the advocates of dual-mechanism view are concerned, it is essential to refer to the models based on dual-mechanism view. Coltheart et al. (1993) have developed a Dual-Route Cascaded (DRC) model of reading as a rejection to single mechanism models. Referring to a similar computational model developed by Reggia, Marsland, and Berndt (1988), Coltheart et al. (1993) point to two essential differences: First, unlike the model of Reggia et al. (1988), Coltheart et al.'s model

(1993) does not have graphemes in the initial input units; graphemes are only available in a later level of the nonlexical route as a result of letter conversion. The second difference is the ability of learning grapheme-phoneme mappings in Coltheart et al.'s model (1993), while in Reggia et al.'s model (1988) these mappings are built in. Two strong features of the PDP model (Seidenberg & McClelland, 1989) are included in the new model of Coltheart et al. (1993): a computational nature and ability to learn. The model has an initial set of training words, which allows it to learn grapheme-phoneme conversion rules. These rules can be context sensitive, position specific, generalizable, multi-letter rules, and multi-phoneme rules. Rules are updated or created as new input contradicting with the current rules are encountered. Whenever a single letter fails to account for a phoneme, a multi-letter GPC rule is created by the model. Also, a *single letter for multiple phonemes* algorithm designed in a similar way is added to model to account for the letter *x*. The model starts examining letters from left to right, and the most general rules complying with the text are applied. A minimum rule frequency is added to the model to prevent extremely rare rules from applying to non-words.

Coltheart et al. (1993) tested the model with exception words, regular inconsistent words, regular consistent words, and non-words. Overall, the DRC model (Coltheart et al., 1993) outperformed the PDP model (Seidenberg & McClelland, 1989) and showed a close pattern with human language behaviors. Furthermore, Coltheart et al. (1993) argued that the nature of aspects like neighborhood size, regularity, and disorders like dyslexia could be explained by the DRC Model (see Coltheart et al., 1993 for a detailed discussion).

2.2.2.2. Pinker's Dual-mechanism Model

Another influential dual-mechanism theory is that proposed by Pinker (1991). Referring to the phenomenal past tense debate in English that has been taken up by many researchers in the word processing literature, Pinker (1991) argues that in addition to regular affixation tendency for novel words and neologisms for English speakers that can lead to errors in which the *-ed* suffix is attached to irregular forms, there is also an irregular affixation tendency in English-speaking children for words that are similar to the base forms of irregularly affixed complex words (e.g. spring-sprang); similarly, this irregular affixation tendency also result in affixation errors (e.g. bring-brang) This pattern observed with children can be referred to a rule application mechanism rather than an analogy process based on statistical patterns; the later view would predict not predict an error like *brang*. Therefore, Pinker (1991) proposes characteristic differences between regulars and irregulars: Regular forms are the products of rule-application processes and irregular forms are directly called from the memory.

There is a *blocking mechanism* in the model that prevents the application of a rule in situations in which an irregular form is retrieved from memory; although, there are examples of the failure of this mechanism in children as they overregularize some verbs. As children develop their language systems, overregularization errors diminish as a result of a more efficient blocking mechanism.

Frequency is another issue that is addressed in the model. Since the model refers to regular forms as the results of rule application, these forms are not subject to associative memory effects based on frequency and similarity while irregular forms are due to their storage in the memory. Pinker (1991) also proposes that the low-frequency irregular forms have been regularized over years unlike the high-frequency irregular forms (e.g. *go*, *make*, *take*).

Focusing on compound words, Pinker (1991) also argued that regular forms cannot be subject to other word-formation process as they are the ultimate output of word-formation processes, while irregular forms, as being memorized items rather than processed, can be (e.g., mice-infested and rat-infested). As solid evidence for this claim, Pinker (1991) pointed to the study of Gordon (1985); in this study, the majority of 3 to 5-year-old children (90%) responded to the definition, a monster who eats mice, as *mice-eater*, while only a small percentage of the same participants (2%) responded to the definition, a monster who eats rats, as *rats-eater*. Considering the low frequency of these compounds and the young age of children, Pinker (1991) argues that the pattern observed is a result of the grammatical systems.

And the most striking assumption of the theory, since they are based on different systems, there should be the cases of brain injuries in which one system is impaired while the other one is still fully operational or relatively more operational. The theory became the ancestor of the Declarative/Procedural model as Ullman has based his theory on similar claims.

2.2.2.3. Declarative Procedural Model

Ullman (2001a, 2001b) bases his dual-mechanism model on the declarative memory and procedural systems, which serve distinct language functions. The two systems differ greatly in their cognitive, computational, and neural bases (see Table 2). The declarative memory is responsible for learning explicit knowledge; it functions as a mental lexicon in which word meanings and sounds are stored. This is seen as an associative memory rather than a route memory adopted by traditional dual-mechanism views. Unlike a route memory, an associative memory is productive. The reason to include a productive memory model (the extend of the productivity is unknown) is the fact that even with irregulars, some patterns may emerge, and language users can use these patterns for novel verbs (e.g. *spring-sprang, spling – splang*).

Table 2. Functions of the two memory systems (based on Ullman, 2001a)

Declarative memory	**Procedural System**
• Learning • Representation • Use of knowledge about facts • Events • Might be important for associative /contextual binding of the information (Related to the ventral visual stream) • Accessible to multiple mental systems	• Learning new and controlling well-established motor and cognitive skills • Encapsulated (dorsal visual system) • Learning, processing • Skill that involve action sequences

The procedural system, on the other hand, works like a rule processer for language functions. These rules are applied through symbol manipulation. This is different from the linguistic patterns proposed by connectionist models. These rules are applied via mental processes. The procedural system is attributed to the implicit learning of any kind, including habits and motor/cognitive skills along with implicit language learning.

It is proposed that the two systems in the model are modular and informationally encapsulated; they do not require input from each other. It is argued that the procedural system has a strict encapsulation that does not allow other processes to access it directly, while the memory system is more accessible by other general processes. The procedural system deals with fully productive transformations or with transformations that only necessitate morphological-sequencing (e.g. *talk- talked*). For the rest of the transformations, including overt phonological changes, the declarative memory is responsible. It is also underlined that a complex form can be learned by the declarative memory and can also be computed through the procedural system. The production of regular and irregular forms at the same time is achieved through a blocking mechanism; however, it does not require information stored in these systems. Rather, the blocking mechanism only needs the information that the memory system is successful in its computation for an irregular form so that the procedural system will not produce a regularized version of the same form.

Ullman (2001a, 2001b) refers to the findings from earlier studies as supporting evidence for the model. First of all, earlier studies related to frequency mostly found frequency effects for irregulars but not for regulars. He argues that the studies in which frequency effects for regulars were found had problems with their material designs.

A further point of support relates to phonological neighborhood. Ullman (2001a, 2001b) states that earlier studies have shown neighborhood effects for irregulars only. This contradicts with single mechanism views; since the sole system is responsible for both regular and irregular processing, the effects should be seen for both forms within the framework of single mechanism views. Furthermore, Ullman argues that the findings are also inconsistent with traditional dual-mechanism models; it would be hard to account for such effects in irregular forms due to their rote-memory based explanations.

2.2.2.4. Taft's dual-mechanism view

Taft (2003, 2004) updated the previous model of Taft and Forster (1975) and accepted the possibility of a dual-mechanism phenomenon. This new model, however, is different from traditional dual-mechanism views. It is argued that all polymorphemic words are decomposed at the initial processing stage and there are no full-form representations. The initial form-based decomposition provides the necessary information for a lemma system. If the word is transparent and the individual meanings of the constituents (e.g. roots, stems, affixes) are sufficient to arrive at the final meaning, then this word does not have its own lemma representation since the constituents are easily combined to get the final meaning.

This recombination stage is thought to be more emphasized in languages with a productive morphology. After recombination, the information is merged with semantic/syntactic information. As for opaque or relatively opaque words, like feathery, there are full lemma presentations along with individual constituent representations at the lemma level. After the decomposition stage, the constituents and the full lemma representations are activated. Full lemma representations are then merged with the semantic/syntactic information.

Frequency effects are also discussed within the model. In two experiments, Taft (2004) manipulated base and surface frequency along with non-word type. The results showed that the participants reacted slower to the low-frequency words with highly-frequent stems, which was attributed to a more challenging recombination stage. Taft (2004) interpreted the results as base frequency affecting the initial processing, while surface frequency effects were only apparent in the combination stage. Any difficulty encountered within this stage might have suppressed the base frequency effects and led to the false assumption that the base frequency did not have any effects at all. The lack of base frequency effects is often referred as a proof for whole-word form processing. Taft (2004) challenges the idea and proposes that the lack of base frequency effects should not be taken as evidence for the absence of decomposition.

2.2.2.5. Grainger and Ziegler’s model

Another well-known dual-mechanism model that is often cited in research on word processing is that by Grainger and Ziegler (2011), which was also discussed in Section 2.1.3 in relation to reading acquisition. Grainger and Ziegler (2011) pointed out how most computational models of orthographic processing have failed to address “the hard problem of orthographic processing”. During reading, human eyes fixate on words in a text and gather information about the position of letters. This information, however, does not tell us the position of the letter in the word; rather, it gives the information based on our eye position and the letter. This representation based on letter positions is then transformed into word-centered representations. Grainger and Ziegler (2011) offer their own dual-mechanism model to explain how this transformation happens. Their intent is to explain how skilled readers get the semantic information necessary for reading comprehension in words despite two kinds of restrictions: letter-in-string visibility restrictions and temporal restrictions caused by reading rate.

The first restriction is related to the frequency of occurrence; low frequency letter combinations give more information about a word's identity. The second restriction is related to the frequency of co-occurrence; high frequency letter combinations can be formed as higher-level orthographic representations, such as digraphs and morphemes. All in all, word frequency is used in different ways in different situations; high frequency can act as an obstacle in terms of word recognition since it does not eliminate many potential word candidates, or it can act like a facilitator since it allows forming higher-level orthographic representations (Grainger & Ziegler, 2011).

The model suggests that these two restrictions in reading lead to the development of two routes. The first type of restriction, in-string visibility restriction, serves for identifying letter combinations that are rare. These letter combinations can best restrain a word's identity, which is crucial to recover a word's meaning directly. The letter combinations do not require letter contiguity as long as they are distinctive. This coding system gives rise to a direct route, which is called the coarse-grained route.

The second type of coding depends more on strict letter orders in words; the multi-layer graphemes and their accurate orders are coded to activate the phonemes, which will later trigger the phonological and semantic representations of whole words. Grainger and Ziegler (2011) underline that this coding system also recognizes highly frequent contiguous letter combinations, like digraphs and morphemes, which are very useful for chunking. This coding system constitute the foundations of an indirect route, namely the fine-grained orthographic route. It is argued that the fine-grained orthographic processes are also related to single letters since most of the letters have corresponding phonemes.

Another phenomenon discussed within the model is morpho-orthographic segmentation. Grainger and Ziegler (2011) argue that morpho-orthographic segmentation is based on the fine-grained route. In the literature it has been reported that while affixed words, pseudo-affixed words, and transposed-letter affixed words showed priming effects for their stems, transposed-letter pseudo-affixed words did not (see Grainger & Ziegler, 2011 for more information). Grainger and Ziegler (2011) argue that affixed words and pseudo-affixed words can make use of the fine-grained orthographic processing as the letter positions are in order for morphemes and pseudo morphemes; however, truly affixed words also use the coarse-grained route more effectively to activate stems. The whole-word of representation of *farmer* can help the activation of *farm* due to shared morpho-semantic representation, while the whole-word presentation of *corner* does not share a morpho-semantic representation with *corn*. In line with these assumptions, the coarse-grained coding helps to activate whole-word orthographic presentations and thus a priming effect can be observed for transposed-letter affixed words. As for the transposed-letter pseudo-affixed words, it is argued that since the only source of priming for these words is the fine-grained orthographic processing, and since the order of the letters that is crucial for this type of coding are manipulated, no priming effects are observed. One of the interesting findings in the literature is the lack of priming effects for transposed-letter words in Semitic languages (e.g. Velan & Frost, 2011). Grainger and Ziegler (2011) argue that Semitic words can be processed by fine-grained orthographic processing only. Grainger and Ziegler (2011) hypothesize that effective use of the fine-grained processing route can hinder coarse-grained orthographic processing from developing for Semitic-root derived words.

2.2.3. Development-focused views

Two views focusing on the development of the processing system and the nature of the representations processed are briefly summarized in this section. The first view, the lexical tuning hypothesis (Castles, Davis, & Letcher, 1999; Castles, Davis, Cavalot, & Forster, 2007) proposes a maturing processing system that functions differently in children and in adults. The other view, the lexical quality hypothesis (Perfetti, 2007) offers an explanation for the effect of individual differences in word processing by referring to the different elements in constructing word representations.

2.2.3.1. Lexical Tuning Hypothesis

The Lexical Tuning Hypothesis (Castles, Davis, & Letcher, 1999; Castles, Davis, Cavalot, & Forster, 2007) proposes that younger readers have a relatively more flexible word recognition system for letter positions and identities. This system gets stricter as vocabulary size grows, and differentiating between words becomes an important aspect of word processing. Strong evidence behind this hypothesis comes from two seminal studies. In the first of these studies, Castles et al. (1999) ran a priming study with children. One-letter-different primes were used with high neighborhood sizes (high N) and low neighborhood sizes (low N). The results showed that both high N and low N one-letter-different primes led to priming effects in second, fourth, and sixth-grade children. The results contradicted with the adult studies showing priming effects only for low-N words primed by one-letter-different words. Castles et al. (1999) interpreted the results as young readers having a limited vocabulary compared to adults and thus lacking many neighborhoods of the words they had learned. Without a strong competition between words based on similar orthographic representations, the children read efficiently without strict letter sequence and letter identity criteria. As readers develop their reading proficiency and the neighborhoods for words increase, their reading systems pay additional focus on letter sequences and letter identities for accurate word processing. Castles et al. (2007) calls this he lexical tuning hypothesis.

In the second study, Castles et al. (2007) improved their design to overcome confounding factors. As stated by Castles et al. (2007), one major problem with previous study (Castles et al., 1999) was the lack of a difference between second grade and sixth grade children. This problem was tried to be overcome by adopting a cross-sectional design. Third-grade children participated in the study, and the same participants again participated in the study 2 years later. In addition, adult readers were included in the study to get a complete developmental picture. This study did not only investigate one-letter-different primes; one-letter-transposed primes were also included. Transposed-letter (henceforth, TL) primes were further categorized into two categories: internal letter transposition and external letter transposition. All words were selected as short, highly-frequent, and high-N words. Overall transposition priming for the adults (8 ms) was much lower than for the third graders (64 ms) and the fifth graders (43 ms). While the place of transposition did not matter for the adult participants, the priming effect for internal letter transposition items (155 ms) was significantly higher than external transposition items (20 ms) for the children. One-letter different primes failed to show any significant priming effects for the adults and the fifth graders, while the effect was significant for third graders (78 ms). Referring to the previous study of Castles et al. (1999), Castles et al. (2007) claimed that such effect sizes were similar to identity priming in children of the same age; thus, one-letter-different and TL primes might have been as effective as control primes, the words themselves. Overall, the findings supported the lexical tuning hypothesis as growing vocabulary size and density seemed to alter the word processing mechanisms. For the contradictory priming effects of one-letter-different primes and one-letter-transposed primes in the fifth graders, Castles et al. (2007) argued that the system for word processing first generated strict letter identity criteria while letter position flexibility continued for some more time. It is also important to consider that the words were all high N words.

2.2.3.2. Lexical Quality Hypothesis

The Lexical Quality Hypothesis has been proposed to explain reading proficiency differences (Perfetti, 2007). It is claimed that word form information, semantic information, and the accurate combination of pragmatic features determine the lexical quality of a word. Enough practice of these components leads to efficiency in word processing. In parallel, this efficiency brings accuracy and flexibility. A word with high lexical quality in one reader might be represented weakly in another reader with the same age or even with the same reading proficiency. While this indicates a great variability between readers, it is argued that the mean lexical quality of words can be taken as reference. Therefore, vocabulary size alone is not a sufficient measure to determine vocabulary skill; lexical quality is another important factor.

The accuracy and flexibility for the words with high lexical quality are both required for efficient comprehension and production (Perfetti, 2007). As a result of high accuracy, a language user would not have problems with similarly written words (desert-dessert), while as a result of high flexibility, a language use could comprehend and use the different synonyms of words. Perfetti, (2007) argues that the words with low lexical quality lead to representation and processing problems for language users. As for representation problems, it is argued that the words with low lexical quality might not be well presented in terms of orthography, phonology, and meaning. Furthermore, these words might lack the adequate range of class forms that are necessary for grammaticality. Perfetti (2007) also states that the bond among orthographic, semantic, and phonological constituents regarding the words with low lexical quality might not be strong. The processing problems include the failure of word activation, the problems with activating a word’s constituents, and the failure of reaching a word’s meaning (for further details, see Perfetti, 2007).

2.2.4. The Use of Morphemes in Word Processing

The word processing theories discussed so far make various claims regarding the nature of word processing. As far as word processing is concerned, the use of morphemes is a major area of interest. Furthermore, the current study aims to reveal the role of real morphemes (real affixes and real stems) and pseudo-morphemes (pseudo affixes and pseudo stems) in the early word processing in Turkish. Considering its importance in the word processing literature and in this thesis, the phenomenon deserves a detailed investigation. Before proceeding to examine whether morphemes are salient units in the early stages of word processing, the next section reviews the role of morphemes in word processing.

2.2.4.1. The Role of Morphemes

The controversy about the role of morphemes in word processing is still unresolved. While some (e.g. Schreuder & Baayen, 1995) see morphemes as meaning-bearing units stored depending on their form and meaning features, others (e.g. Rastle & Davis, 2003; Grainger & Ziegler, 2011) see morphemes as frequent letter clusters stored depending on their statistical powers. There are also different views regarding the role of morphemes in reading development. This subsection reviews some essential studies about morphemes and their roles. In a quest of settling the controversy, many studies have focused on the issue.

Burani, Marcolini and Stella’s (2002) study on Italian included third, fourth and fifth grade children and adults. To investigate the role of morphemes in a shallow orthographic language, they used a naming task and a lexical decision task. The results showed that all participants in the study reacted faster to non-words made up from morphemes compared to non-words without any morphemic constituents. High-frequency was again a facilitative factor for all age groups. The results supported the view that morphemes were functional units of word recognition, at least in a shallow orthographic language like Italian.

In another Italian study, Marcolini et al. (2011) investigated the role of frequency and reading proficiency in word recognition. The study involved sixth graders and adults, further dividing the children as good readers and poor readers. The results for the child participants showed that while poor readers reacted faster to morpheme-constructed words regardless of their frequency, good readers only showed this pattern with low-frequency words. Such a morpheme-based effect was absent in adults for both frequency types. Another interesting outcome of the study was the faster and more accurate responses to high-frequency words (both polymorphemic and simple words) for all groups. Marcolini et al. (2011) argued that less skilled readers have problems using units larger than morphemes (whole words), thus showing decomposition effects for all words while more skilled readers process highly-frequent words as whole-words. Such an argument essentially proposes that morpheme use in word recognition is gradually abandoned for whole-word processing.

Studying a deep orthographic language, Mann and Singson (2003) examined morphological awareness and its role in English-speaking third, fourth, fifth, and sixth graders. The results showed that morphological awareness gradually took a more essential role in word processing while the role of phonological awareness gradually decreased. This developmentally increasing role of morphological awareness was prominent for phonologically opaque and low-frequency words. Such a developmental change was related with increasing vocabulary size, especially for words with complex morphological structure.

In their well-known study, Carlisle and Stone (2005) investigated the role of morphemes in English in primary-school , middle-school and high-school students. A reaction time task, in which participants named non-words, and a word reading task, in which participants read derived words and pseudo-derived words with varying frequency levels, were conducted in the first experiment with the primary-school participants. The second graders and the third graders in the study read derived words faster and more accurately than pseudo derived words. The fifth graders also showed the same pattern; however, the facilitative effect of truly derived words was relatively smaller for them. All primary school participants performed worse with the low-frequency derived words in the study. In the second experiment, with middle-school and high-school participants, the same reaction time task from the first experiment, a word reading task including derived words that had varying phonological transparency, and a lexical decision tasks including the words from the word reading task along with non-words were conducted. Both middle-school and high-school participants read the derived words with transparent phonological structure more accurately, while the middle-school participants also read these words faster. The results showed the effect of morphemes in polymorphemic words with transparent structure in all age groups. The findings could be explained within Taft's model (2004), in which the decomposition of derived words led to enhanced activation of the words. Carlisle and Stone (2005) also argued that the role of morphemes should be extended in the SWRM (Ehri, 2005). For them, the sensitivity to morphemes could be a significant actor in reading acquisition. Phonological transparency also had an effect on the participant performances as both the middle-school and the high-school children provided significantly more accurate responses to phonologically transparent words. The effect of transparency seemed to diminish with increasing age, possibly as a result of increased reading exposure.

Investigating the role of frequency from another perspective, Quémart, Casalis, and Duncan (2012) examined third and fifth grade French speaking children using words and non-words in a lexical decision task. Despite the matched frequencies across items, morphemes in the study (bases and suffixes) proved to be more salient units compared to the frequency-matched letter clusters. As suffixes facilitated word-recognition in all situations, bases speeded up the participants only in the absence of a suffix. This was attributed to the immature processing system of children, which was overwhelmed by the existence of multiple morphemes. The results hence supported the argument that morphemes are salient units in processing both familiar and unfamiliar words.

One of the few studies to focus on the role of syllables and morphemes at the same time, Colé, Bouton, Leuwers, Casalis, and Sprenger-Charolles (2012) conducted a study on French with second and third grade children. The young readers in the study gave faster and more accurate answers to non-words created using real morphemes compared to non-words created using a non-stem and a real suffix combination, implying that morphemes were functional units of word processing in French even for very young readers. Furthermore, another task based on syllable and morpheme segmentation with low-frequency words showed that the reaction times were similar for syllable-segmented, morpheme-segmented, and unsegmented words. The only item category that elicited significantly longer response times in this task was the segmentation of a morpheme along with a grapheme (e.g. mala -de). This condition was included in the study to check whether any potential differences between syllable and morpheme conditions could be attributed to the difference between the amount of information they carried; morphemes included more letters compared to syllables and it was thought that this additional letter information could have an effect. As this latter condition led to longer reaction types, the conclusion was drawn that the amount of information provided by letters between conditions was not responsible for the findings. Colé et al. (2012) further concluded that syllables, morphemes, and whole words were functional units in the processing of low-frequency words.

More recently, Hasenäcker and Schroeder (2017) compared the use of syllables and morphemes in German with second and fourth grade children and adults using the lexical decision task paradigm. Monomorphemic words were divided into syllable-congruent and syllable-incongruent categories, while polymorphemic words were manipulated as syllable-congruent and morpheme-congruent (syllable-incongruent). Second graders in the study reacted faster and more accurately to the syllable-congruent items in both monomorphemic and polymorphemic conditions. This was taken as evidence for the prominent role of syllables in very young readers of German. For the fourth graders, although reaction times were faster in the syllable-congruent -polymorphemic condition, there was no facilitative effect of syllable-congruency on monomorphemic words. Non-words with a real suffix were also rejected slower. This suggested although syllables were still essential units in word processing of fourth graders, the sensitivity to morphemes was also in development. Furthermore, the finding that the participants rejected the non-words including a real suffix with greater difficulty could be due to different processing mechanisms involved in processing familiar and unfamiliar words, like in the previous studies examining frequency effects (e.g. Carlisle & Stone, 2005; Marcolini et al., 2011). Adults readers in the study were not affected by the different syllable and morpheme conditions in the study. Note that this did not eliminate the role of syllables and morphemes in adults since the study was more focused on children and the items were specifically designed for younger readers; rather, the adult data could point to a higher reliance on the coarse-grained route for adults. Unfortunately, the study did not include any control items without boundary separation to compare the syllable-congruent and morpheme-congruent items with normal presented words. The results overall suggested an initial dependence on syllables as salient units along with a gradually developing morpheme sensitivity.

The studies presented thus far have provided evidence for morpheme salience in word processing that is affected by frequency, familiarity, and cross-linguistic effects. Although the role of morphemes in word processing is supported by a good number of studies, what remains to be discussed is the nature of the processes involved in the very early stages of word processing. The next section summarizes some pioneering studies that have examined these early stages.

2.3. Early Stages of Word Processing

Lexical decision tasks and word naming tasks are feasible ways to investigate word processing; yet, they are not capable of offering insights into the earliest stages of word processing. Researchers interested in the very early phases of word processing therefore very often make use of the masked priming paradigm. Before moving to the investigation of various studies the using masked priming paradigm, it is important to explain the procedures and terminology related to the paradigm. The masked priming paradigm (Forster & Davis, 1984) involves representing a prime before a target word. This prime is briefly presented (30-70 msec) after a mask. The purpose of the mask is to make primes harder to see consciously. Masks usually consist of symbols like #s and Xs. The target word appears after the mask and participants decide if the target word on the screen is a real word. What is important in the paradigm is to create specific prime-target conditions in which the effect of the relationship between primes and targets on response times can be examined. The primes have an orthographic, semantic, or morphological relationship (or a combination of these relationships) with their targets and are compared with the primes that have no apparent relationship with their targets; therefore, it can be observed whether the kind of relationship (orthographic, semantic, or morphological) a prime has with its target facilitates the recognition of that target word. Since primes in the paradigm are presented briefly, it is claimed that the paradigm excludes the involvement of conscious awareness and strategies (e.g. Feldman, Kostić, Gvozdenović, O'Connor, and Del Prado Martín, 2012; Forster & Davis, 1984; Forster, Mohan, & Hector, 2003; Rastle et al., 2004). Different studies have used different labels for the word sets they have used; therefore, Table 3 presents the terminology used in this thesis to avoid ambiguity.

Table 3. Terminology for different word set conditions

Condition	Description	Example
Semantic Condition	The primes in this condition are morphologically and orthographically unrelated, but semantically related to the targets (Feldman, Rueckl, DiLiberto, Pastizzo, & Vellutino, 2002).	*house- roof*
Orthographic Condition	The primes in this condition are morphologically and semantically unrelated, orthographically related to the targets (Feldman et al. 2002).	*play- pray*
Opaque Condition	The prime seems to include the target word and an affix; prime-target pairs in this condition bear a morphological relationship but no semantic relationship (Rastle, Davis and New, 2004)	*corner- corn* *Corn* is a legitimate word and *-er* is a legitimate affix in English; yet, the word *corner* has no semantic relations with them.
Formal Overlap Condition	Prime-target pairs in this condition bear an orthographic relationship but no morphological or semantic relationships. What differentiates this condition from the orthographic condition is the pseudo-stems; primes orthographically include their targets and additional letter clusters attached to them that are not affixes (Rastle et al., 2004).	*carrot- car* *Car* is a legitimate word in English; yet, the word *carrot* has no semantic relation with the word *car*.
Transparent Condition	Prime-target pairs in this condition have a semantically transparent morphological relationship (Rastle et al. 2004).	*farmer – farm* *Farm* and *Farmer* have a true morphological relationship; the former is derived from the latter.
Opaque Non-word Condition	The primes in this condition are a combination of their target word and a real affix. What is different in this condition from the opaque condition is that primes themselves do not present real words (Beyersmann, Grainger, Casalis, and Ziegler, 2015b).	*farmation- farm* *Farm* is a legitimate word and *-ation* is a legitimate affix in English; yet the word *farmation* does not exist.

Table 3. (cont.)

Formal Overlap Non-word Condition	The primes in this condition include their targets in them with additional letters clusters that are not affixes in that language. What is different in this condition from formal overlap condition is that primes themselves do not present real words (Beyersmann et al. 2015b).	*farmald – farm* *Farm* is a legitimate word and -*ald* is neither an affix or word. The word *farmald* does not exist in English.
Unrelated Condition	Prime-target pairs in this condition do not bare a semantic, morphological, or orthographic relationship (Rastle et al. 2004).	*notebook- farm*

2.3.1. The Form-First Account

One of the most current discussions in early word processing revolves around the effect of semantic transparency. The advocators of the form-first account (e.g. Rastle et al. 2004) argue that the early word processing is not affected by semantic transparency; therefore, the complex words that have a semantic relationship with their base forms (transparent words like *farmer* and its base form *farm*) are processed in the same way and with the same efficiency compared to the seemingly complex words that have no semantic relationship with the pseudo stem and pseudo affix they possess (opaque words like *corner* that has a pseudo stem *corn* and a pseudo stem -*er*). As solid evidence for this account, the masked priming studies that have found equal priming effects for both transparent and opaque conditions, which will be presented in this section, are shown (see Table 3 for the relevant terminology). It is important to state that the form-first account accepts the facilitative effect of semantic transparency in later stages of word-processing; however, for the very early stages of word processing, the form-first account rejects the effects of semantic transparency. This concept of purely form-based early word processing has been challenged by the form-and-meaning account (Section 2.3.2). The followers of the form-and-meaning account (e.g. Feldman, O'Connor, & del Prado Martín, 2009) argue that the early stages of word processing is affected by semantic transparency; transparent words are processed more rapidly compared to opaque words (see Table 3 for terminology). This account does not reject that opaque words are also decomposed in the early stages of word processing. What is different in this account is the efficiency of early words processing; the masked priming studies showing stronger priming effects for transparent conditions compared to opaque conditions, which will be presented in the next section, are pointed as evidence for this account.

In a study supporting the form-first account, Rastle et al. (2004) investigated whether semantic information played a role in the early stages of word processing using a masked-priming experiment in which the transparency of experimental items was manipulated. Although there was a significant priming effect, the transparency of the items (opaque vs. transparent) did not make a significant difference. The researchers therefore concluded that early word processing is not affected by the semantic properties of the stimuli.

In a later study, McCormick, Rastle and Davis (2008) ran four masked priming experiments in which they found similar results regarding the lack of semantic transparency for the very early stages of word processing. Words getting additional orthographic changes in derivation other than the changes applied in regular derivation (e.g. *adorable*, missing an *e*; *writer*, sharing the *e* with the morpheme; *metallic*, getting an extra *l*) also showed priming effects. Interestingly, this alteration did not even prevent the occurrence of a priming effect in the opaque condition (e.g. fete- fetish), which was taken as an indicator of a pre-lexical orthographic underspecification that was not based on the previous experiences of orthographic stem transformations.

In an extensive meta-analysis, Rastle and Davis (2008) reviewed 19 masked-priming studies with prime durations less than 60 ms and concluded that the form-before-meaning account was well-supported by findings reported in the current literature. It is important to underline that the form-first account does no reject the facilitative effects of semantic primes at later stages of word processing. What they stand for is the lack of semantic effects in very early stages of word processing (60 ms and earlier).

As part of the discussions regarding the effect of semantics in early stages of word processing, Crepaldi, Rastle, Coltheart, and Nickels (2010) investigated whether irregular primes prime their base forms in adult participants. Although Meunier and Marslen-Wilson (2004) had found priming effects for irregular verbs before, Crepaldi et al. (2010) criticized the study for not having controlled for frequency and phonological neighborhood. Another study showing irregular priming Pastizzo and Feldman (2002) was also questioned by Crepaldi et al. (2010) due to their slot-based coding scheme in the study. In this scheme, pairs like ate–EAT are considered as having no orthographic overlap. Instead, Crepaldi et al. (2010) adopted a spatial coding scheme. Spatial coding ignores a letter's serial letter position and its surrounding context; rather, "different letter orderings result in different spatial patterns of activity" (see Davis & Bowers, 2006 for an extensive review). The results showed that legal irregular pairs (e.g. fell-fall) caused significantly larger facilitation than pseudo-irregular pairs (e.g. tell–TALL) and matched orthographic control pairs (e.g. full–FALL). Crepaldi et al. (2010) argued that the results could be explained by Taft's model (2004) with some alterations applied to it. First, considering the significantly greater priming effect in the opaque condition (e.g. brother-broth) than in the formal overlap condition (e.g. brothel-broth), the model's initial decomposition processes failed to explain why brothel did not prime broth as brother did (e.g. Rastle et al., 2004). Crepaldi et al. (2010) proposed a morpho-orthographic decomposition phenomenon rather than a decomposition that breaks down every long word into smaller constituents. The second problem was the lexical representations of bound morphemes in the model. According to the model of Taft (2004), the lemma stage activated the representations for constituents of words as well as the representation for the derived word itself. Following this line of reasoning, the word *darkness* should activate the constituents *dark*, *ness*, and *darkness*. However, the system differentiated real derivational relationships from pseudo ones; thus, the word *corner* activates only the lemma *corner*. As a result, the word *darkness* should prime the word *dark* more than the word *corner* primes *corn*. However, this claim was not supported by the findings of the study. Instead, Crepaldi et al. (2010) proposed a different lemma level in which individual lexical entries were stored by their specific meanings and lexical-syntactic properties. This new suggested lemma level phenomenon suggests that bound morphemes are not stored as lemma entries. As the pairs fell-fall share meaning and lexical-syntactic properties, the enhanced priming effects for them compared to pairs like darkness-dark (different grammatical classes) and corner- corn (dissimilar meanings) could be explained within this new lemma system. Crepaldi et al. (2010) also argued that the model should include an orthographic lexicon. With the addition of an orthographic lexicon, non-existing but legitimately affixed non-words like *falled* would not be represented. In this altered model, the orthographic lexicon and the lemma level were interactively related. For example, the word *fell* activated the representation in the orthographic lexicon first, followed by the activation of the lemma *fall*, which finally fed back to activate the orthographic representation of *fall* in the orthographic lexicon. The morpho-orthographic stage was semantically blind for acting faster, thus only frequent enough letter combinations were decomposed, while rare morphemes might not be.

Crepaldi et al. (2010) made one final suggestion for the model by underlining the unnecessity of a recombination stage in which stem and suffixes combined after getting identified separately in a previous stage. Taft's model (2004) concluded that rare combinations involving a highly-frequent stem in a low-frequency word were processed with more difficulty. As this recombination process was crucial in lexical decisions, rare combinations led to longer reaction times. Crepaldi et al. (2010) proposed a competition-based explanation without a recombination stage. The word *moon* was a highly-frequent word and it served as a good competitor when the low frequent word *moons* was presented. This was not the case with low-frequency plurals of low-frequency stems (fang- fangs). Of course, it was well-accepted by Crepaldi et al. (2010) that the new model needed more support from experimental studies.

2.3.2. The Form-and-Meaning Account

The form-first account presented above has been challenged by Feldman and colleagues. Feldman et al. (2009), for example, examined 18 studies on the facilitative effect of semantic transparency. In these studies, non-significant facilitation values were taken as evidence for the lack of semantic effects in the initial stages of word processing. As opposed to Rastle and Davis (2008), who adopted a qualitative approach in their meta-analysis regarding the masked priming studies in the literature, Feldman et al. (2009) took a quantitative approach for the studies of interest and found a significant effect of semantic transparency. Feldman et al. (2009) argued that the use of different affixes across prime types in various studies may have acted as a confounding factor. In their study, affixes were fixed for all prime types unlike most of the previous masked priming studies. Another important difference of Feldman et al. (2009) with the previous ones was the high percentage of relatedness proportion (above 0.5) in their study. This was achieved through adding a good number of identical prime-target filler trials, which means using the target word itself as the prime in a non-critical trial. Previous work suggested that the high relatedness proportion increased semantic facilitation (e.g. Feldman & Basnight- Brown, 2008).

Rastle et al. (2004) had a relatedness proportion value under 0.5 with more unrelated filler trials. The results showed a significant facilitation difference favoring semantically transparent primes compared to semantically opaque primes. Feldman et al. (2009) took this as evidence against the widely dominant word recognition models that differentiated morpho-semantic and morpho-orthographic processes. They also used a Gaussian kernel density estimate to show that in the literature, their study fell within the overall pattern, thus showing normal data. After excluding three outlier studies in the literature according to the Gaussian kernel density estimate, 85% of the studies showed a facilitation advantage for semantic transparency without Feldman et al.'s study (2009).

Feldman et al. (2012) conducted another study - this time testing Serbian-speaking adults. This study was exceptionally important since most of the studies reported in the relevant literature had tested English. Using the same target items, a transparent prime condition and an opaque prime condition were used in the study. In a follow-up Experiment, alphabet type was also manipulated. Since the Serbian participants both knew the Cyrillic Alphabet and the Roman alphabet, the primes in Experiment 2 were presented in the Cyrillic Alphabet, followed by targets in Roman Alphabet. Despite the numerically small effects, semantic transparency had a significant facilitative effect in Serbian, which is a language with a rich inflection system. Furthermore, the alphabet manipulation did not have a significant effect on this facilitation. The transparent and the opaque primes in the experiments shared the same orthographic stems, the only difference being the semantic status of the affixes; therefore, the findings provided evidence against the models supporting a semantically isolated initial word processing. Rather than this *affix-stripping* view purely founded on form-based segmentation, Feldman et al. (2012) asserted that a stem's behavior with the affix it takes and the contexts that the word appears in should be further considered. It was argued that the prime-targets pairs often appearing in the same contexts (e.g. *farmer-farm*) had processing advantages over the prime-target pairs that were less likely to appear in the same contexts (e.g. *corn-corner*). All in all, Feldman et al. (2012) concluded that “morpho-orthographic and morpho-semantic processes are not independent and sequential".

In a more recent study, Feldman, Milin, Cho, Moscoso del Prado Martín, and O’Connor (2015) aimed to measure priming effects using a variety of SOAs to get a more comprehensive picture of semantic transparency effects. 3 experiments were run. The first two experiments used varying SOAs (34, 67, and 84 ms in Experiment 1, 48 and 100 ms in Experiment 2) while Experiment 3 used a single SOA (48 ms). The results of the first experiment showed semantic transparency effects as early as 34 ms SOA. The reliability of the findings in the Experiment 1 was even more consolidated with the confirming results of Experiment 2 and 3. Although using multiple priming durations in a single experiment (Experiment 1) slowed down responses, the findings were identical in the subsequent tasks using a single SOA: The transparent primes led to significantly faster responses the than opaque primes Thus, a semantically blind processing stage was not supported. As a conclusion, it was argued that with constant targets, pairs with semantic transparency led to better priming effects than semantically opaque and form-based pairs across different SOAs; Following these findings, the form-first accounts were accused of falling utterly short to explain such early semantic facilitation effects. Instead, Feldman et al. (2015) proposed parallel or interactive form-and-meaning processes.

2.3.3. Individual Differences in the Early Stages of Word Processing

One major issue in word processing research concerns the question of whether individual differences affect early word processing. Little is known about the effects of individual differences as the evidence regarding the topic is inconclusive.

In a study which set out to determine the effects of individual differences in early word processing, Andrews and Lo (2013) used the masked priming paradigm with adults. The masked priming experiment in the study included 4 conditions: a transparent condition, an opaque condition, a formal overlap condition, and an unrelated condition. Three tests were used to measure individual differences: a vocabulary test that measured semantic knowledge, a dictation test and a spelling recognition test to measure orthographic knowledge. Based on the spelling and vocabulary scores of the participants, Andrews and Lo (2013) created two profiles: an orthographic profile and a semantic profile. The participants with an orthographic profile had better spelling scores compared to their vocabulary scores, while the participants with a semantic profile had better vocabulary scores compared to their spelling scores.

The overall results showed larger priming effects for the transparent condition (33 ms) compared to the opaque condition (19 ms) and the formal overlap condition (10 ms). ANOVA analyses found no significant differences among the test conditions (transparent, opaque and formal overlap). Linear Mixed Effects (henceforth, LME) analyses, on the other hand, showed a significant difference between the transparent condition and the other two test conditions (opaque and formal overlap). Furthermore, similar to the ANOVA analyses, the LME analyses found no difference between the priming effects of the opaque condition and the formal overlap condition.

General proficiency scores (a combination of vocabulary and spelling scores) had no significant effects on the priming strengths across the test conditions; however, there were significant differences between the semantic profile and the orthographic profile. The participants with a semantic profile showed stronger priming effects for the transparent condition than the opaque condition, while the participants with an orthographic profile showed equal priming effects for the both conditions.

The analyses of RT quantiles revealed further patterns. Both profiles showed slightly greater priming for the transparent and opaque conditions compared to the formal overlap condition in the fast responses. However, individual differences were more apparent in the slow responses. The semantic profile showed increased priming effects in the transparent condition as the reaction times lengthened, while the orthographic profile showed decreased priming effects in the transparent and formal overlap conditions for the longer reaction times. Andrews and Lo (2013) attributed the differences among reaction times to the varying difficulty of items, which included low-frequency words with longer letter strings that were usually responded to slower; therefore, it was argued that the response times to low-frequency words were modulated by the individual differences based on vocabulary and spelling skills.

Overall, it was argued that the participants with an orthographic profile had used a bottom-up reading strategy as a result of precise, high quality lexical presentations (Section 2.2.3.2), considering that they responded slower than the participants with a semantic profile in the transparent condition. As an explanation for the slower responses in the transparent and formal overlap conditions, Andrews and Lo (2013) referred to the previous studies of Andrews (2010, 2012), which associated high spelling ability with strong lexical competition. Recall that while the participants with an orthographic profile showed equal priming effects in the transparent and opaque conditions, the participants with a semantic profile showed more priming effects in the transparent condition compared to the two other test conditions (opaque and formal overlap). Andrews and Lo (2013) suggested that the participants with a semantic profile might have relied more on context depending reading strategies that depended more on decomposition. A relatively more decompositional lexicon could have enhanced mappings among morphological and semantic units, which might have led to a relatively degraded sensitivity for orthographic similarity.

Beyersmann, Casalis, Ziegler, and Grainger (2015a) examined stem priming effects and individual differences affecting these priming patterns in a study with French speaking adults using a masked priming paradigm. The word sets consisted of a transparent condition, opaque condition non-word, formal overlap non-word condition and unrelated condition. The spelling and vocabulary skills of the participants were also measured; a high language proficiency and a low language proficiency group were created based on the results of these measurements. The high language proficiency group showed equal priming effects for all three test conditions, while the low language proficiency group scored significantly lower for non-suffixed primes. Beyersmann et al. (2015a) suggested that higher language proficiency could lead to the dominant use of the coarse-grained route in word processing. The reason behind the lack of differences between suffixed words (transparent condition) and suffixed non-words (non-word opaque condition) was attributed to a possible competition between real word targets and primes at the cost of semantic facilitation. The study failed to provide solid support for Andrews and Lo (2013)'s semantic profile and orthographic profile argument in explaining individual differences. However, Beyersmann et al. (2015a) admitted that the study did not have the data necessary to differentiate the participants into two distinct vocabulary-high and spelling-high groups. It was argued that further studies including vocabulary-high and spelling-high groups would find similar patterns between vocabulary-high groups in their studies and the high language proficiency group in Beyersmann et al.'s (2015a) study. It is important to refer to Feldman et al. (2015), who stated that "...once the by-participant random variations were properly modeled" in their study, individual reading proficiency differences based on psychometric measures were not found to be a strong factor in morphological processing and semantic facilitation. Therefore, conclusive remarks related to the issue of individual differences in morphological processing need further empirical evidence.

2.3.4. Factors Affecting Word Processing

There are many factors (e.g. frequency, family size, word category) known to affect the ease with which a morpheme is processed. Perhaps, the most widely discussed factor in morphological processing is *frequency*. It is important, however, to recognize that frequency is an umbrella term for a number of frequency definitions. *Cumulative frequency*, for example, refers to the sum of all complex word frequencies sharing the same root, while *base frequency* refers to the frequency of a root and *surface frequency* refers to the frequency of the whole word.

A number of researchers have reported frequency effects in word processing. Colé, Beauvillain, and Segui (1989) examined the effect cumulative frequency in processing complex words using the lexical decision task paradigm. Two experiments were run with French-speaking participants: one experiment manipulating affix type (suffix and prefix), and another one manipulating suffix type for the same targets. The findings of the first experiment suggested that cumulative frequency affects the processing of suffixed words, but not prefixed words. In the second experiment, the results showed that the reaction times to complex words differed for different suffixes. Colé et al. (1989) attributed this finding to the varying whole word frequencies in the second experiment.

Ford, Davis, and Marslen-Wilson (2010) conducted three experiments using the lexical decision paradigm. The first experiment examined the effects of base morpheme frequency and family size on word processing. The second experiment included a larger set of words divided into a *less productive suffix group* and a *more productive suffix group* to gain a better insight about the role of suffix productivity in word processing. The last experiment focused on the words with low-frequency suffixes. Overall, the results showed base frequency effects only for productive suffixes, while family size significantly affected both productive and unproductive suffixes. Ford et al. (2010) concluded that there was no interaction between base frequency and morpheme family size; productive suffixes had their own representations in the mental lexicon regardless of their morpheme family size.

Giraudo and Grainger (2000) used four masked priming experiments to investigate the role of word frequency and cumulative root frequency in French. The frequencies of primes and targets were manipulated across the experiments. The results were not all consistent. In three experiments, there were morphological processing effects for the target words with high frequencies, while the prime frequency (high or low) interacted with the morphological priming effect in two experiments. Nevertheless, Giraudo and Grainger (2000) interpreted the results as prime frequency having a significant effect on morphological processing. In parallel, they rejected the argument that only words with low frequency were subject to morphological decomposition.

McCormick et al. (2008) re-investigated surface frequency effects in word processing using the masked priming paradigm with English-speaking participants. The experiment included morphologically related highly-frequent and low-frequency primes, and morphologically constructed non-word primes. At the end of the experiment, not only did low-frequency primes lead to equal priming effects with highly-frequent primes, but non-word primes also showed comparable priming effects. McCormick et al. (2008) concluded that all complex words were decomposed regardless of surface frequency.

Giraudo and Orihuela (2015) carried out a study in French to compare surface frequency effects using a masked priming paradigm. The experiment included two prime conditions: a higher frequency prime condition, in which the primes had higher surface frequencies than their targets, and a lower frequency prime condition, in which the primes had lower surface frequencies than their targets. The results showed that the higher frequency prime condition led to more priming effects compared to the lower frequency prime condition. It was argued therefore that surface frequency was more prominent in early word processing than morpheme frequency.

In a study investigating base frequency effects in English derived words, Xu and Taft (2015) used the lexical decision paradigm. The experiment manipulated the frequency and semantic transparency of items. Although the results showed base frequency effects, this effect was strongly related with semantic transparency. While opaque words did not show any base frequency effects, transparent items showed significant base frequency effects. In parallel with these findings, the partially transparent words in the study showed a rather lower base frequency effect compared to the items with higher semantic transparency.

Other than the studies on frequency effects, there is also a considerable number of studies that have investigated other factors in word processing. In one of these studies, which was conducted in English, Bertram, Schreuder, and Baayen (2000) examined the roles of affix productivity, word category, and affix homonym size (the number of homonyms for an affix) in word processing using the lexical decision task paradigm. It was argued at the end of the study that affix productivity was an essential factor for decomposition. It was, however, not adequate; Bertram et al. (2000) argued that productive affixes that had productive strong homonym rivals were stored in the lexicon as whole words. Finally, word category was found to be an important factor in determining whether a word would be stored or be decomposed. Bertram et al. (2000) refuted the strict idea that derived words were always stored and inflected words were always decomposed. Alternatively, they proposed that a word’s category was extremely effective in word processing; meaning invariant morphemes were decomposed if they also complied with the aforementioned conditions. As a summary, it was suggested that the complex words with productive meaning changing or adding affixes that had strong homonym rivals were either decomposed or stored. On the other hand, the complex words with productive meaning invariant affixes that had strong homonym rivals were always decomposed.

Using a fragment completion task in English, Feldman et al. (2002b) investigated the effect of semantic transparency in word processing. 88 fifth graders were tested individually using flashcards. 3 material groups were created: The first material group (transparent.p condition) consisted of morphologically transparent primes (masking-mask) and orthographically transparent primes (marking- mask). These orthographic forms did not include the target form as whole (mask); they rather showed a mere orthographic similarity. The second material group (opaque condition) consisted of morphologically opaque primes (ridden-ride) and orthographically opaque primes (riddle-ride); both prime conditions did not include whole target (ride). The final material group (transparent.c condition) again included transparent morphological and orthographic primes; however, in this condition, orthographic primes were orthographically similar to morphological primes in a position sensitive way (turned - turnip - turn). Although all three test conditions led to significant morphological priming, both transparent conditions yielded significantly more priming than the opaque condition and also led to the highest priming effect for the identical primes. The transparent.c condition, in which the primes and the targets shared an item-by-item similarity, showed more priming effects than the transparent.p condition. Before jumping into conclusions, note that the orthographic primes in the transparent.c condition also led to significant priming effects while the orthographic primes in the transparent.p condition did not. Therefore, the difference between the amount of priming effects in the transparent and opaque conditions might be due to the orthographic similarity differences among conditions rather than categorical differences.

Referring to the possibility of two distinct mechanisms for processing transparent and opaque words, Feldman et al. (2002b) argued that the existence of orthographic priming in the study was an indicator of established word processing mechanisms. On the other hand, considering the other possibility of a single mechanism for both word types, it was argued that the findings might point to a well-established lexicon that could even capture the morphological relationships obscured by orthographic and phonological changes. Unlike a similar study in adults (Rueckl, Mikolinski, Raveh, Miner, & Mars, 1997), this study found significant orthographic priming effects in the transparent.c condition; therefore, Feldman et al. (2002b) suggested that orthographic similarity could have an essential role in the development of word processing mechanism.

In another study investigating affix invariance effects in adult word processing, Järvikivi, Bertram, and Niemi (2006) used the lexical decision paradigm. The number of allomorphs for suffixes was manipulated across items. At the end the study, it was argued that suffix allomorphy had an important effect on affix saliency, which was crucial in morphological processing. It was also underlined that the results could be specific to morphologically rich languages like Finnish.

Another common discussion in the word processing literature is neighborhood effects. Andrews and Hersch (2010) examined neighbor (henceforth, N) effects and how these effects were modulated by spelling skills in word processing. In addition to measuring individual differences tasks (e.g. spelling skill task), the masked priming paradigm was used in two experiments. In the first experiment, there were two related prime conditions (related word primes and related non-word primes) and two unrelated prime conditions (unrelated non-word primes and unrelated word primes). The related primes were orthographic neighbors to the target words. Half of the target words had a low N size, while the other half had a high N size. In the second experiment, partial-word prime conditions were used with varying neighborhood sizes. The ambiguous partial-word prime condition included ambiguous primes that could refer to multiple words (*glo#e* can refer to *glove* or *globe*). The unambiguous partial-word primes condition included primes that could only refer to a single word (*g#lobe-globe*). The related word prime condition in the second experiment had orthographic primes to the target words, similar to the related word prime condition in Experiment 1. Finally, there was an unrelated condition. In both experiments, the primes for the non-word targets were also grouped as related (neighbors of the targets) and unrelated. The findings of the first experiment suggested that high N targets caused inhibitory effects for the participants with higher spelling skills, while the both high N and low N items induced priming effects for the participants with lower spelling skills. Andrews and Hersch (2010) argued that the better spellers more rapidly activated the primes, which led to inhibition effects due to the competition of neighbor words including the target. This lexical competition was not as strong for the poor spellers since they activated primes slower as a result of less precise word representations. At the second experiment, the better spellers showed the highest inhibitory effect for neighbor word primes, while the poor spellers showed relatively lower inhibitory effect for the same primes. Both ambiguous and unambiguous partial-word primes led to significant priming effects in both better spellers and poor spellers; however, the priming effect for ambiguous partial-words was reduced for the better spellers. This finding was also attributed to lexical competition; the better spellers activated the neighbor word primes and the ambiguous partial-word primes faster, which led to a high lexical competition. The unambiguous word primes induced comparable priming effects for both groups since the primes could be associated with a single word that ruled out lexical competition. Andrews and Hersch (2010) concluded that spelling skill was related to lexical competition, thus affecting word processing.

Voga and Giraudo (2009) explored the effect of a novel variable, *pseudo- family size*, using the masked priming paradigm. The term *pseudo-family* size refers to the potential candidates in word processing that are likely to be in competition in lexical-orthographic level with the word of interest. These competing words can be a member of that word's morphological family (a neighbor) or can also share the stem with the word without sharing any morphological or semantic relationship. Think of the word *dogma*; although -ma is not a suffix in English, this word would be regarded as a part of pseudo-family size for the word *dogs*, since they share the stem *dog*. Two experiments were run. In the first experiment, Voga and Giraudo (2009) used highly-frequent targets with four primes types: an identity prime condition, two morphological prime conditions, and an unrelated prime condition. Two morphological prime conditions differed as one of them included highly-frequent primes and the other included low-frequency primes. In both conditions, half of the primes had high pseudo-family sizes, and the other half had low pseudo-family sizes. The targets in Experiment 1 were either base forms or infinitive words. Experiment 2 included low-frequency targets that were inflected complex words. The results of the first experiment showed that only the identical prime condition and the highly-frequent morphological prime condition led to significant priming effects while the low-frequency morphological prime condition did not show any priming effects regardless of pseudo-family size. For the second experiment, the results showed significant priming effects for the primes with low pseudo-family sizes regardless of prime frequency. The primes with high pseudo-family sizes did not show any priming effects. Voga and Giraudo (2009) argued that since base or infinitive forms, which were used as the targets, had a low activation threshold, pseudo-family size did not show a significant effect in Experiment 1. In the second experiment, pseudo-family size significantly modulated the priming effects since the targets were low-frequency and assumedly were not the easiest activated members among their neighbors.

Casalis, Quémart, and Duncan (2015) compared word processing in English-speaking children and French-speaking children. These two languages have different characteristics: English has a relatively more opaque orthography, while French has a relatively richer morphology. The lexical decision paradigm was used to compare the effects in processing suffixes and pseudo suffixes. Along with a group of fourth graders from the UK, two groups of French children (third and fourth graders) participated in the study. The reason behind the inclusion of two French grade levels was to match both grade and age of the children in analyses since the children in the UK had started school a year earlier than the children in France. Four different word sets were used in the task: a real suffixed word group, a pseudo-suffixed word group, a pseudo root only group, a group with no pseudo-suffixes or roots. Similarly, four pseudo word sets were constructed with the same characteristics. The results showed that French children were more sensitive to suffixes and pseudo-suffixes. Casalis et al. (2015) attributed this finding to the richer morphological productivity of French.

Quémart, Gonnerman, Downing, and Deacon (2017) used the cross modal priming paradigm with English speaking third and fifth grades. Five different word sets were created. Along with semantic and orthographic control conditions, three morphological conditions with varying semantic transparency were used (a low semantic similarity condition, a medium semantic similarity condition, and a high semantic similarity condition). The results indicated higher priming effects for the primes with high semantic transparency and the primes with medium semantic transparency compared to the primes with low semantic transparency and to the primes in the two control conditions; therefore, it was concluded that morphological priming effects cannot be attributed only to form overlap or semantic similarity. As an indicator for the lack of developmental changes between the grade levels, the third grade and the fifth grade children in the study reflected a similar pattern. Overall, the findings supported a distributed view of morphological processing as they pointed to a mutual contribution of both form-and-meaning in morphological processing. Quémart et al. (2017) also argued that the results contradicted with a suffix-oriented priming view (e.g. Quémart et al., 2012).

There are well-apparent differences among the results of the studies for the same factor. These differences are likely due to cross-linguistic effects between languages, task effects, and individual differences, which are argued to influence word recognition (e.g. Andrews & Hersch, 2010) but often disregarded. This study does not intend to investigate the effects of these factors; therefore, as many of these factors as possible are kept constant across the conditions in the present study.

2.3.5. Derivation versus Inflection

Recall that Distributed Morphology does not draw a line between derivation and inflection; this theoretical framework rather adopts a rather different categorization: f-morphemes and l morphemes (Harley & Noyer, 1998, 1999). While f-morphemes are limited in offering vocabulary alternatives and are pre-determined by the characteristics of a sentence, l-morphemes do not force an obligatory word choice. Consider the following example:

(1) *The student ate a hamburger.*

This sentence (1) is related to a specific noun, *the student*. In addition, the action happened in the past. Therefore, the selection of *the* and the past tense of *eat* are enforced by the English grammar. Features like definiteness and tense necessitate a non-flexible set of morphemes, so-called f-morphemes. The words *student* and *hamburger*, on the other hand, are not subject to the same limitations. One can replace *student* with *teacher* and *hamburger* with *pizza* without violating the grammar. These morphemes, which offer more flexibility, are called l-morphemes (Harley & Noyer, 1998;1999).

In Realization-Based Morphological Theories, the difference between derivation and inflection is crucial. While canonical inflection changes the form features of a word, thus representing the same lexeme with form modifications, canonical derivation changes semantic, syntactic, and form features, and it creates a new uninflected lexeme entry (Spencer, 2016). Although there are affixes that do not fit in the canonical definitions of derivation and inflection, these less-canonical derivation and inflectional affixes are referred as *intermediate categories* and are explained within Realization-Based Morphological Theories (for a detailed review, see Spencer, 2016).

The existing literature on affixes is extensive and beyond the scope of the derivation-inflection phenomenon. There are different views regarding affix acquisition and processing. Carlisle and Fleming (2003) suggest that affix acquisition starts with binding frequent letter combinations together and continues with adding meaning to these combinations. Children detect patterns in complex words to create concept nodes, which give rise to the development of representations. These representations are further enriched with semantic and syntactic information through more exposure to the letter combinations. Carlisle and Fleming (2003) tested a group of participants (first and third graders) using a word analysis test and a definition task and then tested the same participants again two years later (when they were third and fifth graders) using a morphological structure task and a reading test. The results showed that older children had better morphological awareness, morphological decomposition, and morphological problem-solving skills. Carlisle and Fleming (2003) concluded that older children had more accessible morpheme representations as morphological information was gradually added to the representations.

Rabin and Deacon (2008), on the other hand, argued that this process of binding form and meaning involved using phonological, orthographic, and semantic information at the same time. They supported this view by conducting a study, in which a priming task and a fragment completion task were used with primary school children. The results showed there was no differences between priming effects of second graders and third graders, which was taken as an evidence for simultaneous association of multiple information to the form; second graders had already added phonological, orthographic, and semantic information to the forms used in the study, and third graders had similar representations. Therefore, the two grade levels did not differ from each other in the tasks, which contradicted the view that semantic and syntactic information were added gradually to the form representations of letter combinations.

These two studies had some shortcomings. First, both studies had a limited number of participants (34 first graders and 26 third graders in Carlisle & Fleming, 2003; 24 children from each grade in Rabin & Deacon, 2008). Another reason for the contradictory findings could be potential task effects between two studies. Therefore, these claims need further empirical data for decisive conclusions.

Why the work of Schreuder and Baayen (1995) is discussed in this section is related to their interpretation of affix acquisition. Rather than adopting a strict inflection and derivation separation, Schreuder and Baayen (1995) propose 6 factors modulating affix acquisition and underline that there can be more. The first factor refers to how easy a child can comprehend a concept related to an affix, namely conceptual complexity; abstract concepts are more difficult for children to acquire. The second factor is related to the information provided by an affix; semantically transparent affixes are acquired earlier than semantically opaque affixes. Another factor stated is the complexity of semantic operations. Some affixes require more complexity; for example, deverbal nominalization requires argument structure to be involved in the derivation process. For this kind of affixes, acquisition is more difficult. Pseudo-affixation is listed as another factor by Schreuder and Baayen (1995). A highly frequent pseudo-affix inhibits the acquisition of the real affix that is orthographically identical with that pseudo-affix. Phonological transparency, or affix allomorphy, is pointed out as another potential factor. Affixes with allomorphs are acquired later than affixes with a single form. The final factor is affixal homonymy. An affix with distinct meanings is acquired later than an affix with a single meaning or function. The more homonyms an affix has, the more difficult it is acquired.

Studies seeking empirical evidence for or against the distinction between derivation and inflection have not reached conclusive results. Feldman (1994), for example, ran 6 experiments with university students, half of which were overt priming experiments while the other half of the experiments included segment shifting tasks. Overt priming experiments are like masked priming experiments except that primes are presented for a longer duration. In segment shifting tasks, on the other hand, participants are required to shift a given sequence of letters to a target word to create a new meaningful word and to read it then aloud.

Although both inflected and derived primes led to significant priming effects in overt priming experiments, infected primes showed significantly more priming effects despite the fact that both inflected and derived primes used the same targets. In segment shifting tasks, inflected words were shifted more quickly than derived words and non-morphemic control words. Overall, the results showed that inflected forms were processed faster.

Rabin and Deacon (2008) compared the effects of inflected, derived, and orthographically similar primes in a fragment completion task. 100 English-speaking primary school children (grade 1 to grade 5) participated in the study. The results showed higher completion rates for the targets primed by an inflected or derived word. This was taken as an indicator of the morphological features embedded in inflected and derived words; complex words were related to their targets beyond a mere orthographic overlap relation. Derived and inflected primes did not differ significantly from each other in any of the grades tested. Also, there was no developmental pattern since the priming amount for morphologically related pairs did not change across the grades. The study contradicted the oral production studies (e.g. Brown, 1973), in which children performed better on inflected forms. Rabin and Deacon (2008) argued that since production and manipulation tasks demanded higher cognitive loads, the differences could be due to task effects. Another explanation for the difference was the derived primes in the study; the material set included transparent derived words. It was argued that the possibility for transparent inflected words and transparent derived words being processed and stored in similar ways should not be disregarded.

In a later study, Deacon, Campbell, Tamminga, Kirby (2010) used a fragment complement task with English speaking fourth, sixth, and eighth graders. The material set included the same targets for both derived and inflected primes. There were also orthographic control primes as a control prime condition. Children in all grades showed more priming in the morphological condition compared to orthographic condition, which was taken as evidence for morphological processing in children. Although there was a significant development across the grades, this development did not affect priming patterns. There was no difference between inflected and derived primes across grade levels.

Clahsen and Fleischhauer (2014) investigated regular and irregular inflection in German speaking children using the cross-modal priming paradigm. Although the study did not compare derivation and inflection, it was insightful in investigating potential differences between inflected forms. Regularly inflected -*t* participles and irregularly inflected -*n* participles (with and without stem changes) were used in the study. Along with two children groups (age means were 7;3 and 10;7), an adult group was included in the study for examining possible developmental patterns. The results showed that although -*t* participles led to similar priming effects in all three groups, younger children did not show any priming effects for -*n* participles. Furthermore, the priming effect of -*n* participles was smaller than the priming effect of -*t* participles in all three groups. Another outcome of the study was the slower response times of younger children to -*n* participles with stem changes compared to the other two groups. Clahsen and Fleischhauer (2014) concluded that while -*t* participles had their stem and affix representations available, -*n* participles were lexical sub-entries.

Priming studies using short SOAs that focused solely on L1 users have yielded contradictory results. Raveh (2002) used the masked priming paradigm to compare derivation and inflection in English with different SOAs and different types of derived primes varying in semantic transparency. While the experiment with university students showed equal priming effects for low frequency derived primes and inflected primes, inflected primes induced more priming effects than high-frequency derived primes at 250 ms. The second experiment manipulated SOA and included a semantic prime condition (see Table 3 for relevant terminology). The results showed similar priming effects for derived and inflected primes and no priming effects for semantic primes at 50 ms. As SOA was increased, the priming effect for derived primes decreased, while the priming effect for semantic primes increased. The priming effect for inflected primes remained relatively stable across different SOAs. All in all, Raveh (2002) concluded that semantic transparency and SOA affected the processing of derived words.

Feldman, Barac-Cikoja, and Kostić (2002) conducted an unmasked priming study to investigate the potential differences between derivation and inflection with 48 native Serbian speakers. Two SOAs, 250 ms and 48 ms, were used in the study, while the alphabet used for primes also differed (Roman vs. Cyrillic). The targets in the study were all presented in the Roman alphabet. Two groups of derived primes were used: a high semantic similarity group and a low semantic similarity group. No matter what the prime alphabet was, inflected primes led to significantly more priming in both SOAs. Feldman et al. (2002a) attributed this finding to the greater orthographic and semantic similarity of the inflected primes with their targets. Semantic similarity differences between two derived prime groups showed a differentiating effect at 250 ms. Interestingly, using a different alphabet than the alphabet of the targets led to more priming. Although an older study found exactly the opposite pattern (Lukatela, Feldman, Turvey, Carello, & Katz, 1989), Feldman et al. (2002a) stated that the contradiction could be due to longer SOA times (700 ms) used Lukatela et al. (1989). Note that although Feldman et al. (2002a) found more priming effects for inflected primes, it used the unmasked priming paradigm unlike the other studies discussed here using short SOAs via the masked priming paradigm.

In the literature of word processing, whether L2 word processing shows the characteristics of L1 word processing has been subject to considerable debate. Diependaele, Duñabeitia, Morris, and Keuleers (2011), for instance, used the masked priming paradigm with L1 and L2 English speakers. Four conditions were used in the study: a transparent condition, an opaque condition, a formal overlap condition, and an unrelated condition. Both L1 and L2 speakers showed similar priming effects; the transparent condition led to strongest priming effects followed by the opaque condition, while the formal overlap condition showed the weakest priming effects. Diependaele et al. (2011) concluded that the processes involved in L2 word processing were similar to the processes involved in L1 processing, at least for high-proficiency L2 speakers. Studies investigating the derivation-inflection distinction by comparing L1 and L2 speakers using the masked priming paradigm found significant priming effects for only derived primes in L2 speakers, who had been exposed to naturalistic L2 input (Jacob, Heyer, & Veríssimo, 2017; Kırkıcı & Clahsen, 2013; Silva & Clahsen, 2008). Furthermore, these three studies failed to find significant differences between derived and inflected primes in L1 data. Considering the lack of priming effects for derived primes in L2, Kırkıcı and Clahsen (2013) argued that word processing in L1 and L2 were profoundly different. Studies on the derivation-inflection distinction using the masked priming paradigm with L2 speakers who had acquired their L2 in a classroom setting and had not been exposed to naturalistic L2 input (Şafak, 2015; Voga, Anastassiadis-Symeonidis, Giraudo, 2014), however, found significant priming effects for both inflected and derived primes in L2. Şafak (2015) proposed that the way of L2 acquisition (naturalistic input vs. classroom setting) might have affected the word processing in L2.

As a novel contribution to the controversy on derivation-inflection distinction in L2 word processing, Veríssimo, Heyer, Jacob, and Clahsen (2017) investigated the effects of age of acquisition on the processing of inflected and derived words in Turkish using the masked priming paradigm (50 ms SOA for primes). 94 Turkish-German bilinguals were divided into three different groups according to their age of acquisition onset: simultaneous bilinguals, early bilinguals who acquired German after the age of 3, late bilinguals who acquired German after the age of 10. Age of acquisition was found to be a significant factor in only processing inflected forms. The language acquisition after the age of five started to reflect decreasing inflected priming effects in parallel with the increasing AoA.

Overall findings of the studies have lacked decisive evidence for derivation-inflection distinction in L1. L2 studies have provided important insights to this discussion. Studies with early bilinguals and L2 speakers who acquired their L2 in a classroom setting showed comparable priming effects for both derived and inflected primes. However, there is also strong evidence that inflected forms are different in word processing than derived forms, at least for L2 who had been exposed to naturalistic L2 input. In addition, the same amount of priming found in L1 studies and the aforementioned L2 studies does not necessarily eliminate the possibility that two different processes led to similar priming effects. No study so far has compared inflected primes with derived primes in children using the same targets.

2.3.6. Masked Priming Studies with Children

While the studies using the masked priming paradigm with adults have found priming effects for truly-suffixed primes (transparent condition) and pseudo-suffixed primes (opaque condition) at short SOAs, similar studies with children have presented contradicting results. This section will summarize some of the well-known masked priming studies conducted with children.

In the study of Casalis, Dusautoir, Colé and Ducrot (2009), French-speaking fourth graders (53 participants) showed equal priming effects in transparent and orthographic conditions at 75 ms (26 participants) , while only the transparent condition led to priming at 250 ms (27 participants). Interpreting the results, Casalis et al. (2009) suggested that morphological information helped with word processing, and the nature of the morphological information was different from orthographic information, at least for French.

In an extensive study including a variety of age groups, Quémart et al. (2011) investigated French speaking third, fifth, seventh grade children, and adults. Along with transparent, opaque, and orthographic conditions, they also used a semantic condition in the masked priming tasks with different SOAs (60 ms, 250 ms, and 800 ms). Morphological priming in the transparent condition was apparent in all SOAs for all participant groups. Opaque primes led to priming effects at 60 ms and 250 ms for the child-groups and at 60 ms for the adult group. This supported the idea that morphemes were salient units of processing as early as third grade and even at prime durations as short as 60ms. The results also suggested that although semantic features were available as early as 250 ms, their role was only essential in later word processing (800 ms). Orthographic primes did not lead to priming effects in all SOAs for all groups with the exception of the children groups at 800 ms; however, Quémart et al. (2011) acknowledged that this data was uninterpretable due to statistical problems. Thus, the overall findings supported initial morpho-orthographic word processing (e.g. Rastle, Davis & New, 2004).

Table 4. The number of participants in the three experiments of Quémart et al. (2011)

	Third graders	Fifth graders	Seventh graders	Adults
Experiment 1 (60 ms)	21	19	20	17
Experiment 2 (250 ms)	22	21	20	14
Experiment 3 (800 ms)	21	21	24	0

Quémart et al. (2011) failed to find any developmental patterns in morphological processing and attributed this finding to the limited number of participants, which was likely to reduce the power of the statistical analyses. Still, one important difference between developing readers and adults was the role of semantic features. For adults, semantics played an essential role in earlier prime durations. Quémart et al. (2011) argued that the reading expertise of adults could be the reason behind this finding. Another possible explanation suggested was the quality of orthography-semantics correspondences, of which adults presumably had high-quality correspondences.

In the absence of a suffix in a prime, no priming effects were observed. Quémart et al. (2011) stated that bases and suffixes could be necessary for morphological decomposition and suffix endings could be the trigger key for morphological decomposition process. Quémart et al. (2011) also pointed to the linguistic status of items as the reason behind the differences between their study and Casalis et al. (2009); Casalis et al. (2009) used complex words as targets while Quémart et al. (2011) used base words. Another essential difference was the frequency; Casalis et al. (2009)

used words with much lower frequency. Quémart et al. (2011), therefore, argued that the children in Casalis et al.’s (2009) study might have found these low-frequency items unfamiliar.

Quémart et al. (2011) also argued that orthographic consistency, derivation system, and morphological productivity could be determinant factors in explaining the different results across languages. Referring to McKay, Davis, Savage, and Castles (2008), who suggested a more enhanced role for semantics in skilled reading for words with irregular grapheme-phoneme connections, Quémart et al. (2011) argued that deep orthographies could foster the involvement of semantics much more than shallow orthographies. Although excluding first graders and second graders from the study did not result in a more complete picture, Quémart et al. (2011) argued that the lexical decision task used in the study was too difficult for young readers.

Although the findings of Quémart et al. (2011) are interesting, it is important to consider the number of the participants in each experiment (Table 4); the mean participant number for each child group was around 20, while this number was even fewer for adult groups. Also, the contradictory results between Casalis et al. (2009) and Quémart et al. (2011) is another vital point to discuss. Quémart et al. (2011) pointed to target word complexity and frequency as possible confounding factors for the contradicting results; however, these claims still need further validation with studies including a larger number of participants for each group.

Beyersmann, Castles, and Coltheart (2012) examined word processing in English-speaking adults (42 university students) and English-speaking children (42 third graders, 50 fifth graders) using the masked priming paradigm. The adults in the study showed significant priming effects for both transparent and opaque conditions, although the priming effects in the opaque condition were stronger. The children, on the other hand, showed significant priming effects for only the transparent condition.

None of the groups showed priming effects for the formal overlap condition. Beyersmann et al. (2012) concluded that morpho-orthographic decomposition was not developed even in fifth graders. It was also argued that children acquired the full forms of morphologically complex items first, only then to construct affix-representations as their reading proficiency increased. After constructing semantically coded morphemes, it was likely that these units fed the orthographic lexicon to create an affix-storage. The study could not provide an answer to whether low-frequency letter combinations were also useful in morpho-orthographic processing or it was merely based on constructing form-meaning irregularities and highly-frequent letter combinations. A second question was the nature of interaction between full forms and decomposed morphemes. Beyersmann et al. (2012) argued that if salient morpheme representations were acquired, full forms could be only accessed after the morphemes of the words were activated. This view complied with form-then-meaning accounts as it necessitated complex words to be always decomposed (e.g. Rastle & Davis, 2008; Taft, 2003, 2004). Beyersmann et al. (2012) also argued that in addition to initially acquired full-form representations, decomposed morphemes could also be stored for direct access. This view complied with parallel dual-mechanism views in which both full forms and morphemes were available at the same time. (e.g. Diependaele, Sandra, & Grainger, 2009).

In a large study based on a shallow orthographic language (Dutch), Zeguers, Snellings, Huizenga, and van der Molen (2017) examined phonological and orthographic priming effects and their emergence patterns with second, fourth , and sixth graders. 3 types of non-word primes were used: pseudohomophone (vrient-vriend), orthographic (and not homophonic) (vrienk- vriend), and unrelated (claumf-vriend). There were two experiments: Experiment 1 included 329 participants (104 second graders, 102 fourth graders, 123 sixth graders), and Experiment 2 included 311 participants (99 second graders, 92 fourth graders, 120 sixth graders). Experiment

2 also manipulated the phonological difference between orthographic primes and phonological primes (PD small: small phonological difference, PD large: large phonological difference). The results showed orthographic priming as early as the second grade and its efficiency was increased with developing reading proficiency. Phonological priming was not apparent in children, even with the manipulated large phonological differences; this finding contradicted the adult study of Zeguers, Snellings, Huizenga, and Van der Molen (2014), in which phonological priming was apparent in early stages of word processing of adults. As sixth graders showed significant phonological priming effects in longer durations (83 ms), Zeguers et al. (2017) argued that automatization in phonological processing is a late developing process, which was not available even for sixth graders. Second grade and fourth grade children showed similar orthographic priming effects whereas sixth grade children showed earlier priming effects, which was taken as an indicator of a strong developmental leap enhancing orthographic representations after the fourth grade. The second experiment failed to reveal an effect of phonological manipulation on overall orthographic and phonological priming; therefore, Zeguers et al. (2017) underlined that it was difficult to support the argument that orthographic processes always interacted with phonological processes. Altogether, Zeguers et al. (2017) argued that orthographic processes were the earliest in word processing, and better reading proficiency enhanced the facilitative effect of orthographic primes.

Beyersmann et al. (2015b) conducted a masked priming study with 191 French-speaking children including second (46 participants), third (48 participants), fourth (49 participants), and fifth (48 participants) graders. The study investigated embedded priming effects and whether individual differences played any role in this type of priming. Four different primes types were used: transparent word primes, opaque non-word primes, formal overlap non-word primes, and unrelated primes (see Table 3 for relevant terminology). A spelling proficiency test, a reading proficiency test, and a morphological awareness test were used to determine the individual differences between the participants. Priming effects in the transparent condition were significantly greater than priming effects in the other conditions regardless of grade and proficiency. In addition, there was no significant difference between the priming effects of suffixed non-word primes and non-suffixed non-word primes. Beyersmann et al. (2015b) asserted that the data supported embedded stem activation mechanisms rather than morpho-orthographic segmentation in the early word processing of children. Neither priming nor the magnitude of suffixed and non-suffixed non-words was changed by grade level. The findings pointed to a lack of developmental changes for early decomposition during primary school. In addition, reading proficiency played a role in suffixed and non-suffixed non-word priming; the participants with higher language proficiency had a facilitative priming effect for both suffixed and non-suffixed non-words, while the participants with lower language proficiency had an inhibitory priming effect. Beyersmann et al. (2015b) referred to the previous studies without embedded stem priming (e.g., Beyersmann et al., 2012; Quémart et al., 2011) and argued that the absence of priming effects could be due to using stems in real words. Such a design could lead to competition between real word and stem, thus preventing the priming effect.

One of the most striking results about the study was the inhibitory effects of non-word primes with and without a suffix on the participants with lower language proficiency. Beyersmann et al. (2015b) stated that non-words led to a competitive process similar to the competitive process used when learning novel orthographic forms. This then affected the activation of word stem since acquiring a new orthographic representation require blocking the activation of the words with similar orthographic features. This blocking phenomena was the reason behind the slower response times of the participants with lower language proficiency; a similarly orthographic real word presented right after a non-word in the experiment, and the participants with lower language proficiency perceived it as a novel orthographic form. For the participants with higher language proficiency, non-words did not act as novel words and thus activated the embedded stem rather than blocking it.

There was no difference between suffixed and non-suffixed non-words across all grades and all proficiency levels. These results contradicted the adult study of Beyersmann et al. (2015a), in which the participants with lower language proficiency had a priming effect for suffixed non-words but not for non-suffixed non-words. Beyersmann et al. (2015a) referred to a morpho-orthographic segmentation mechanism for the results; this mechanism compensated for the worse whole-word processing in the adults with lower language proficiency. Beyersmann et al. (2015b) interpreted the findings of the study conducted with children as primary school children did not have an automatized morpho-orthographic processing mechanism yet and such mechanism was likely to develop later in reading development around middle school or high school. After this mechanism emerged, argued Beyersmann et al. (2015b), it will be used to make up for low-proficiency adults' relatively lower performance in activating whole-word representations, similar to Beyersmann et al. (2015a).

Hasenäcker, Beyersmann, and Schroeder (2015) examined the effects of language proficiency on word processing using the masked priming paradigm with German speaking children and German speaking adults. There were 24 university students as the adult group and 24 elementary school children (third- fifth grades) as the children group. The materials included four prime conditions: transparent primes, opaque non-word primes, formal overlap non-word primes, and unrelated primes (see Table 3 for relevant terminology). Vocabulary and spelling tests were used to measure individual differences. The adults showed priming effects with transparent primes, opaque non-word primes, and formal overlap non-word primes. However, language proficiency modulated this pattern; only the adults with a high language proficiency showed priming effects for formal overlap non-word primes. Similarly, while the children with a high language proficiency acted like adults in all three prime conditions, the children with low language proficiencies showed no priming effects in the three conditions (a numerical 40 ms advantage was found in the transparent condition). Hasenäcker et al. (2015) commented that children with a low proficiency could only benefit from morpho-semantic information, while the children with a high language proficiency could additionally benefit from morpho-orthographic information. Referring to Grainger and Ziegler (2011), who found affix stripping patterns for the adults with a low language proficiency, Hasenäcker et al. (2015) argued that both adults and children with high language proficiencies were likely to use embedded stem segmentation. It is important to underline that the number of participants for both the adult and children groups were limited. Moreover, these limited number of participants were further divided into sub-groups according to their proficiency levels.

Hasenäcker, Beyersmann, and Schroeder (2016) conducted a study based on non-word processing using the masked priming paradigm. There were both German-speaking adults (24 university students) and German-speaking children (40 primary school children between second grade and fifth grade) in the study. The same four prime condition used in Hasenäcker et al. (2015) were employed: a transparent condition, an opaque non-word condition, a formal overlap non-word condition, and an unrelated condition. As was expected, the adults outperformed the children in overall accuracy. Furthermore, the adults gave significantly faster responses for all related prime conditions (the transparent condition, the opaque non-word condition, and formal overlap non-word condition) compared to the unrelated condition. Two suffixed conditions (the transparent condition, the opaque non-word condition) did not differ significantly from each other, while they elicited significantly shorter reaction times than the formal overlap non-word condition.

The children, on the other hand, had significantly faster reaction times in all related prime conditions compared to the unrelated condition; however, the related prime conditions did not differ significantly from each other. Hasenäcker et al. (2016) argued that the form-first accounts did not fit the data since they predicted semantically blind initial decomposition followed by morpho-semantic decomposition. Such a claim would require significant differences between suffixed primes (the transparent and opaque non-word conditions) and non-suffixed primes (the formal overlap condition) in terms of priming magnitude and RT distribution patterns. Supralexical accounts (e.g. Giraudo & Grainger, 2001) also contradicted the findings since they assumed an initial whole-word activation followed by a morpheme representation activation. Such a model would expect no priming in the opaque non-word condition. Amorphous theories (e.g. Baayen, Milin, Đurđević, Hendrix, & Marelli, 2011), in which the priming was seen as a result of both form and meaning similarity, could not be fully rejected by the findings; yet, the lack of a significant difference between the transparent condition and the opaque non-word condition was not in line with what these theories suggested. The findings best complied with Hybrid Accounts or Obligatory Segmentation (e.g. Morris, Porter, Grainger, & Holcomb, 2011; Beyersmann et al., 2015a, 2016) that accept stems along with morphemes as salient units in word processing. Hasenäcker et al. (2016) underlined that the children did not display significantly different reaction times for opaque non-word primes and formal overlap non-word primes; therefore, morphological decomposition could not explain the priming effects observed in the children. Alternatively, it was suggested that children could use stem activation in the situations when salient affix representations, which were necessary for morphological decomposition, were not available. Referring to earlier work, Hasenäcker et al. (2016) claimed that embedded stems were likely to behave as automatically activated lexical representations in the early stages of word processing (Beyersmann et al., 2015b), and even a partial orthographic overlap could lead a mapping between an embedded stem and a whole word representation (Ziegler et al., 2014). It was argued that this stem-activation mechanism in children developed later to become an automatized morpho-orthographic segmentation mechanism (e.g. Rastle & Davis, 2008).

Oliveira and Justi (2018) used the masked priming paradigm with 60 ms and 250 ms SOAs in a study with Brazilian-Portuguese speaking children. The study used three conditions: a transparent condition, an opaque condition, and an unrelated condition. 141 primary school children (35 second graders, 33 third graders, 33 fourth graders, 40 fifth graders) participated in the study. Only the fifth graders showed significant priming effects in the transparent condition at 60 ms. Oliveira and Justi (2018) argued that the priming effects observed in the lower grades at 250 ms was related to morpho-semantic processing, rather than morpho-orthographic processing. Children had already had morphological knowledge in their native language before they started to read. Oliveira and Justi (2018) proposed that children during phonological recoding process could benefit from semantic features of morphemes. This was why second, third, and fourth graders showed significant priming in longer prime durations (250 ms). Oliveira and Justi (2018) asserted that as more reading experience was gained, children developed an automatic processing mechanism for processing complex words, which was also put forward as an explanation for why only the fifth graders in the study showed significant priming effects in the transparent condition at 60 ms.

In another more recent masked priming study, Lázaro, Illera, Acha, Escalonilla, García, and Sainz (2018) examined Spanish-speaking primary school children (33 fourth graders, 31 fifth graders, 25 sixth graders) and Spanish-speaking adults. Unlike the aforementioned studies discussed here, the related primes in the study shared only their endings with their targets. There was a suffixed prime condition in which a prime and a target shared a legitimate suffix, and an orthographic ending condition in which a prime and a target shared an orthographic similarity in their ending. The SOA was 50 ms in the experiment. Although the Go -No Go version of the masked priming paradigm was used, which was shown to be easier for children (e.g. Davis, Castles, & Iakovidis, 1998; Moret-Tatay, & Perea, 2011; Perea, Soares, & Comesaña, 2013), only the adults and the sixth graders in the study showed priming effects in the suffixed prime condition. The orthographic ending condition failed to show any significant priming effects for all participant groups. Lázaro et al. (2018) interpreted the results as the existence of a developmental pattern for suffix saliency in early word processing, which was for real suffixes only rather than frequent letter clusters. The nature of the study did not allow to make inferences about morpho-semantic effects in early word processing, since the orthographic ending condition did not include the primes presenting pseudo-stems once their common orthographic endings shared with their targets were stripped.

Table 5. Masked priming studies with children using SOAs under 80 ms

	Orthograp.	Seman.	Transparent	Opaque	F. O.	Opaque Non-word	F.O. Non-word
Casalis et al. (2009) – *French*	Priming (4th grades)	NI	Priming (4th grades)	NI	NI	NI	NI
Quémart et al. (2011)- *French**	No priming	No priming	Priming* (3rd,5th, 7th grades)	Priming* (3rd, 5th, 7th grades)	NI	NI	NI
Beyersmann et al. (2012) - *English**	NI	NI	Priming* (3rd and 5th grades)	No Priming*	No Priming	NI	NI
Beyersmann et.al(2015b)- *French*	NI	NI	Priming* (2nd,3rd ,4th,5th grades)	NI	NI	Priming (high prof.)	Priming (high prof.)
Hasenäcker et al. (2015) – *German**	NI	NI	Priming* (high prof. 3rd-5th grades)	NI	NI	Priming* (high prof. 3rd-5th grades)	Priming* (high prof. 3rd-5th grades)
Hasenäcker et. al (2016) - *German**	NI	NI	Priming* (2nd-5th grades)	NI	NI	Priming* (2nd-5th grades)	Priming* (2nd-5th grades)
Oliveira and Justi (2018)- *Portuguese*	No priming	NI	Priming (5th grades)	NI	NI	NI	NI

* a mark (*) on the language of the study means that the study included adult participants, a mark (*) on the word “Priming” means that the study found significant priming effects for adult participants in that prime condition, NI: not included, Orthograp.: orthographic, Seman.: semantic, F.O. : formal overlap

The studies using masked priming with children have included different types of prime conditions and found priming effects for some of them. Table 5 summarizes these studies and their findings.

Overall, the masked priming studies with children have revealed significant priming effects for truly-affixed primes (transparent condition). As a contradiction, Casalis et al. (2009) found priming effects for orthographic primes unlike Quémart et al. (2011). Quémart et al. (2011) argued that the study of Casalis et al. (2009) included low-frequency words and used complex words as primes; therefore, it was difficult to generalize the results. In another set of experiments that produced conflicting results, Beyersmann et al. (2012) failed to find significant priming effects for pseudo-derived primes (opaque condition) in English-speaking children, while Quémart et al. (2011) found significant priming for such primes in French-speaking children. Note that in addition to the language-related difference between the two studies, Quémart et al. (2011) used low numbers of participants for each grade level. The inconclusive results for pseudo-derived prime types call for further empirical evidence. Studies in French and German investigating priming effects with suffixed non-words and non-suffixed non-words have found significant priming effects for such primes with children, or at least with high proficient children (Beyersmann et.al, 2015b; Hasenäcker et al., 2015; Hasenäcker et. al. 2016). These findings suggest that even the morphemes in non-words are salient units of word processing in children.

2.3.7. Turkish Studies

Masked priming studies investigating morphological processing in Turkish are highly limited in number. As was already mentioned in Section 2.3.5, Kırkıcı and Clahsen (2013) conducted a study with adult L1 and L2 speakers of Turkish using the masked priming paradigm. Three conditions were used in the study: a transparent condition, a formal overlap condition, and an unrelated condition. The transparent condition included two prime conditions: a derived prime condition including the primes derived by the derivational suffix -lIk and an inflected condition including the primed inflected by the inflectional suffix -(A)r. Both prime types (derived and inflected) in the transparent condition contained the bare forms of their targets. There were 2 experiments: Experiment 1 included the transparent and unrelated conditions, while the Experiment 2 included the formal overlap and unrelated conditions. The primes were presented for 50 ms in both experiments. The first experiment had 32 Turkish-speaking young adults and 32 L2 young adult learners of Turkish. For the second experiment, 28 Turkish-speaking young adults and 28 L2 young adult learners of Turkish, who also participated in the first experiment, participated.

The results of Experiment 1 showed that while morphological decomposition and priming effects were evident for both inflected and derived primes in L1 Turkish speakers, only derived words caused facilitative priming in L2 Turkish speakers. Neither groups showed priming effects for the formal overlap condition in the second experiment; therefore, Kırkıcı and Clahsen (2013) concluded that the observed priming effects in the first experiment could not be attributed to the orthographic overlap between the prime-target pairs in the transparent condition.

Th priming effects in the derived prime condition for L2 speakers was explained by the shared lexical entries; derived primes in the transparent condition had their own lexeme entries for Turkish L2 speakers. Kırkıcı and Clahsen (2013) argued that word processing of L1 and word processing of L2 were not identical in that L2 users processed words the same way L1 users did but only slower and with L1 interferences. Rather, it was argued that L2 users could not benefit from morphological decomposition, which was essential for obtaining priming effects in inflected prime conditions. Following this line of reasoning, regularly inflected words were argued to have no lexical entries, thus lacking shared lexeme entries with their base forms.

Gacan (2014) used the masked priming paradigm with Turkish-speaking adults to investigate morphological processing both in L1 (Turkish) and in L2 (English). Two experiments were conducted using a short SOA (50 ms). In the first experiment including Turkish primes and targets, a transparent condition, a formal overlap condition, and an unrelated condition were used. There were two derived prime conditions in the transparent condition: one condition consisted of the primes derived by the Turkish suffix -*lI* and another condition consisted of the primes derived by the Turkish suffix -*sIz*. Same target words were used for the two prime conditions in the transparent condition. 64 Turkish-speaking university students participated in the first experiment. Both the derived and inflected primes in the transparent condition led to comparable priming effects, while primes in the formal overlap condition did not show any priming effects. Gacan (2014) argued that since the primes having merely orthographic relations with their targets did not lead to significant priming effects, the priming effects observed in the transparent condition could be attributed to morphological relations between the prime-target pairs. The results were taken as an indicator of morphological decomposition in Turkish-speaking adults, at least for the complex words derived by productive, transparent, and common suffixes.

In the second experiment, English words and primes were used with the same conditions, except for the formal overlap condition. Gacan (2014) used a mixed condition in the experiment that included both opaque primes and formal overlap primes. 60 Turkish-speaking university students with good English proficiencies participated in the second experiment. The participants were divided into two groups according to their English proficiencies: high-proficiency group (advanced level English) and low-proficiency group (upper-intermediate level English). Similar to the first experiment, the transparent condition had two derived prime conditions: one condition included the primes derived by the English suffix -*ful*, and another condition included the primes derived by the English suffix -*ness*. The reasons behind using these suffixes were as follows: First, they were considered as the diaforms of the

Turkish suffixes used in the first experiment. Second, they were transparent, productive, and common suffixes like the Turkish suffixes used in the study. While the high-proficiency group showed significant priming effects for both prime conditions in the transparent condition, the low-proficiency group showed significant priming effects only for the primes derived by the English suffix *-ful*. Gacan (2014) argued that the low-proficiency group might have stored the complex words derived by the *-ful* suffix. Surprisingly, both groups showed significant priming effects in the orthographic condition, unlike Experiment 1. Gacan (2014) underlined that if the priming effects observed were to be the result of pure orthographic overlap, then the suffix *-less* would also lead to significant priming effects for the low-proficiency group; therefore, rather than attributing the priming effects to orthographic overlap, Gacan (2014) concluded that both orthographic and morphological features contributed the observed priming effects in the second experiment.

Gacan (2014) argued that cross-linguistic effects or L2 instruction might have been the factors resulting in the differences between the two experiments. In addition to the different characteristics of Turkish and English, the participants in the second experiment had acquired their L2 English in a classroom environment; none of them were reported to be exposed to English in an English-speaking country. The differences between the two groups in the Experiment 2 were discussed within the Declarative/Procedural Model (Ulman 2001a, 2001b). Gacan (2014) proposed that the high-proficient group in the study might have relied more on the procedural system and might have decomposed both prime types (derived by *-ful* suffix and *-less* suffix) in the transparent condition, thus showing significant priming effects for both prime types in the transparent condition. The low-proficient group, on the other hand, might have used the declarative memory for processing the primes derived the suffix *-less*, thus showing no priming effects for these primes.

In a more recent study, Şafak (2015) conducted two similar experiments to Gacan (2014). What differentiated the study of Şafak (2015) from Gacan (2014) in the first experiment was the inclusion of a semantic condition and an inflected prime condition. Furthermore, an orthographic condition, in which a prime had orthographic overlap with its target without including the whole target, was used. Therefore, the study had 4 conditions: a transparent condition, an orthographic condition, a semantic condition, and an unrelated condition. All primes and targets in the Experiment 1 were Turkish words. The transparent condition consisted of two prime conditions: one condition including the primes inflected by the Turkish suffix -*mIş*, and another prime condition including the primes derived by the Turkish suffix –*(y) IcI.* 40 Turkish-speaking young adults participated in the first experiment. The results showed significant priming effects for only the transparent condition, while there was no significant difference between the inflected and derived primes. There were, however, significant differences between the identical prime condition and the suffixed prime conditions (inflected and derived); Şafak (2015), therefore, interpreted the priming effects observed in the suffixed prime conditions as partial priming effects.

The second experiment used a formal overlap condition and an opaque condition instead of the orthographic condition. Other conditions (semantic, transparent, and unrelated) were the same with Experiment 1. The transparent condition in the second experiment similarly had two prime conditions: one condition including the primes inflected by the English suffix *-ed,* another condition including primes derived by the English suffix *-er.* The reasons for selecting these English suffixes were again the interpretation of these English suffixes as being the diaforms of the Turkish suffixes used in the first experiment, and the similar high productivity, transparency, and frequency of these English suffixes to the Turkish suffixes used in the study. 44 Turkish-speaking adults that had advanced English proficiency participated in the second experiment. The participants showed full priming effects for the transparent and opaque conditions, and a partial priming effect for the formal overlap condition. The study contradicted Clahsen and Kırkıcı (2013), as both the inflected and derived primes in the transparent condition, and the primes in the formal overlap condition led to significant priming effects in L2. Şafak (2015) pointed to the participants' different L2 learning environments in the two studies; while the L2 participants in Şafak (2015) had acquired their L2 in a classroom environment, the L2 participants in Clahsen and Kırkıcı (2013) had been exposed to natural L2 input. Şafak (2015) further concluded that the partial priming effect observed in the formal overlap condition for L2 speakers could be due to the lack of morphological relationship between the prime-target pairs in the formal overlap condition, unlike the prime-target pairs in the transparent and opaque conditions; therefore, it was argued that both morphological and orthographic features contributed to the observed priming effects.

CHAPTER 3

THE STUDY

3.1. Background to the Study

As has been discussed in earlier sections, a good number of studies have investigated the nature of early word processing considering different features; however, there is still a considerable gap in the literature, especially when it comes to non-Indo-European languages like Turkish. First, to date no study has investigated the lexical/morphological processing of Turkish by children using the visual masked priming paradigm. Although there have been a few masked priming studies with adults in Turkish (e.g., Gacan, 2014; Kırkıcı & Clahsen, 2013; Şafak, 2015), none of them included an *opaque condition* (e.g. corner-corn); therefore, it is unknown whether Turkish readers decompose pseudo-affixed words (Rastle, Davis & New, 2004; Quémart et al., 2011). Second, L1 masked priming studies comparing inflections and derivations in Turkish using identical targets are limited for adults and non-existent for children. Furthermore, Andrews and Lo (2013) found an effect of individual differences on word processing; participants who had better vocabulary skills than spelling skills (semantic profile) and participants who had better spelling skills than vocabulary skills (orthographic profile) showed subtle differences in the observed priming effects across different conditions. The argument regarding Orthographic and Semantic Profiles (Andrews & Lo, 2013), then, needs further validation, especially for young learners.

Turkish is an agglutinative language, and its morphology is extremely productive. Hankamer (1989) states that an educated Turkish speaker would need to store 200 billion lexeme entries if all words were to be stored in the mental lexicon. Showing an example of highly productive affixation, Lewis (1970) refers to the possible Turkish word *Avrupalılaştırıverilemeyebilenlerdenmişsiniz* (*I gather that you are one of those who may be incapable of being speedily Europeanized*). For Lewis (1970), describing English sentences as “drystone walls, with one chunk of meaning dropped into place after another” and referring to Turkish sentences as “bricks, each cemented to the next” are accurate similes to describe Turkish morphological characteristics. One should note, however, that such extreme examples are rare and nearly non-existing in written and spoken language use. Hankamer (1989) created a rather small data sample including a few thousand words and found that 19.8 percent of these words included five morphemes or more, showing that complex words with a fairly high number of morphemes were frequently used in Turkish language.

Turkish has an extremely shallow orthography; it is well documented that reading acquisition in Turkish is mostly achieved within one school year (e.g. Babayiğit & Stainthorp, 2007; Durgunoğlu & Öney, 1999; Öney & Durgunoğlu, 1997). This process is known to be longer for languages with a deeper orthography (e.g. Seymour, Aro, & Erskine, 2003).

Affixation in Turkish does usually not lead to major changes in a word’s phonology or orthography (see Göksel & Kerslake, 2004). In the reading acquisition literature, it has been suggested that the orthography of a language has effects on the acquisition order and nature of its salient units in reading (e.g. Marcolini et al. 2011; Ziegler & Goswami, 2005). Furthermore, there are common views in the literature that characteristics like affix saliency and productivity have effects on the nature of language processing. (e.g. Marcolini et al. 2011; Quémart et al. 2011; Schreuder & Baayen,1995; Ziegler & Goswami, 2005).

Factors like affix saliency, affix productivity, frequency, and orthographic similarity, which are known to influence morphological processing, were taken into consideration in the present study to minimize any distinguishing processing effects (see Section 2.3.4 for more details). As the present study studies a sample of children, the morphemes to be employed in the experimental task needed to be high in frequency. Furthermore, using the same targets for both inflected and derived primes would prevent many unpredictable or unavoidable confounding factors stemming from between-items effects. It was also necessary to identify a derivational and an inflectional morpheme that could be added to a good number of target words with similar frequencies and lengths in a child corpus. Bearing in mind the aforementioned criteria and constraints, the suffixes -lI and –(y)lA were selected since, in addition to meeting these criteria, they displayed a high orthographic similarity.

Table 6. -(y) lA suffix meanings

Comitative meaning	Ahmet'**le** okula gittik.	*We went to school* ***with*** *Ahmet.*
Instrumental meaning	Kırık cam**la** parmağımı kestim.	*I cut my finger* ***with*** *broken glass.*
Conjunctive meaning	Elif'**le** Aslı sinemaya gitti.	*Elif* ***and*** *Aslı went to the cinema.*

-(y)lA is a nominal inflectional marker in Turkish which can convey three different meanings (Table 6): a comitative meaning, an instrumental meaning, and a conjunctive meaning (Göksel & Kerslake, 2004; Lewis, 1970). This marker is a post-clitic, and it can be written in a separate form as *ile*; however, this separate form is rare (Göksel & Kerslake, 2004).

-lI, on the other hand, is a productive derivational suffix in Turkish. It can denote different meanings: (a) having the qualification or the object itself expressed by the stem it is attached to, e.g. *tuz- tuzlu* (salt-salty), (b) having the qualification or the object itself expressed by the stem it is attached in high degree, e.g. *hız-hızlı* (speed-

fast), (c) stating a belongingness to somewhere, e.g. *kasaba- kasabalı* (village-villager) (Lewis, 1970).

3.2. Research Questions and Expected Outcomes

1. How do Turkish child L1 readers in primary school process morphology complex words that are inflected with the affix *–(y)lA* or derived with the affix -*lI*?
    - 1.1. Is there a difference between second graders and fourth graders in processing these morphologically complex words?
    - 1.2. Do participants with a semantic profile and participants with an orthographic profile process these morphologically complex words differently?
2. How do Turkish child L1 readers in primary school process words with pseudo-stems only (formal overlap condition) and words with pseudo-stems and pseudo-affixes (opaque condition)?
    - 2.1. Is there a difference between second graders and fourth graders in processing these words?
    - 2.2. Do participants with a semantic profile and participants with an orthographic profile process these words differently?

Statistically significant differences between the mean reaction times to the test primes and the unrelated primes in any of the experimental conditions can be interpreted as manifestations of decomposition if the reaction times in the unrelated conditions are slower. Such an outcome would provide additional evidence for dual-mechanism models against all-words-are-stored models, while it cannot rule out the possibility of a rule-processing single mechanism. Finding decomposition in the opaque and formal overlap conditions will support Rastle et al.'s (e.g. 2004) assumptions of semantically-blind early word processing. However, it is important to keep in mind that the present study focuses on primary school children; the lack of evidence for decomposition in some conditions may point to a developmental process rather than the absolute absence of such decomposition effects. As was discussed before, while Rastle et al. (2004) found significant priming effects with opaque items for English-speaking adults, English speaking children (e.g., Beyersmann et al. 2012) did not show significant priming effects for opaque words.

Another possibility is that different word processing patterns exist for derived and inflected words. If L1 Turkish developing learners act like L2 Turkish learners, it can be assumed that partially developed word processing mechanism(s) may not handle inflectional decomposition, whereas derived words may lead to priming effects due to shared lexeme entries (Kırkıcı & Clahsen, 2013). Another possibility is the significant priming advantage of inflected primes over derived primes. Of course, there is a third possibility that both groups of affixed primes will lead to the same degree of priming. Such a finding may be interpreted as both affix categories being decomposed, or as both decomposition and lexical similarity leading to similar degree of priming effects.

If the differences between the test primes and the unrelated primes are not statistically significant in the transparent condition, it may be argued that Turkish L1 readers in primary school do not have (a) fully-developed word processing mechanism(s), since earlier Turkish masked priming studies have found significant priming effects (Gacan, 2014; Kırkıcı & Clahsen, 2013; Şafak, 2015). Finally, Andrews and Lo (2013) found significant differences in word processing characteristics between participants having a vocabulary score advantage and participants having a spelling score advantage. To validate or falsify these findings with children, the study will use a vocabulary test and a spelling test. In addition, a reading speed task and a reading comprehension task will also be applied to examine any possible effects of these factors on word processing.

3.3. Methodology

The study employed the visual masked priming paradigm (Forster & Davis, 1984). In this paradigm, a visual prime is presented for a short duration (30-70 msec) following a mask. This mask typically has an identical number of masking symbols (usually #s or Xs) with the number of prime letters; therefore, it can *mask* the prime and it will be harder for participants to consciously see the prime. After the prime, the intended target word appears, and participants are expected to decide whether the string forms a real word or not (i.e., perform a lexical decision task). Primes and targets are presented in different letter cases (generally primes in lowercase and targets in uppercase) or different font types (Heyer & Kornishova, 2018) to ensure that they do not visually overlap. The paradigm offers important insights as it is often referred to as a way to investigate early stages of word processing without the involvement of conscious awareness and strategies (e.g. Feldman et al., 2012; Forster & Davis, 1984; Rastle et al., 2004).

There are two common versions of this technique: the Yes/No version and the Go/No Go version. While the Yes/No version requires participants to press separate buttons to indicate whether the on-screen visual target is a word or a non-word, the Go-No Go version only necessitates participants to press a single button for words and wait for non-words to disappear when they pop up without taking any action. The latter version may seem to lack in delivering useful non-word data; however, some studies have shown that it is more reliable especially for younger children (Davis et al.1998; Moret-Tatay, & Perea, 2011; Perea, Soares, & Comesaña, 2013). As it is important for the purposes of the present study to obtain detailed data regarding the processing of non-words in addition to words, the Yes/No version of the masked priming paradigm was employed.

It is customary to present experimental items in a masked priming task in three conditions. These are:

1. Identity Condition
2. Test Condition(s)
3. Unrelated Condition

The *identity* condition can be described as a way to investigate whether participants actually benefit from primes. This condition includes completely identical prime-target pairs; for example, for the target *house*, the prime is also selected as *house* in this condition. If participants fail to show priming effects in this condition, it becomes difficult to interpret the results of test conditions since the lack of identity priming suggests that participants did not benefit from the primes. A priming effect can be described as the facilitation effect in recognizing target words after the presentation of primes.

Test condition(s) can be more than one even within the same prime-target word set. For example, as the present study investigates whether there are any differences between the processing of derived primes and inflected primes, there are 2 test conditions for the transparent word set: the *derived* prime condition and the *inflected* prime condition. The reason for including test condition(s) is to investigate if a specific relationship (e.g. semantic, morphological, orthographical) between targets and primes leads to priming effects.

The *unrelated* condition serves as a baseline for measuring priming effects in the identical and test conditions. This condition includes primes that have no apparent semantic, orthographic, phonological, and morphological similarity with their targets. These unrelated primes are accepted to induce no facilitation effects; therefore, any facilitation effect supposedly caused by identical primes and item primes can be examined by comparing these conditions with the unrelated condition.

The comparison of conditions is straightforward. Statistically significant reaction time differences favoring the identical condition over the unrelated condition is referred to as *identity priming*. Identity priming is a way to ensure that participants make use of primes. Any significant differences favoring test condition(s) over the unrelated condition is interpreted as the test items of interest leading to statistically significant facilitation for recognizing target words. The general expectation for identity priming is to draw the fastest reaction times among all conditions. The closer a test condition to the identity condition is, the more powerful priming effects the test condition has.

The test prime sets in this study (semantic, opaque, formal overlap, transparent) will be tested against unrelated prime sets and identity prime sets to investigate any possible priming effects. Significant facilitation effects after different test prime types cannot be all regarded as a result of decomposition. Take semantic condition, for example. The prime-target words do not share any morphological relationship. It is also important to recall that the possible priming effects observed with derived primes in the morphological condition might or might not be due to morphological decomposition. Shared lexeme entries could also lead to priming effects.

3.4. Participants

The participants of the study were 76 primary school children. While 39 of the participants were second grade students (mean age: 7.45, SD: 0.36), the remaining 37 participants were fourth grade students (mean age: 9.36, SD: 0.41). All participants were selected from 2 state primary schools in Erzurum; one of these schools was randomly selected, and the other one was conveniently selected due to reasons of accessibility. Approval to test this sample of participants was obtained from the University Ethics Committee as well as from the Provincial Directorate for National Education (see Appendix N and Appendix P). Since the participants were all under the age of 18, the written consent of their parents was obtained for the study. Furthermore, each of the participants was asked whether s/he was willing to participate and was informed that s/he could withdraw from the study at any point. None of the participants reported to be bilingual. Furthermore, the teachers and the parents stated that the participants did not have any language or learning disorders. All participants had normal or corrected-to-normal vision. Participation was voluntary, and the participants did not receive any payment.

For the piloting of the Vocabulary test and the Spelling test, 11 classroom teachers volunteered to conduct the tests in their classrooms since the tests would provide valuable information about the vocabulary and spelling skills of their students. As a part of their Turkish class evaluation, 107 Turkish native speakers in the 2nd Grade and 146 Turkish native speakers in the 4th grade took the vocabulary test and the spelling test.

As for deciding whether related primes and unrelated primes serve their purposes, 20 adult Turkish native speakers took the relatedness test created for test items. The participation was voluntary, and they did not get paid.

3.5. Materials

3.5.1. Word Association Task

A word association task with 61 frequent words was used to find out which words were semantically more associated with the possible target words for children. Words were selected from the Turkish National Corpus (TNC; Aksan, Aksan, Koltuksuz, Sezer, Mersinli, Demirhan, & Kurtoglu 2012). The reason for conducting this task was the potential difference between the perception of semantic relations among words in adults and in children; if the researcher or adults had selected semantically related words, these items might not have been perceived to have strong semantic relationships by children. To avoid answers with high orthographic similarity, obvious word candidates that have a high orthographic similarity with the target were instructed to be left out. Participants were supposed to write the first word that came to their minds after reading each word in the task (see Table 7). The task was given to 40 second grade children that were different from the participants selected for the main experiment (Appendix L).

Table 7. An example from the instructions in the Word Association Test

göz (eye)	e.g. *kirpik* (eyebrow)
! *Gözlük* cevabını verme (Do not answer as *glasses*)	

3.5.2. Word Recognition Task

A Word Recognition Task was also administered to check whether Turkish speaking second-grade students were familiar with the words. The task included all potential target words and prime words to be used in the main experiment. In this test, participants were asked to cross out the words that they were unfamiliar with. The task was intended to eliminate commonly unknown words among second graders to avoid high percentages of error rates in the main experiment. The words that were crossed out by more than 3 students were not included in the final word sets (Appendix K).

3.5.3. Vocabulary Test

Measuring the vocabulary skills of the participants was necessary to create two profiles: the so-called semantic profile and orthographic profile (Andrews & Lo, 2013). A multiple-choice vocabulary test was created for each grade. To do this, a question pool was foemed, which included 9 difficulty levels with 10 questions each. With increasing difficulty level, the frequency of words used for options was decreased. For the second grade vocabulary test, the difficulty levels 1-6 were used to create a test with 60 questions. Similarly, the difficulty levels 4-9 were used to create a 60-question test for fourth graders. The results of these two tests were examined with the help of a Turkish teacher (with a teaching experience of over 8 years), and items that could be extremely difficult or vague for the grade of interest were removed from the both tests. The final versions of the two tests had 54 items each, with 26 questions in common (Appendix G and Appendix H).

3.5.4. Spelling Test

Spelling skills were also essential in the creation of the aforementioned profiles. In the creation of spelling tests, the same procedures as with the Vocabulary Test were followed. A question pool was created with 90 multiple choice questions varying in terms of difficulty. Examining the questions with the same Turkish teacher, a spelling tests was created for each grade. The number of questions was again 54 for each of these tests, and they shared 28 common questions (Appendix E and Appendix F).

3.5.5. Reading Task and Comprehension Test

For the reading tasks, short passages in Turkish (214 words for second graders, 265 words for fourth graders) were used from the books *The Little Black Fish* and *Jayden's Rescue* for second and fourth graders, respectively. A class teacher (with more than 10 years of experience) suggested the books for the intended grade levels. With the help of the same class teacher, 10 comprehension questions were created for each reading sample (Appendix I and Appendix J).

3.5.6. Target-Prime Relatedness Test

A 7-point Likert-scale was created to test the relatedness of prime-target pairs in the related and unrelated conditions before the experiment. The test was given to 20

Turkish speaking adults. An independent samples t-test showed that there was a significant difference between the ratings for the related primes (M=5.59, SD=0.41) and the ratings for the unrelated primes (M=1.39, SD=0.25), t (298) =85.79, p<0.0001.

3.5.7. Masked Priming Experiment

The targets and the primes to be used in the masked priming experiment, the main experiment of the study, were divided into 4 different word sets: the semantic condition word set, the opaque condition word set, the formal overlap condition word set, and the transparent word set. As outlined before, each word set included three types of primes: identical, test, and unrelated. Identity primes were used to control whether the participants benefited from priming effects and how close the priming effects obtained in the test condition, if any, to the identity priming. The test primes were the core of the experiment since they were the means to measure any priming effects related to their features (semantic, pseudo-affixed pseudo-stem, pseudo-stem only, truly-affixed). As for unrelated primes, the point of the test design was to find statistical differences between the related primes (identity, test) and them. Only then would it be possible to state that there were priming effects. The unrelated primes had no semantic, orthographic, or morphological relationships with their targets. In the process of word selecting, the Turkish National Corpus was used (Aksan et al., 2012).

The *semantic condition* word set included 24 prime-target pairs that had strong semantic relations without any morphological relations and with little to no orthographic similarity between them (Appendix A). Table 8 shows example items from this word set. The reason for some of the prime-target pairs to have a small degree of orthographic similarity was due to the Word Association Test. Since the tests was given to 40 students in the second grade, and the most common answers were counted for each of the target words, the semantic word set included highly frequent answers that had little orthographic similarity with the target.

Table 8. Related prime, unrelated prime, and target examples from the semantic word set

Related Prime	Unrelated Prime	Target Word
Soru	Priz	cevap
"question"	"socket"	"answer"

The *opaque condition* word set included 24 existing Turkish simple words that looked like complex words with pseudo stems and pseudo affixes (Appendix B). Adding such a word set into the study was important since studies like Davis et al. (2004) found strong priming effects for pseudo-affixed words with adults. It was therefore important to test whether similar effects would be observed with developing readers in Turkish. Recall that Beyersmann et al. (2012) found no priming effects with pseudo-affixed words in English-speaking children; therefore, a similar absence in this study could point to a developing word processing system. Table 9 presents example items from this word set. Note that *-a* is a legal suffix and *kir* (*dirt*) is an existing word-stem in Turkish.

Table 9. Related prime, unrelated prime, and target examples from the opaque word set

Related Prime	Unrelated Prime	Target Word
kira	tost	Kir
"rent"	"toast"	"dirt"

The *formal overlap* condition word set included 24 existing Turkish simple words that had no morphological complexity; yet, they seemed to have another stem embedded in them (Appendix C). What distinguished this set from the previous set was the words in the formal overlap condition did not have pseudo-affixes after their seemingly embedded pseudo-stems (i.e., *-aş* in *telaş* is not an existing suffix in Turkish). Since earlier studies on Turkish (Gacan, 2014; Kırkıcı & Clahsen, 2013) found no priming effects for adults in the formal overlap condition, the question of whether developing readers would show a contradicting pattern was of particular interest. An example item set is presented in Table 10.

Table 10. Related prime, unrelated prime, and target examples from the formal overlap word set

Related Prime	Unrelated Prime	Target Word
Telaş	kibir	"tel"
"hurry, haste"	"arrogance"	"wire"

Unlike the previous word sets introduced above, the transparent condition word set contained 2 test prime conditions: the *derived* prime condition and the *inflected* prime condition (Appendix D). The derivational suffix -lI and the inflectional suffix –(y)lA were attached to the same targets to create the derived prime condition and the inflected prime condition, respectively; therefore, these two conditions had identical targets. Each test prime group had 28 primes with the common target words across test prime groups in the transparent condition. This word set is not merely important for investigating whether meaning-bearing affixes differ from pseudo-affixes but also for examining any possible differences between inflected word processing and derived word processing. Table 11 shows example items from this condition.

Table 11. Related primes, unrelated prime, and target examples from the transparent word set

Related Prime (Derived)	Related Prime (Inflected)	Unrelated Prime	Target Word
Gururlu "proud"	Gururla "with pride"	akılsız "mindless"	gurur "pride"

The orthographic overlap degree between the prime-target sets the in five prime conditions was matched using the Match Calculator (Davis, 2010) using four different coding systems. The results are presented in Table 12.

Table 12. The mean scores of orthographic similarities between related prime- target pairs based on four different coding systems

	Absolute	Vowel Centric (L-R)	Vowel Centric (R-L)	SOLAR (Spatial Coding)
Semantic	0.04	0.08	0.09	0.11
Opaque	0.64	0.63	0.51	0.60
Formal Overlap	0.62	0.62	0.42	0.58
Inflected	0.68	0.65	0.46	0.67
Derived	0.65	0.68	0.48	0.63

The degree of prime-target orthographic overlap in the semantic condition was significantly different from the other conditions in all four coding systems ($p<0.0001$ in all instances). The semantic prime condition was a control condition to test whether pure semantic relations had an effect; therefore, it was meant to have little to no orthographic overlap between prime-target pairs, unlike the other conditions.

For the other 4 prime conditions (opaque, formal overlap, inflected, derived),there were no significant differences among them in absolute coding, vowel centric (L-R) coding, and vowel Centric (R-L) coding. For Spatial Coding, only the derivational prime-target set in transparent condition differed significantly from opaque the condition (p=0.009) and from the formal overlap condition (p<0.0001). Overall, the prime-target sets except for semantic condition showed very close orthographic overlap similarity with each other.

Other possible factors like prime frequency, prime length, target frequency, and target length were also checked. The numerical mean values for each factor and each condition are presented in Table 13.

Table 13. Frequency and Length values for related primes and targets

	Prime Frequency	Prime Length	Target Frequency	Target Length
Semantic	1.89	5.04	5.47	4.66
Opaque	1.67	4.58	6.71	2.91
Formal Overlap	1.32	4.79	6.96	2.95
Inflected	1.27	6.85	5.88	4.53
Derived	1.35	6.53	5.88	4.53

*Frequency values are out of 1 million

One-way Anova results showed significant differences in prime length [F (4, 123)=43.47, p<0.0001], and target length [F (4, 123)=27.57, p<0.0001]. Bonferroni Post-hoc tests revealed that inflected primes (p<0.0001) and derived primes (p<0.0001) were significantly longer than the other prime conditions while they did not significantly differ from each other. This result was expected since the inflected prime condition and the derived prime condition were the only conditions in which the primes were suffixed words.

Further Bonferroni post-hoc tests showed that the targets of the opaque condition and the formal overlap condition were significantly shorter than the targets in other conditions (p<0.0001 for all comparisons) while they did not significantly differ from each other. The reasons behind these differences were two-fold: firstly, second graders chose the primes for the target words in the semantic condition; therefore, we had little control over those primes. Even though we had 60 prime-target pairings suggested by second graders, it was difficult to come up with a perfect matching over all four criteria among conditions with this limited word choice. Secondly, the differences between opaque condition targets and formal overlap targets on the one hand and the other targets in different conditions on the other were due to the rareness of words in Turkish that seem to have a pseudo-affix or a pseudo-stem. In addition to these, finding derived and inflected words with a common target was another challenge for the transparent condition. Therefore, the pseudo conditions (opaque and formal overlap) and the transparent condition could not be matched in terms of target length and prime length.

A 7-point Likert-Scale scale was created to test the relatedness of prime-target pairs in the related and unrelated conditions before the experiment. The test was given to 20 Turkish speaking adults. An independent samples t-test showed that there was a significant difference between the ratings for the related primes (M=5.59, SD=0.41) and the ratings for the unrelated primes (M=1.39, SD=0.25), t (298) =85.79, p<0.0001.

In addition to the 100 test items, 100 filler words and 200 filler non-words were added to the design. The Turkish module of Wuggy software were used to created non-words (Keuleers & Brysbaert, 2010). To avoid semantic and orthographic similarity, the unrelated primes shared no apparent semantic similarities and no letters in the same position with their targets. For the complex word primes in the study, the corresponding unrelated primes were also selected as complex words. A Latin-square design was used to create 4 different lists and 4 reversed versions of the same lists to avoid fatigue and task familiarity effects; therefore, each participant saw each target only once. All participants answered the same 10 practice items before they saw the actual experimental items.

3.6. Procedure

The whole study was carried out in the first term of the 2017-2018 school year. The Vocabulary tests and the spelling tests were applied on different days. For each test, students were given 40 minutes' time and a 10-minute break. 3 students in the fourth-grade and eleven students in the second grade could not finish the tests on time and were excluded from the reliability analyses. For the reliability analyses, SPSS 25.0 software was used.

Before the main masked priming experiment, a pilot study was conducted with 4 second-grade participants, using each list. The reasons for selecting all four participants from the second grade was their younger age and comparatively little reading experience. It was expected that they would have more problems with the Yes/No version of the masked priming experiment. As a contingency plan, the Go/No Go version of the masked priming experiment (see Section 3.3.), in which participants were required to respond only for words, would have been used. However, as no problems were encountered during the piloting, no changes were made to the main experiment materials and procedures.

The masked priming experiment was created using the DMDX software (Forster & Forster, 2003). For the presentation of the stimuli, an ASUS laptop with a screen size of 15.6 inches was used. The participants responded to the stimuli using a Logitech F510 wired gamepad. Items were presented in white Times New Roman 24 fonts on a black background. Trials began with a fixation cross remaining for 500 ms in the middle of the screen. Just before the primes showed up, a mask having the same number of hashtags (#) with the upcoming prime was presented for 500 ms. This was followed by the presentation of primes for a duration of 50 ms and the targets for

5000 ms or until participants responded. The primes were in lower case letters while the targets were in upper case letter to prevent visual continuity. If no answer was given within 5000 ms, it was counted as an incorrect answer. This procedure can be seen in Figure 5.

Figure 5. Masked priming experiment procedure

The masked priming experiment took approximately 40 minutes for each participant. Each participant was tested individually in a silent empty room. Although the room was quiet, the participants used professional noise blocking earmuffs to avoid any disturbing noise that might come from the outside. A detailed explanation on how to carry out the experiment was provided to each participant, followed by a 10-trial practice run. The participants were told to respond as quickly and accurately as they could. This explanation did not include any information related to the primes in the experiment; therefore, the participants were unaware of the intention of the experiment. The participants were told to use their dominant hand to react to words, and the left-handed participants were noted. All participants were offered a break after every 100 words (3 breaks in total). The breaks were compulsory, and the participants could continue the experiment after 5- 10 minutes depending on when they were ready. Each participant only took part in a single experiment for a single list.

After the masked priming experiment, the participants were asked to read the text selected for their grade and answer the comprehension questions related to it. The pilot study also included a reading speed task and comprehension questions; as no problems were apparent, neither the task materials nor the procedures were changed, and the data was used in the main analysis. The participants were told to read aloud the passages as fast and accurate as they could. After that, 10 comprehension questions were asked relating to the book passage they read. Both their reading output and the answers to the questions were recorded using a Sony ICD-PX440 voice recorder. Words read in a minute for each student were counted using Wavepad Sound editor 7.05. If a participant misread a word and did not correct it, this word was not counted. The researcher (an English teacher with a teaching experience of over 3 years) and the class teacher (with a teaching experience of over 20 years) evaluated the answers to the comprehension questions.

One participant from the second grade withdrew from the study after the masked priming experiment. 4 participants from the second grade and 2 participants from the fourth-grade were excluded and their reaction times were not taken into consideration since they had high error rates in all items or in either words or non-words (> 50%). One fourth grade participant giving slower responses to words compared to non-words and one second grade participant having a low reading speed along with a low spelling score (2.5 SD below the spelling score mean of her grade mean) were also removed. Prior to the reaction time analysis, incorrect answers were removed. Then, all answers above 3000 ms and below 400 ms were removed. Items that had error rates higher than 2.5 SD above the mean error rates for that item in each grade were removed (6 items; 1 item from the Semantic Condition, 3 items from the Opaque Condition, 2 items from the Formal Overlap Condition, and 1 item from the Transparent Condition). In addition, each participant’s mean reaction time means for the test items was calculated, and answers 2.5 SD above this participant mean were removed for each participant. Mean reaction times and standard deviations of each prime condition (identical, test, unrelated) in all word sets were calculated for each grade level. Participants having a mean reaction time 2.5 SD above in a prime condition were removed at the final step of outlier exclusion (3 second graders, 2 fourth graders). The final numbers of the participants were 30 for second graders and 32 for fourth graders. Finally, the cleaned data was analyzed in SPSS 25.0 and Jamovi 0.9.0.3.

3.7. Results

The raw data for the error rates will be used both in the analyses and in the tables provided in the next section. On the other hand, the log-transformed data will be used in the reaction times analyses, while the raw data for the reaction times will be used in the tables given in Section 3.7.2.

3.7.1. Accuracy

Table 14 shows the accuracy rates for the test prime conditions and the unrelated conditions. The table presents separate-group analyses separated by grade levels. Furthermore, *Part.* rows show by-participant results, and *Item* rows show the by-item results. To analyze whether the differences among error rates were statistically significant, Repeated Measures ANOVAs and t-tests were conducted.

Accuracy rates were analyzed using a Repeated Measures ANOVA with the factors Prime Type (Word, Non-word), Grade (Second, Fourth), Profile (Semantic Profile, Orthographic Profile) and with the covariates (Reading Speed, Reading Comprehension). The analysis revealed a significant effect of Prime Type, $F_1(1, 56)= 22.73$, $p<0.0001$, a significant effect of Grade, $F_1(1, 56)= 42.20$, $p<0.0001$, and a significant interaction between Prime Type and Grade, $F_1(1, 56)= 4.76$, $p=0.033$. There were no further significant main effects or interactions.

Table 14. Second grade and fourth grade participant accuracy rates across experimental conditions

		Semantic		Opaque		Formal Overlap		Transparent		
		Test	Unr.	Test	Unr.	Test	Unr.	Der.	Inf.	Unr.
2.grd	Part.	89.94	86.36	86.19	89.32	85.63	85.05	89.92	85.79	84.68
	Item	89.91	87.83	88.11	91.63	87.36	84.32	88.60	84.99	83.86
4.grd	Part.	95.64	95.92	92.85	95.94	95.46	88.67	93.75	96.50	93.97
	Item	95.20	95.53	92.97	96.81	96.45	89.55	93.72	96.76	93.57

*grd = grade, unr=unrelated primes, der=derived primes, inf=inflected primes

A Repeated Measures ANOVA for the semantic condition (see Table 14) with the factors Prime Type (Identical, Test, Unrelated), Grade (Second, Fourth), Profile (Semantic Profile, Orthographic Profile) and with the covariates in by-participant analyses (Reading Speed, Reading Comprehension) revealed a significant effect of Prime Type in the by-participant analysis only, $F_1(2, 112)= 10.16$, $p<0.0001$; $F_2(2,88)= 0.18$, $p=0.834$, a significant effect of Grade, $F_1(1, 56)= 13.50$, $p<0.001$; $F_2(1,44)=16.05$, $p<0.0001$, and a significant interaction between Prime Type and Grade (only in the by-participant analysis), $F_1(2, 112)= 6.17$, $p=0.003$; $F_2(2,88)=0.65$, $p=0.522$. There were no further significant main effects or interactions.

A Repeated Measures ANOVA for the accuracy rates in the opaque condition (see Table 14) with the factors Prime Type (Identical, Test, Unrelated), Grade (Second, Fourth), Profile (Semantic Profile, Orthographic Profile) and with the covariates in participant analyses (Reading Speed, Reading Comprehension) showed a significant effect of Prime Type, $F_1(2, 112)= 13.91$, $p<0.0001$; $F_2(1.73, 69.48)= 3.25$, $p=0.051$), and a significant effect of Grade, $F_1(1, 56)= 28.69$, $p<0.001$; $F_2(1,40)=69.15$, $p<0.0001$. There were no further significant main effects or interactions.

An ANOVA for the accuracy rates in the formal overlap condition (see Table 14) with the factors Prime Type (Identical, Test, Unrelated), Grade (Second, Fourth), Profile (Semantic Profile, Orthographic Profile) and with the in participant analyses covariates (Reading Speed, Reading Comprehension) showed a significant effect of Prime Type, $F_1(2, 112)= 22.44$, $p<0.0001$; $F_2(2, 84)= 2.49$, $p=0.089$, and a significant effect of Grade, $F_1(1, 56)= 13.70$, $p<0.0001$; $F_2(1,42)=13.16$, $p<0.001$. There were no further significant main effects or interactions.

A Repeated Measures ANOVA for the accuracy rates in the transparent condition (see Table 14) with the factors Prime Type (Identical, Derived, Inflected, Unrelated), Grade (Second, Fourth), Profile (Semantic Profile, Orthographic Profile) and with the covariates in the by-participant analysis (Reading Speed, Reading Comprehension) revealed a significant effect of Prime Type, $F_1(3, 168)= 2.69$, $p=0.047$; $F_2(3,156)=0.56$, $p=0.637$, a significant effect of Grade, $F_1(1, 56)= 16.35$, $p<0.0001$; $F_2(1,52)=44.22$, $p<0.0001$, and a significant interaction between Prime Type and Grade, $F_1(3, 168)= 4.07$, $p=0.008$; $F_2(3,156)=0.91$, $p=0.435$. There were no further significant main effects or interactions.

Overall, the analyses of the accuracy scores revealed an expected higher accuracy for word targets over non-word targets, with fourth graders outperforming second graders in both word targets -regardless of the condition- and non-word targets. As for the different conditions, the general pattern was that overall higher error rates were observed for the targets primed by the unrelated primes - with the exception of the opaque condition (see Table 14).

3.7.2. Response Times

As mentioned above, the log-transformed mean reaction times were used in the analyses and the raw mean reaction times were used in the tables. The next section (Section 3.7.2.1) will present the analyses for all participants together (whole-group analyses), while the subsequent sections (Sections 3.7.2.2 and 3.7.2.3) will show grade-level separated and profile-type separated analyses, respectively.

3.7.2.1. Overall Results

Table 15 presents the results of the whole-group analyses of word reaction times, non-word reaction times, vocabulary test scores, spelling test scores, reading task scores, and comprehension test scores. To test whether the difference between the reaction times of words and non-words was significant, a Repeated Measures ANOVA was conducted.

Table 15. Descriptive statistics for reaction times (in ms) and the individual tests

	Word RT (in ms)	Non-word RT (in ms)	Vocabulary Scores (max: 54)	Spelling Scores (max: 54)	Reading Scores (wpm)	Comprehension Scores (max:10)
Mean	1272.73	1563.56	33.44	45.42	75.69	5.65
S.E.	33.12	42.98	1.02	0.60	2.33	0.28

*S.D: standard deviation, RT: reaction time, max: maximum score for the test, wpm: words per minute

A Repeated Measures ANOVA for the mean reaction times of words and non-words with the factors Word Type (Word, Non-word), Grade (Second, Fourth), Profile (Semantic Profile, Orthographic Profile) and with the covariates (Reading Speed, Reading Comprehension) in the by-participant analyses showed a significant main effect of Word Type, F(1, 56)= 323.81, p<0.001, a significant effect of Grade, F(1, 56)= 69.51, p<0.001, a significant effect of Profile, F(1,56)=11.66, p=0.001, and a significant 3-way interaction among Word Type, Grade, and Profile F(1,56)=5.60, p=0.02. There were no further significant main effects or interactions.

Table 16 presents the results of the whole-group analyses of the reaction times across experimental conditions. Repeated Measures ANOVAs and t-tests were conducted to investigate significant differences between the related prime conditions (the identity condition and the test condition) and the unrelated condition.

Table 16. Descriptive statistics for the reaction times (in ms) across experimental conditions.

	Semantic		Opaque		Formal Overlap		Transparent		
	Test	Unr	Test	Unr	Test	Unr.	Der.	Infl.	Unr.
M	1245.92	1254.69	1194.24	1189.36	1274.69	1303.00	1221.87	1216.75	1324.30
SE	42.20	38.74	36.37	34.26	34.09	39.42	41.21	37.86	42.81
SD	332.30	305.06	286.34	269.74	268.39	310.40	324.51	298.09	337.08

*S.D: standard deviation, S.E.: standard error, Mean: reaction time means, Test: statistics for the test conditions, Unrelated: statistics for the unrelated conditions

3.7.2.1.1. Semantic Condition

Table 17 presents the results of the whole-groups analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the semantic condition. The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the semantic condition, respectively. The p values in the table indicate whether the priming effect is significant. The column *Participant* shows by-participant results, while the column *Item* shows by-item results.

Table 17. Response times (in ms), priming effects (in ms), and p values in the semantic condition

Semantic Condition		
	Participant	Item
Test	1245.92	1244.16
Unrelated	1254.69	1242.38
Priming	8.78	-1.77
p value	p=0.56	p=0.85

*Participant: by-participant analyses, Item: by-item analyses

A Repeated Measures ANOVA for the mean reaction times in the semantic condition (see Table 17) with the factors Prime Type (Identical, Test, Unrelated), Grade (Second, Fourth), Profile (Semantic Profile, Orthographic Profile) and with the covariates in the by-participant analyses (Reading Speed, Reading Comprehension) a significant effect of grade, $F_1(1, 56)= 46.48$, $p<0.001$; $F_2(1,44)=97.9$, $p<0.001$. There were no further significant effects or interactions.

Two paired paired-samples t-tests were conducted for the semantic condition to investigate the priming effects. The t-tests showed a significant difference between the mean reaction times between the identical primes and the unrelated primes in the by-participant data only, $t_1(61)=2.25$, $p=0.028$, $d=0.29$; $t_2(45)=1.32$, $p=0.193$, $d=0.19$. There were no further significant differences among the semantic condition prime types (see Table 17).

3.7.2.1.2. Opaque Condition

Table 18 presents the results of the whole-groups analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the opaque condition. The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the opaque condition, respectively. The p values in the table indicate whether the priming effect is significant. The column *Participant* shows by-participant results, while the column *Item* shows by-item results.

Table 18. Reaction times (in ms), priming effects (in ms), and p values in the opaque condition

Opaque Condition		
	Participant	Item
Test	1194.24	1195.14
Unrelated	1194.24	1213.40
Priming	-4.89	18.25
p value	p=0.38	p=0.58

*Participant: by-participant analyses, Item: by-item analyses

A Repeated Measures ANOVA for the mean reaction times in the opaque condition (see Table 18) with the factors Prime Type (Identical, Test, Unrelated), Grade (Second, Fourth), Profile (Semantic Profile, Orthographic Profile) and with the covariates in the by-participant analyses (Reading Speed, Reading Comprehension) showed a significant effect of the Prime Type for item data only, $F_1(2, 112)= 0.82$, $p<0.443$; $F_2(2,80)=3.99$, $p<0.022$, a significant interaction between Prime Type and Grade in the by-items analysis only , $F_1(2, 112)= 2.67$, $p<0.073$; $F_2(2,80)= 3.47$, $p=0.036$, a significant effect of grade, $F_1 (1, 56)= 39.41$, $p<0.001$; $F_2 (1, 40)= 71.5$, $p<0.001$,and a significant effect of Profile, $F_1(1,56)=7.84$, $p=0.007$; $F_2(1, 40)= 4.44$, $p=0.041$. There were no further significant main effects or interactions.

Another pair of paired-samples t-test was conducted for the opaque condition to investigate priming effects. There was a significant difference between the mean response times of the identical primes and the unrelated primes in the by-item analysis only, $t_1(61)=1.40$, $p=0.15$, $d=0.18$; $t_2(41)=3.44$, $p=0.001$, $d=0.53$. There were no further significant differences among the opaque condition prime types (see Table 18).

3.7.2.1.3. Formal Overlap Condition

Table 19 shows the results of the whole-groups analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the formal overlap condition. The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the formal overlap condition, respectively. The p values in the table indicate whether the priming effect is significant. The column *Participant* shows by-participant results, while the column *Item* shows by-item results.

Table 19. Reaction times (in ms), priming effects (in ms), and p values in the formal overlap condition

	Formal Overlap Condition	
	Participant	Item
Test	1274.69	1271.31
Unrelated	1303.00	1297.76
Priming	28.31	26.44
p value	p=0.41	p=0.85

*Participant: by-participant analyses, Item: by-item analyses

A Repeated Measures ANOVA for the mean reaction times in the formal overlap condition (see Table 19) with the factors Prime Type (Identical, Test, Unrelated), Grade (Second, Fourth), Profile (Semantic Profile, Orthographic Profile) and with the covariates in the by-participant analyses (Reading Speed, Reading Comprehension) showed a significant main effect of Prime Type, $F_1(2, 112)= 9.61$, $p<0.001$; $F_2(2, 84)= 4.81$, $p=0.010$, a significant effect of Grade, $F_1(1, 56)= 41.90$, $p<0.001$; $F_2(1, 42)= 75.18$,

$p<0.001$, and a significant effect of Profile, $F_1(1,56)=6.74$, $p=0.012$; $F_2(1,42)=4.84$, $p=0.033$. There were no further significant main effects or interactions.

For the formal overlap condition, paired-samples t-tests showed a significant difference between the mean reaction times for the identical primes and the unrelated primes, $t_1(61)=4.16$, $p<0.001$, $d=0.53$; $t_2(43)=3.01$, $p=0.004$, $d=0.45$. There were no further significant differences among the formal overlap condition prime types (see Table 19).

3.7.2.1.4. Transparent Condition

Table 20 shows the results of the whole-groups analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the transparent condition. The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the transparent condition, respectively. The p values in the table indicate whether the priming effect is significant. The column *Participant* shows by-participant results, while the column *Item* shows by-item results.

Table 20. Reaction times (in ms), priming effects (in ms), and p values in the transparent condition

	Transparent Condition			
	Derivation		Inflection	
	Participant	Item	Participant	Item
Test	1221.87	1221.95	1216.75	1316.43
Unrelated	1324.30	1169.02	1324.30	1238.26
Priming	102.43	94.49	107.55	91.20
p value	p<0.001	p<0.001	p<0.001	p=0.007

*Participant: by-participant analyses, Item: by-item analyses

A Repeated Measures ANOVA for the mean reaction times in the transparent condition (see Table 20) with the factors Prime Type (Identical, Test, Unrelated), Grade (Second, Fourth), Profile (Semantic Profile, Orthographic Profile) and with the covariates in by-participant analyses (Reading Speed, Reading Comprehension) showed a significant main effect of Prime Type, $F_1(3, 168)= 6.54$, $p<0.001$; F2(3, 156)= 4.90, p=0.003, a significant interaction between Prime Type and Profile (in the by-participants analysis only) $F_1(3, 168)= 2.70$, $p=0.047$; $F_2(3,156)=3.42$, $p=0.083$, a significant effect of Grade, $F_1(1, 56)= 66.64$, $p<0.001$; $F_2(1, 52)= 200.81$, $p<0.001$, and a significant effect of Profile, $F_1(1,56)=10.20$, $p=0.002$; $F_2(1, 52)= 12.76$, $p<0.001$. There were no further significant main effects or interactions.

Four paired-samples t-tests were run in the transparent condition to compare the effects of the prime types. There was a significant difference between the mean reaction times for the identical primes and the unrelated primes, $t_1(61)=3.47$, $p<0.001$, d=0.44; t (53)=3.23,p=0.002, d=0.44, a significant difference between the mean reaction times for the derived primes and the unrelated primes, $t_1(61)=3.57$, $p<0.001$, d=0.45; t_2 (53)=3.68, $p<0.001$, d=0.50, a significant difference between the mean reaction times for the the inflected primes and the unrelated primes, $t_1(61)=4.36$, $p<0.001$, d=0.55; t_2 (53)=2.83, p=0.007, d=0.39. There were no further significant main effects (see Table 20).

Table 21 summarizes the findings regarding the priming effects across experimental conditions. The value under a *test* column shows the difference between the mean reaction times for a test condition and an unrelated condition. A p value indicates whether the numerical difference given on the left is significant. The row *participant* presents by-participant results, while the row *item* presents by-item results. Statistically significant values are emphasized by bold fonts.

Table 21. Priming effects (in ms) and p values in the word sets

	Semantic		Opaque		Formal Overlap		Transparent			
	Test	p value	Test	p value	Test	p value	Derived	p value	Inf.	p value
P	8.78	p=0.56	-4.89	p=0.38	28.31	p=0.41	**102.43**	**p<0.001**	**107.55**	**p<0.001**
I	-1.77	p=0.85	18.25	p=0.58	26.44	p=0.48	**94.49**	**p<0.001**	**91.20**	**p=0.007**

*p=participant data, I= item data, Inf= inflected

3.7.2.2. Grade-level Differences

Table 22 presents the results of the separate-group analyses of word reaction times, non-word reaction times, vocabulary test scores, spelling test scores, reading task scores, and comprehension test scores. The rows present the results for the two grade levels in the present study (second grade and fourth grade). To test whether the difference between the mean reaction times for words and non-words was significant, t-tests were conducted.

Table 22. Descriptive statistics for the reaction times (in ms) and the individual tests by graded levels

Grade		Word RT (in ms)	Non-word RT (in ms)	Vocabulary Scores (max:54)	Spelling Scores (max:54)	Reading Scores (wpm)	Comp. Scores (max:10)
2. Grade	Mean	1455.21	1795.92	31.03	43.40	66.20	5.95
	S.E.	41.14	45.52	1.39	0.97	3.15	0.39
	S.D.	225.32	249.31	7.60	5.33	17.24	2.12
	N	30	30	30	30	30	30
4. Grade	Mean	1101.67	1345.72	35.69	47.31	84.59	5.38
	S.E.	27.32	45.41	1.39	0.56	2.61	0.40
	S.D.	154.52	256.88	7.87	3.19	14.76	2.28
	N	32	32	32	32	32	32

*S.D: standard deviation, S.E.: standard error, RT: reaction time, max: maximum score for the test, wpm: words per minute, Comp.: comprehension

To examine the differences between the mean reaction times given for words and non-words for different grade levels (see Table 22), an independent samples t-test was conducted. There was a significant difference between the mean word reaction times for the the second grades (M=1455.21, SD=225.32) and the fourth grades (M=1101.67, SD=154.52); t(60)=7.36, p<0.001, d=1.87. Similarly, there was also a significant difference between the mean non-word reaction times for second grades (M=1795.92, SD=249.31) and fourth grades (M=1345.72, SD=256.88); t(60)=7.15, p<0.001, d=1.82.

Within the grades, two separate paired-sample t-tests were run to see any potential significant differences between the mean reaction times for words and non-words (see Table 22). For the second graders, the results showed a significant difference between the mean reaction times for words (M=1455.21, SD=225.32) and non-words (M=1795.92, SD=249.31); t(29)=12.58, p<0.001, d=2.30. There was also a significant difference for the fourth graders between the mean reaction times for words (M=1101.67, SD=154.52) and non-words (M=1345.72, SD=256.88); t(31)=12.30, p<0.001, d=2.18.

Table 23 presents the results of the separate-group analyses of the reaction times across experimental conditions. The row *2.Grd* presents the results for the second graders, while the row *4. Grd* presents the results for the fourth graders. Repeated Measures ANOVAs and t-tests were conducted to investigate significant differences between the related prime conditions (identity condition and test condition) and the unrelated condition.

Table 23. Descriptive statistics for the reaction times (in ms) in the word sets by grade levels

		Semantic		Opaque		Formal Overlap		Transparent		
		Test	Unr.	Test	Unr.	Test	Unr.	Derived	Inf.	Unr.
2. Grd	M	1425.17	1458.77	1309.27	1334.96	1431.77	1479.60	1452.77	1392.55	1533.48
	S.E.	64.46	48.57	49.51	50.98	46.24	55.02	50.08	52.65	58.91
	S.D.	353.04	266.04	271.17	279.24	253.26	301.38	274.32	288.40	322.66
4. Grd	M	1077.87	1063.38	1086.41	1052.86	1127.44	1137.44	1005.41	1051.93	1128.20
	S.E.	35.55	34.83	46.01	30.86	33.30	37.98	33.94	34.95	37.14
	S.D.	201.10	197.03	260.29	174.58	188.36	214.83	192.00	197.72	210.11

*S.D: standard deviation, S.E.: standard error, Mean: reaction time means, Test: statistics for the test conditions, Unrelated: statistics for the unrelated conditions, Inf: inflected, Grd: grade

3.7.2.2.1. Semantic Condition

Table 24 shows the results of the separate-group analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the semantic condition by grade levels (*2. Grade* and *4. Grade* in the table). The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the semantic condition, respectively. The p values in the table indicate whether the regarding priming effect is significant. The *Participant* column presents by-participant results, while the *Item* column presents by-item results.

Table 24. Reaction times (in ms), priming effects (in ms), and p values in the semantic condition by grade levels

		Semantic Condition	
		Participant	Item
2. Grade	Test	1425.17	1413.84
	Unrelated	1458.77	1439.14
	Priming	33.59	25.29
	p value	p=0.28	p=0.65
4. Grade	Test	1077.87	1074.48
	Unrelated	1063.38	1045.63
	Priming	-14.49	-28.85
	p value	p=0.59	p=0.43

*Participant: by-participant analyses, Item: by-item analyses

For investigating the potential priming effects within the grades, multiple paired-samples t-tests were run. For the second graders in the semantic condition, there was a marginal significant difference between the mean reaction times for the identical primes and the unrelated primes in the by-participant data only; t_1 (29)= 1.94, p=0.063, d=0.35; t_2 (22)=1.19, p=0.24, d=0.25. There were no more significant differences among the prime types in the semantic condition both for the second and the fourth grades (see Table 24). Fourth grade data for the unrelated primes in the semantic condition was not normal.

3.7.2.2.2. Opaque Condition

Table 25 presents the results of the separate-group analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the opaque condition by grade levels (*2. Grade* and *4. Grade* in the table). The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the opaque condition, respectively. The p values in the table indicate whether the priming effect is significant. The *Participant* column shows by-participant results, while the *Item* column shows by-item results. The details of the statistical tests conducted in the opaque condition for different grade levels are given below the table.

Table 25. Reaction times (in ms), priming effects (in ms), and p values in the opaque condition separated by grade levels

		Opaque Condition	
		Participant	Item
2. Grade	Test	1309.27	1300.19
	Unrelated	1334.96	1362.98
	Priming	25.70	62.78
	p value	p=0.54	p=0.19
4. Grade	Test	1086.41	1090.09
	Unrelated	1052.86	1063.82
	Priming	-33.56	-26.26
	p value	p=0.57	p=0.48

*Participant: by-participant analyses, Item: by-item analyses

As for the opaque condition, there was a marginal significance in the second grade item data between the mean scores of the target response times primed by the identical primes and the target response times primed by the unrelated primes; t_1 (29)= 0.26, p=0.79, d=0.05; t_2 (20)=1.92, p=0.06, d=0.42. In the fourth grade data, there was also a significant difference between the mean scores of the target response times primed by the identical primes and the target response times primed by the unrelated primes; t_1 (31)= 2.72, p=0.011, d=0.48; t_2 (20)=2.90, p=0.009, d=0.63. There were no more significant differences among the prime types in the opaque condition both for the second and the fourth graders (see Table 25).

3.7.2.2.3. Formal Overlap Condition

Table 26 presents the results of the separate-group analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the formal overlap condition by grade levels (*2. Grade* and *4. Grade* in the table). The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the formal overlap condition, respectively. The p values in the table indicate whether the priming effect is significant. The *Participant* column shows by-participant results, while the *Item* column shows by-item results.

Table 26. Reaction times (in ms), priming effects (in ms), and p values in the formal overlap condition by grade levels

		Formal Overlap Condition	
		Participant	Item
2. Grade	Test	1431.77	1409.66
	Unrelated	1479.60	1462.37
	Priming	47.83	52.71
	p value	p=0.23	p=0.40
4. Grade	Test	1127.44	1132.97
	Unrelated	1137.44	1133.14
	Priming	10.01	0.17
	p value	p=0.88	p=0.93

*Participant: by-participant analyses, Item: by-item analyses

In the formal overlap condition, there was a significant difference between the mean reaction times for the identical primes and the unrelated primes in the second grade data (the significance in the by-item analysis was marginal); $t_1(29)=2.74$, p=0.010, d=0.50; $t_2(21)=1.89$, p=0.07, d=0.40. Identically, there was also a significant difference between the mean reaction times for the identical primes and the unrelated primes in the fourth grade data; $t_1(31)=3.13$, $p=0.004$, $d=0.55$; $t_2(21)=2.33$, $p=0.03$, $d=0.50$. There were no more significant differences among the prime types in the opaque condition both for the second and the fourth grades (see Table 26).

3.7.2.2.4. Transparent Condition

Table 27 presents the results of the separate-group analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the opaque condition separated by grade levels (*2. Grade* and *4. Grade* in the table). The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the opaque condition, respectively (Inflected test primes and derived test primes are given separately under different columns). The p values in the table indicate whether the priming effect is significant. The *Participant* column shows by-participant results, while the *Item* column shows by-item results.

Table 27. Reaction times (in ms), priming effects (in ms), and p values in the transparent condition by grade levels

		Transparent Condition			
		Derivation		Inflection	
		Participant	Item	Participant	Item
2. Grade	Test	1452.77	1442.54	1392.55	1396.63
	Unrelated	1533.48	1510.85	1533.48	1510.85
	Priming	80.71	68.32	**140.92**	**114.23**
	p value	p=0.16	p=0.14	**p=0.003**	**p=0.04**
4. Grade	Test	1005.41	1001.36	1051.93	1053.85
	Unrelated	1128.20	1122.02	1128.20	1122.02
	Priming	**122.79**	**120.66**	**76.26**	68.17
	p value	**p<0.001**	**p<0.001**	**p=0.006**	p=0.08

*Participant: by-participant analyses, Item: by-item analyses

For the transparent condition, there was a significant difference between the mean reaction times for the identical primes and the unrelated primes in the second grade data (the significance for the item data was marginal); $t_1(29)=2.15$, $p=0.04$, $d=0.39$; $t_2(t26)=1.99$, $p=0.057$, $d=0.38$. There was also a significant difference between the mean reaction times for the inflected primes and the unrelated primes in the second grade data; $t_1(29)=3.19$, $p=0.003$, $d=0.58$; $t_2(26)=2.16$, $p=0.040$, $d=0.42$. For the fourth grade data, there was a significant difference between the mean reaction times for the identical primes and the unrelated primes; $t_1(31)=2.71$, $p=0.01$, $d=0.48$; $t_2(26)=2.52$, $p=0.018$, $d=0.49$.There was a further significant difference between the mean reaction times for the derived primes and the unrelated primes; $t_1(31)=3.68$, $p<0.001$, $d=0.65$; $t_2(26)=3.77$, $p<0.001$, $d=0.73$.Finally, there was a significant difference between the mean reaction times for the inflected primes and the he unrelated primes (a marginal significance in the by-item analysis) in the fourth grade data; $t_1(31)= 2.95$, $p=0.006$, $d=0.52$; $t_2(26)=1.80$, $p=0.083$, $d=0.35$. There were no further significant main effects for either grade level (see Table 27).

Table 28 presents the priming effects across experimental conditions by grade levels. Identical to Table 21, the value under a *test* column shows the difference between mean reaction times for a test condition and an unrelated condition. The p values indicate whether the difference given on the left is significant. The rows *2. Grd* and *4. Grd* show the results for second graders and fourth graders, respectively. The row *participant* presents by-participant results, while the row *item* shows by-item results. Statistically significant values are emphasized by bold fonts.

Table 28. Priming effects in ms and p values in the different conditions by grade level

		Semantic		Opaque		Formal Overlap		Transparent			
		Test	p value	Test	p value	Test	p value	Der.	p value	Inf.	p value
2.Grd	P	33.59	p=0.28	25.70	p=0.54	47.83	p=0.23	80.71	p=0.16	**140.92**	**p=0.003**
	I	25.29	p=0.65	62.78	p=0.19	52.71	p=0.40	68.32	p=0.14	**114.23**	**p=0.04**
4.Grd	P	-14.49	p=0.59	-33.56	p=0.57	10.01	p=0.88	**122.79**	**p<0.001**	**76.26**	**p=0.006**
	I	-28.85	p=0.43	-26.26	p=0.48	0.17	p=0.93	**120.66**	**p<0.001**	68.17	p=0.08

*Grd: grade

3.7.2.3. Semantic Profile and Orthographic Profile

Table 29 presents the results of the separate-group analyses of word reaction times, non-word reaction times, vocabulary test scores, spelling test scores, reading task scores, and comprehension test scores. The rows present the two profile types in the study (*Semantic profile* and *Orthographic Profile*). To analyze whether the differences between the means reaction times for words and non-words were significant, t-tests were conducted.

Table 29. Descriptive statistics for the reaction times (in ms) and the individual tests by profile types

Grade		Word RT(in ms)	Non-word RT (in ms)	Vocabulary Scores (max:54)	Spelling Scores (max:54)	Reading Scores (wpm)	Comprehension Scores (max:10)
Semantic Profile	Mean	1204.73	1475.36	38.83	43.79	75.10	6.47
	S.E.	44.15	62.99	1.28	0.96	3.48	0.34
	S.D.	237.78	339.23	6.87	5.19	18.74	1.81
	N	29	29	29	29	29	29
Orthographic Profile	Mean	1332.49	1641.06	28.70	46.85	76.21	4.94
	S.E.	46.80	56.24	0.98	0.67	3.19	0.40
	S.D.	268.84	323.09	5.65	3.87	18.33	2.30
	N	33	33	33	33	33	33

*S.D: standard deviation, S.E.: standard error, RT: reaction time, max: maximum score for the test, wpm: words per minute

An independent samples t-test was run to investigate potential differences between the Semantic Profile and the Orthographic Profile. There was a marginally significant difference between the Semantic Profile group (M=1204.73, SD=237.78) and Orthographic Profile group (M=1332.49, SD=268.84) in terms of the mean word reaction times; t(60)=1.98, p=0.052, d=0.50. For the mean non-word reaction times, there was also significant difference between the Semantic Profile group (M=1475.36, SD=339.23) and Orthographic Profile group (M=1641.06, SD=323.09); t(60)=2.07, p=0.043, d=0.53.

To further investigate the differences within the profiles, two independent t-tests were used. Within the Semantic Profile group, there was a significant difference between the mean reaction times for words (M=1204.73, SD=237.78) and non-words (M=1475.36, SD=339.23); t(28)=13.50, p<0.001, d=2.51. As for Orthographic profile group, there was also a significant difference between the mean reaction times for words (M=1332.49, SD=268.84) and non-words (M=1641.06, SD=323.09); t(28)=11.88, p<0.001, d=2.07.

Table 30 presents the results of the separate-group analyses for the reaction times in different conditions. The row *Sem. P.* presents the results of the Semantic Profile, while the row *Ort. P.* presents the results of the Orthographic Profile. Repeated Measures ANOVAs and t-tests were conducted to investigate significant differences between the related prime conditions (the identity condition and the test condition) and the unrelated condition.

Table 30. Descriptive statistics for the reaction times (in ms) in the word sets by grade levels.

		Semantic		Opaque		Formal Overlap		Transparent		
		Test	Unr.	Test	Unr.	Test	Unr.	Derived	Inflected	Unr.
Sem. P.	Mean	1197.37	1191.02	1092.64	1138.31	1202.63	1244.38	1189.55	1160.99	1226.57
	S.E.	60.47	54.83	42.24	40.11	39.95	54.08	60.36	51.66	54.76
	S.D.	325.66	295.24	227.48	215.98	215.13	291.25	325.06	278.22	294.90
Ort. P.	Mean	1288.58	1310.65	1283.54	1234.22	1338.03	1354.51	1250.28	1265.75	1410.19
	S.E.	58.69	53.43	53.21	53.21	51.63	56.03	56.81	54.04	61.36
	S.D.	337.17	306.95	305.68	305.69	296.61	321.87	326.36	310.43	352.46

*S.D: standard deviation, S.E.: standard error, Mean: reaction time means, Test: statistics for the test conditions, Unrelated: statistics for the unrelated conditions, Sem.P,: semantic profile, Ort.P.: orthographic profile

3.7.2.3.1. Semantic Condition

Table 31 presents the results of the separate-group analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the semantic condition by the profile types (Semantic Profile and Orthographic Profile in the table). The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the semantic condition, respectively. The p values in the table indicate whether the priming effect is significant. The *Participant* column presents by-participant results, while the *Item* column presents by-item results.

Table 31. Reaction times (in ms), priming effects (in ms), and p values in the semantic condition by profile types

		Semantic Condition	
		Participant	Item
Semantic P.	Test	1197.37	1224.20
	Unrelated	1191.02	1202.78
	Priming	-6.35	-21.42
	p value	p=0.45	p=0.68
Orthographic P.	Test	1288.58	1250.62
	Unrelated	1310.65	1232.68
	Priming	22.07	-17.94
	p value	p=0.64	p=0.70

*Participant: by-participant analyses, Item: by-item analyses, Semantic P.: semantic Profile, Orthographic P.: orthographic Profile

For the semantic condition, there were no significant differences among the prime types in the Semantic Profile data. As for the Orthographic Profile, there was a significant difference between the mean reaction times for the identical primes and the unrelated primes in the by-participant analysis only, $t_1(32)=2.30$, p=0.028, d=0.40; $t_2(22)=1.08$, p=0.292, d=0.23. There were no further significant main effects for both profiles (see Table 31). The identical prime data and the test prime data were not normal in the Semantic Profile data.

3.7.2.3.2. Opaque Condition

Table 32 presents the results of the separate-group analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the opaque condition separated by the profile types (*Semantic Profile* and *Orthographic Profile* in the table). The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the opaque condition, respectively. The p values in the table indicate whether the priming effect is significant. The *Participant* column presents by-participant results, while the *Item* column presents by-item results.

Table 32. Reaction times (in ms), priming effects (in ms), and p values in the opaque condition by profile types

		Opaque Condition	
		Participant	Item
Semantic P.	Test	1092.64	1117.08
	Unrelated	1138.31	1170.29
	Priming	45.67	53.21
	p value	p=0.11	p=0.12
Orthographic P.	Test	1283.54	1264.25
	Unrelated	1234.22	1251.37
	Priming	-49.32	-12.88
	p value	p=0.32	p=0.88

*Participant: by-participant analyses, Item: by-item analyses

In the opaque word condition, the only significant difference was between the mean reaction times for the identical primes and the unrelated primes in the by-item analysis of the Semantic Profile, $t_1(32)=0.76$, p=0.452, d=0.13; $t_2(20)=2.44$, p=0.024, d=0.53. There were no further significant main effects (see Table 32).

3.7.2.3.3. Formal Overlap Condition

Table 33 presents the results of the separate-group analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the formal overlap condition by the profile types (*Semantic Profile* and *Orthographic Profile* in the table). The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the formal overlap condition, respectively. The p values in the table indicate whether the priming effect is significant. The *Participant* column presents by-participant results, while the *Item* column presents by-item results.

Table 33. Reaction times (in ms), priming effects (in ms), and p values in the formal overlap condition by profile types

		Formal Overlap Condition	
		Participant	Item
Semantic P.	Test	1202.63	1213.20
	Unrelated	1244.38	1259.62
	Priming	41.76	46.42
	p value	p=0.35	p=0.40
Orthographic P.	Test	1338.03	1337.28
	Unrelated	1354.51	1327.77
	Priming	16.49	-9.51
	p value	p=0.75	p=0.86

*Participant: by-participant analyses, Item: by-item analyses

In the formal overlap condition, there was a significant difference between the mean reaction times for the identical primes and the unrelated primes for the Semantic Profile (a marginal significance for the by-item analysis), t_1(28)=2.95, p=0.006, d=0.55; t_2(21)=1.98, p=0.061, d=0.42. Similarly, there was a significant difference between the mean reaction times for the identical primes and the unrelated primes for the Orthographic Profile, $t_1(32)=2.90$, $p=0.007$, $d=0.51$; $t_2(21)=1.92$, $p=0.068$, $d=0.41$. There were no further significant main effects (see Table 33).

3.7.2.3.4. Transparent Condition

Table 34 presents the result of the separate-group analyses of the mean reaction times, priming effects, and the p values regarding to the t-tests in the transparent condition by the profile types (*Semantic Profile* and *Orthographic Profile* in the table). The rows named *Test* and *Unrelated* present the mean reaction times for the test primes and the unrelated primes in the transparent condition, respectively (Inflected test primes and derived test primes are given separately). The p values in the table indicate whether the priming effect is significant. The *Participant* column presents by-participant results, while the *Item* column presents by-item results.

Table 34. Reaction times (in ms), priming effects (in ms), and p values in the transparent condition by profile types

		Transparent Condition			
		Derivation		Inflection	
		Participant	Item	Participant	Item
Semantic P.	Test	1189.55	1198.85	1160.99	1170.74
	Unrelated	1226.57	1227.33	1226.57	1227.33
	Priming	37.02	28.24	65.58	56.59
	p value	p=0.26	p=0.50	p=0.06	p=0.22
Orthographic P.	Test	1250.28	1201.31	1265.75	1217.27
	Unrelated	1410.19	1371.18	1410.19	1371.18
	Priming	**159.91**	**169.87**	**144.43**	**153.91**
	p value	**p<0.001**	**p=0.009**	**p<0.001**	**p=0.006**

*Participant: by-participant analyses, Item: by-item analyses

As for the transparent condition, there was a significant difference in the Semantic Profile between the mean response times for the identical primes and the unrelated primes, $t_1(28) = 2.83$, $p=0.008$, $d=0.53$; $t_2(26) = 2.77$, $p=0.010$, $d=0.53$, and a marginal significance between the mean response times for the inflected primes and the unrelated primes, $t_1(28)=1.94$, $p=0.063$, $d=0.36$; $t_2(26)=1.23$, $p=0.229$, $d=0.24$. In the Orthographic Profile, there was a significant difference between the mean reaction times for the identical primes and the unrelated primes , $t_1(32)=2.04$, $p=0.049$, $d=0.36$; $t_2(26)=1.02$, $p=0.31$, $d=0.20$, a significant difference between the mean reaction times for the derived primes and the unrelated primes, $t_1(32)=3.87$, $p<0.001$, $d=0.67$; $t_2(26)=2.83$, $p=0.009$, $d=0.54$, and a significant difference between the mean reaction times for the inflected primes and the unrelated primes, $t_1(32)=4.27$, $p<0.001$, $d=0.74$; $t_2(26)= 2.99$, $p=0.006$, $d=0.57$. There were no further significant main effects (see Table 35).

Table 35 presents the priming effects across experimental conditions by the profile types. Identical to Tables 21 and 29, the value under a *test* column shows the difference between the mean reaction times for a test condition and an unrelated condition. The p values indicate whether the difference given on the left is significant. The rows *Sem.* and *Ort.* present the results for the Semantic Profile and the Orthographic Profile, respectively. The row *participant* presents by-participant results, while the row *item* presents by-item results. Statistically significant values are emphasized by bold fonts.

Table 35. Priming effects in ms and p values in the different conditions by profile type

		Semantic		Opaque		Formal Overlap		Transparent			
		Test	p value	Test	p value	Test	p value	Der.	p value	Inf.	p value
Sem.P	P	-6.35	p=0.45	45.67	p=0.11	41.76	p=0.35	37.02	p=0.26	65.58	p=0.06
	I	-21.42	p=0.68	53.21	p=0.12	46.42	p=0.40	28.24	p=0.50	56.59	p=0.22
Ort. P.	P	22.07	p=0.64	-49.32	p=0.32	16.49	p=0.75	**159.91**	**p<0.001**	**144.43**	**p<0.001**
	I	-17.94	p=0.70	-12.88	p=0.88	-9.51	p=0.86	**169.87**	**p=0.009**	**153.91**	**p=0.006**

*Sem: semantic profile, Ort: orthographic profile, P: by-participant analyses, I: by-item analyses, Der: derivation, Inf.: inflection

CHAPTER 4

DISCUSSION AND CONCLUSION

The main goal of the present study was to determine the early word processing patterns in Turkish primary school children. With respect to grade level, two different grade levels (second and fourth) were included in the study to examine a possible developmental pattern. Furthermore, the vocabulary test scores and spelling test scores of the participants were used to investigate the potential effect of displaying an *orthographic* or *semantic* profile (Andrews & Lo, 2013). Reading speed and reading comprehension scores were not found to be significant factors in the analyses; therefore, they were not further discussed in the upcoming sections.

The following sections discuss these issues in the light of the findings. Although they are not the primary aims of the thesis, implications for reading instructions in L1 are also included to provide insights for teaching.

4.1. Word Processing in Primary School

The investigation of overall error rates showed that children produced fewer errors with the words compared to the non-words in the study. Generally, the test primes led to fewer errors than the unrelated primes except for one condition; the test primes in the opaque condition led to more errors. Beyersmann et al. (2015b) argued that the reason behind the lack of priming effects in the opaque and the formal overlap conditions of some studies with children (e.g. Beyersmann et al., 2012) could be the real stems; words like *corner* could activate the words *corn* and *corner* both. The competition between two words, therefore, could inhibit the priming effects. While such an argument for the lack of priming effects in the present study would be speculative, the higher errors rates for the test primes in the opaque condition could be attributed to this competition. Still, the formal overlap condition did not show the same pattern even though the test primes in this condition also had pseudo-stems embedded in them; therefore, the results need to be interpreted with caution. It is possible that the pseudo-affixes helped with the recognition of the pseudo-stems in the formal overlap condition. It is important to underline at this point that such a claim would require further empirical evidence.

The most obvious finding to emerge from this study is the sensitivity shown by Turkish primary school children for affixed words (the transparent condition) in early word processing. The mean reaction times for the different conditions and the different prime types revealed that the role of affixes in word processing was apparent for Turkish primary school children. The inclusion of a semantic condition (e.g. house- roof), and two other conditions in which the primes had a similar orthographic overlap to their targets compared to the transparent condition (Section 3.5.7) eliminated the possibility that pure semantic or pure orthographic features were responsible for the observed priming effects. The semantic condition, the opaque condition, and the formal overlap condition in the present study failed to show any significant priming effects.

The findings are in line with earlier studies on morphological processing in Turkish using the masked priming paradigm (Kırkıcı & Clahsen, 2013; Gacan, 2014; Şafak, 2015); however, it is important to note that these studies did not include an opaque condition. With regard to studies in other languages, the present findings further support the study of Beyersmann et al. (2012), in which English speaking children showed priming effects only in the transparent condition. Furthermore, the present findings contradict the findings of Quemart et al. (2011) in French, who found priming effects in the transparent, opaque, and formal overlap conditions.

Both the derived primes and the inflected primes in the present study led to significant priming effects, while their mean reaction times did not significantly differ from each other. Such a finding should not be taken as conclusive evidence that both forms are processed in the same way. As mentioned in Section 3.2, developed word processing systems can lead to equal amounts of priming while they work in different ways. The second grade data in the next section questions whether the derivation-inflection distinction in the early word processing is feasible or not.

Considering the comparatively shallower orthography and more productive morphology of French compared to English, it is surprising that findings of the present study are in line with the results obtained for English (Beyersmann et al., 2012).

It is important to consider, however, that the participant numbers in Quemart et al. (2011) were limited, while the study of Beyersmann et al. (2015b) in French used an opaque non-word condition and a formal overlap non-word condition, instead of an opaque condition and a formal overlap condition used in this study.

With regard to the reading acquisition theories examined in Section 2.1, the present findings present inconclusive results. Although it does not reject the possibility of morphemes being salient units in word processing, the SWRM (1991, 2005) cannot give an adequate explanation for the salient role of morphemes in the early stages of word processing. Similary, the PSGT (Ziegler & Goswami, 2005) does not provide an extensive framework to include the findings. While the PSGT accepts the possibility of bigger grain sizes developing according to language characteristics, these bigger grain sizes were argued to be apparent in deep orthographies. The present study on Turkish contradicts such claims since it has an extremely shallow orthography and a productive morphology. The Dual-route model of Grainger and Ziegler (2011) can account for the findings well; the morphological priming effects found in the current study can be attributed to the fine-grained route and the coarse-grained route. It can be argued that since the coarse-grained route could not induce priming effects in the opaque condition and in the formal overlap condition due to the lack of shared morpho-semantic representations (Section 2.2.2.5) between the primes and the targets, the test primes in these conditions failed to show significant priming effects.

4.2. Developmental Pattern

Although the error data in the study suggests that second grade children greatly decrease their error rates (especially non-word error rates) over two years, the overall pattern for both grades were identical. Only the test primes in the opaque condition led to more errors compared to the unrelated primes for both grades. The errors rates in the other conditions either favored the test primes or did not make a noticeable difference.

Both the second and the fourth graders in the study showed significant priming effects only in the transparent condition. The second graders showed significant priming effects for the inflected primes and not for the derived primes. These finding might both point to a developmental pattern and a possible distinction between derivation and inflection. The studies comparing derivation and inflection in both L1 and L2 reached the findings that only derived forms led to significant priming effects in L2 for the L2 speakers who had been exposed to naturalistic language input (Jacob, Heyer, & Veríssimo, 2017; Kırkıcı & Clahsen, 2013; Silva & Clahsen, 2008). Interpreting these findings from a Realization-based Morphological view (e.g. Spencer, 2016), derived forms can be subject to storage effects and can be represented differently than inflected forms. Recall that the Declarative/Procedural models proposes that there are two systems at work during word processing: a declarative memory system and a procedural system. Considering the studies showing higher proficiency for inflection than derivation in preschool children (e.g. Brown, 1973) and the recent study of Clahsen et al. (2017) suggesting an AoA effect for inflections in bilinguals, it can be argued that the procedural system processes inflected forms, and this system develops faster in children. As the declarative memory system developed over the years in primary school, it allows equal priming effects for derived forms later in the fourth grade, as a result of qualified lexical representations.

It is important to consider, however, that although the inflected primes led to significant primes effects in the second grade data, there was no significant difference between the mean reaction times for the inflected primes and the derived primes. This finding is in line with the studies on L2 word processing, which included the participants who had acquired their second language in a classroom setting (Şafak, 2015; Voga, Anastassiadis-Symeonidis, Giraudo, 2014). If young readers were to show a similar pattern with L2 speakers, it was more plausible to expect them to process words in the same way L2 speakers who had been exposed to naturalistic language input did. Current findings, then, challenge the idea of similar word processing for developing L1 speakers and L2 speakers.

Further objections to a conclusive interpretation of a derivation-inflection distinction comes from the vocabulary and spelling skill measurements, which will be discussed in the next sub-section; the participants with an orthographic profile failed to show significant priming effects for the derived primes. Since the semantic profile was assumed to indicate a superior vocabulary skill, it is plausible to think that if the derived forms were to be stored in the declarative memory system, they would lead to significant priming effects for the participants with an orthographic profile. A more likely explanation would then be the uncontrolled confounding factors and the limited number of the participants in the present study might be the reasons for the absence of priming effects for the derived primes in the second grade data. The next section will interpret the findings from a profile-based view regarding individual differences.

4.3. Orthographic and Semantic Profile

Since the ANOVAs in the error data did not reveal any significant effect of profile, it can be argued that the error rates for both profiles showed similar patterns. To validate this hypothesis, the descriptives of the error rates for both profiles were examined, and it was confirmed that the error patterns were identical.

Creating two groups according to the participants' vocabulary and spelling skills allowed to gain further insights into the phenomenon of *orthographic profile* and *semantic profile* (Andrews & Lo, 2013). The lack of significant priming effects for the test primes in the conditions other than the transparent condition (semantic, opaque, and formal overlap) was also apparent in the analyses based on profiles; therefore, only the transparent condition will be discussed in this section regarding to the profiles.

The participants with a semantic profile showed a significant priming effect only for the identical primes in the transparent condition, while the participants with an orthographic profile showed significant priming effects for all the related primes (identical, derived, and inflected) in the same condition. Furthermore, the participants with a semantic profile generally gave slower reactions in all conditions. While the mean reaction times for the inflected primes and the derived primes did not differ significantly for the two groups, the participants with a semantic profile gave significantly faster answers to identical primes and unrelated primes. In line with the Declarative/Procedural model of Ulman (2001a, 2001b), it can be asserted that children with a semantic profile use their declarative system more effectively as a result of superior vocabulary skills. Recall that Table 30 shows faster reaction times for the participants with a semantic profile in all conditions. This finding can be attributed to a more efficient use of the declarative memory system (Figure 6).

Figure 6 shows how different mean reaction times between the participants with a semantic profile and the participants with an orthographic profile might have occurred. In line with the current study's implications, children with a semantic profile access the simple word *play* faster in their declarative memory compared to children with an orthographic profile. Since the word *play* is a simple word and does not require procedural processes, this effective use of the declarative memory can explain the faster reaction times by the participants with a semantic profile for the prime conditions using simple words in the current study.

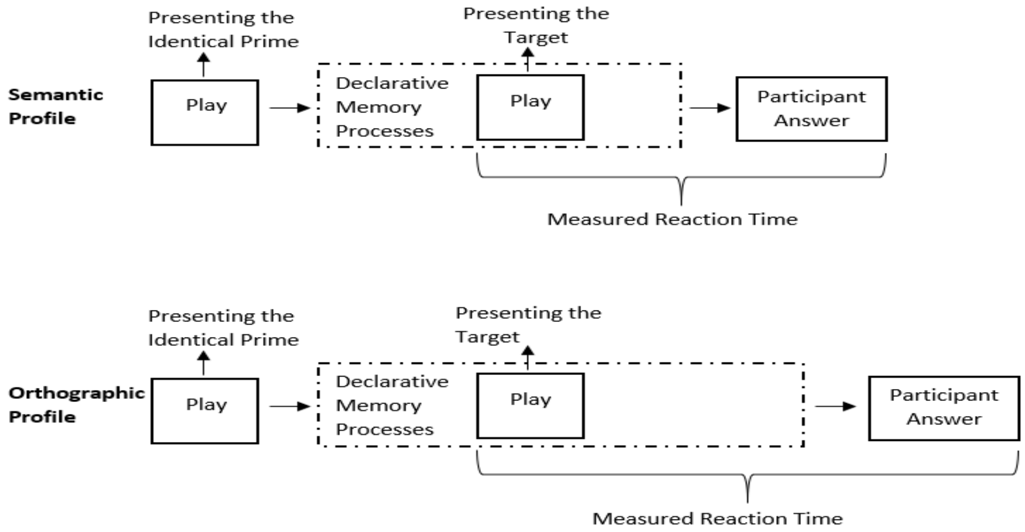

Figure 6. Processes involved in processing the targets primed by identical primes in both profiles

One may wonder whether the participants with a semantic profile had more fourth graders among them, thus the mean reaction time differences were due to the grade level. The numbers of the fourth grade participants in the both profiles, however, reject this possibility; the orthographic profile included 18 fourth graders, while the semantic profile had a relatively fewer number (14) of fourth graders.

Children with an orthographic profile, on the other hand, can be regarded as more sensitive to letter cluster patterns; they might use the procedural system more effectively. The absence of significant differences between the mean reaction times for the primes (in the transparent condition) in the two profiles does not necessarily mean that the participants went through the same processes with the same efficiency. The participants with a semantic profile might have decomposed the complex words slower and reached the stem representations faster in their declarative memory, while the participants with an orthographic profile might have decomposed the complex words faster and reached the stem representations slower in their declarative memory (Figure 7).

Figure 7 shows the processes that might have resulted in the comparable reaction times for the complex word primes in the transparent condition for both profiles. The word *played* is decomposed faster by children with an orthographic profile; however, as reaching the stem *play* takes a longer time compared to children with a semantic profile, both profiles react in similar reaction times in the conditions using complex primes that are morphologically related to their targets.

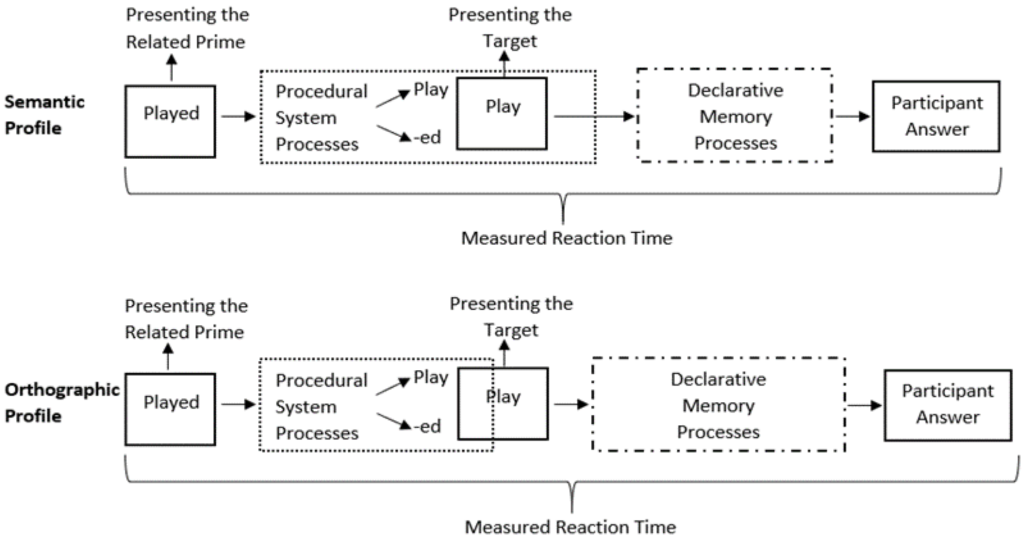

Figure 7. Processed involved in processing the targets primed by truly-affixed primes in both profiles

The longer reaction times for the unrelated primes in the transparent condition by the orthographic profile also needs an explanation. It is possible that while the participants with a semantic profile accessed the representations of the unrelated stems and rejected them more rapidly due to a more efficient declarative memory system, the participants with an orthographic profile might not reject the unrelated prime stems that easily. Considering this with the slower access to the target word representations in the declarative memory system, the participants with an orthographic profile might give significantly slower responses for the unrelated primes in the transparent condition, despite their more efficient morphological decomposition (Figure 8).

Figure 8 shows the implications of the current study regarding the longer reaction times given by the orthographic profile for the unrelated primes in the transparent condition. Although children with an orthographic profile have an advantage in decomposing the complex word *farmer,* since this prime word is both morphologically and semantically unrelated to the target word *play,* declarative processes take even longer times; first, the meaning of the *farmer* is reached and rejected, and then, the meaning of the target word, *play,* is reached. These multiple processes in the declarative memory provide an advantage for children with a semantic profile, who both reject unrelated primes and reach the meanings of target words faster.

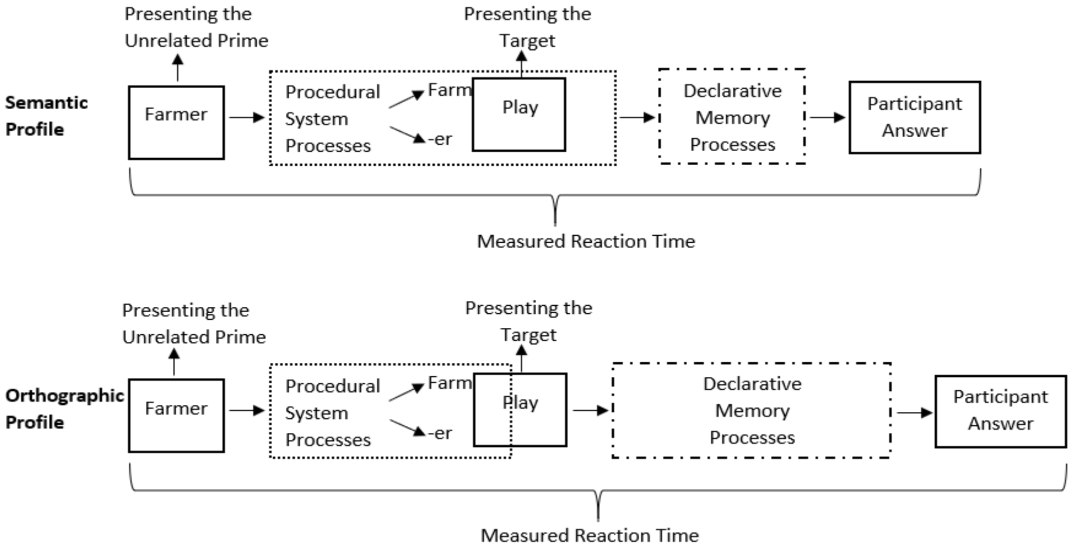

Figure 8. Processed involved in processing the targets primed by unrelated primes for both profiles

Another potential factor for the slower response times of the participants with an orthographic profile might be the strong competition among words during word activation (Andrews et al., 2010, 2012). The participants with an orthographic profile might have activated more potential candidates for a single prime word, which in turn resulted in slower response times.

A puzzling issue concerns the reason why a developed procedural processing system in the participants with an orthographic profile failed to decompose the pseudo-affixes and pseudo-stems in the opaque condition and in the formal overlap condition. Recall that Beyersmann (2012) also failed to find priming effects in the same conditions for English-speaking children, while the adults in that study and in other studies (e.g. Rastle et al.,2004) showed significant priming effects in pseudo conditions. The current findings may point to a not-fully-automatized procedural processing system that still needs semantic information in morphological decomposition. Or, it may be simply that Turkish readers are not sensitive to pseudo-affixes regardless of their reading experience. Since the studies on Turkish including an opaque condition are non-existent, conclusive claims related to the issue need further research.

4.4. Conclusions

The results overall indicated a semantically sensitive early word processing in Turkish primary school children, while the findings strongly reject pure semantic or pure orthographic priming effects for the examined age group in the early stages of word processing. The findings regarding the derivation-inflection distinction are not conclusive and require further empirical evidence; there were no differences between derived primes and inflected primes in either grade, yet the second graders in the study showed priming effects only for inflected primes. Likewise, the interpretation of how spelling skills and vocabulary skills modulate the early stage of word processing in this study is insightful but still requires further validation. Two reasons can be put forward for this: First, the study did not have enough participants to create profiles within the grade levels. Another reason is the number of tests used to measure individual skills; multiple tests with multiple formats can be used to measure each skill to get a more extensive picture regarding individual differences.

Rather than the view that the inflectional marker –(y)lA and the derivational marker -lI were processed differently as an interpretation of the lack of priming effects for the derived primes in the second grade data, non-significant difference between the mean reaction times of the inflected primes and the derived primes in that grade level suggest that this finding could be due to some uncontrolled factors or to the limited number of the participants. It is also plausible to attribute a more efficient declarative memory system to the participants with a semantic profile since they had superior vocabulary skills. If this view is true, then it could be concluded that the derived forms used in the present study did not have their own lexemes for the primary school participants; if these derived forms were to be stored, the participants with a semantic profile therefore should have processed the derived forms faster, while this expectation contradicts the results.

The derivational suffix -lI is highly transparent, productive, and frequent in Turkish; considering these factors and the aforementioned contradictions to the storage-based assumption for the derived forms in the study, it is possible that the complex words affixed with -lI are decomposed and don't have their own lexical entries (at least for developing readers). Such an assumption is also supported by the cross-linguistic views of word processing in the literature. The Dual-Route Model of Grainger and Ziegler (2011) accepts the possibility that the effective use of the fine-grained processing route could hinder the development of the coarse-grained route. This hindrance might not block the use of the coarse-grained route completely; rather, it may lead to varying efficiency for this route in different languages. Other studies highlight that cross-linguistic differences were likely to affect word processing (e.g Marcolini, Traficante, Zoccolotti, & Burani, 2011; Ziegler & Goswami, 2005). Schreuder and Baayen (1995) argue that rather than a simple derivation-inflection distinction, multiple factors such as transparency and allomorphy are influential in the acquisition of affixes (and thus in the processing of affixes). Considering these with the present interpretation based on the profiles, the findings present a more convincing picture for the proposal that both the derived forms and the inflected forms in the study were processed similarly. Of course, this interpretation does not hold that all Turkish derived forms are processed in the same way; in addition to productivity, transparency, and frequency, there are many factors affecting the acquisition and the processing of affixed forms (Section 2.3.4, Section 2.3.5).

It is also possible that developing readers first store derived forms and then start decomposing the complex words with frequent derivational affixes; therefore, the complex words with frequent affixes are always decomposed. It is unclear, however, why the declarative memory did not directly access the derived forms and block the procedural process by the participants with a semantic profile. Two possible arguments can be put forward: First, the lexical representations for the derived words in the present study could be still in development, thus accessing them could be more demanding compared with unaffixed words. Second, it is also possible that the frequent derivational affixes in the present study led to decomposition that blocked the direct activation of the derived words. Needless to say, such claims are speculative at this point and need further research.

All in all, the current findings perfectly fit within the Declarative/Procedural Model of Ullman (2001a, 2001b) and the Dual-Route Model of Grainger and Ziegler (2011). It is difficult to reach conclusive claims regarding the dual-mechanism view using the present findings, or to validate derivation-inflection distinction; yet, the present study offers evidence for semantic transparency effects in the early word processing by Turkish primary school children.

4.5. Implications for Reading Instruction in L1

The findings of the present study suggest that even second graders (at least in Turkish) use morphemes as salient units in the early word processing. It is therefore plausible to support the development of these units. Although there have been some objections to the explicit instruction of morphemes in the early grades, the extensive literature review of Bowers, Kirby, and Deacon (2010) on morphological instruction suggests that such instruction is as effective in the early grades as it is for the later grades. Similarly, Kieffer and Lesaux (2007) not only argue that morphology is strongly related with vocabulary skill and reading comprehension, but also offer insights and techniques to teach morphemes in the classroom. Taken together, including explicit morpheme instruction in Turkish primary schools is likely to have positive effects on the word processing of Turkish primary school children.

In addition to morpheme instruction, vocabulary instruction is often neglected in the Turkish primary school context. Considering the present findings, it can be assumed that enhanced vocabulary and spelling skills will also enhance the efficiency of word processing. Bruce Taylor, Mraz, Nichols, Rickelman, and Wood (2009) argue that explicit vocabulary teaching is helpful in schools, especially for struggling readers. Ouellette (2006) concludes in a study investigating the role of vocabulary in reading with fourth graders that although teaching phoneme awareness is essential, it should not preclude vocabulary enrichment activities. To end on a practical note, including vocabulary activities in primary schools, some of which focus on spelling, is likely to contribute a lot to reading skills and word processing effectiveness in Turkish primary schools.

4.6. Limitations of the Study

Only second graders showed a marginal significant effect for the identical items in the semantic condition only for the by-item analysis. Although both groups failed to show strong priming effects for the identical primes in this condition, the numbers indicated numerical priming effects for the identical primes in the semantic condition.

Similarly, only the fourth graders showed significant priming effects for the identical primes in the opaque condition in both the by-participant and by-item analyses, while second graders showed only a marginal significance for the identical primes in the opaque condition in the by-item analysis. These results, however, do not lay strong doubts on the implications regarding the word processing in the opaque condition for two reasons: First, the test primes in the opaque condition failed to show any significant or marginally significant priming effects both in the by-participant and by-item data for both grades. Also, the fourth graders showed clear priming effects for the identical primes in the opaque condition. Even if we assume that the second grade data is not interpretable due to weak identical priming, a word processing system that is automatized enough to decompose pseudo-affixes failing to show such effects after two more years of reading experience is unlikely.

Another limitation was related to Turkish Vowel Harmony; some pseudo-affixes in the opaque condition did not comply with Turkish Vowel Harmony (e.g. the pseudo-suffix *–a* in *bina*). This could be another factor behind the absence of priming effects. A masked priming study comparing the effects of the pseudo-affixes complying with Vowel Harmony and the pseudo-affixes not complying with the Vowel Harmony is likely to provide important insights for the issue.

Perhaps further studies with more participants can overcome the aforementioned limitations. Also, the limited number of participants did not allow for the investigation of the semantic/orthographic profile phenomenon for different grade levels; studies with a higher number of participants with both profiles in different grade levels can provide a more comprehensive picture.

Factors like neighbor effects or pseudo-neighbor effects were not controlled in this study. This could be another reason for the partial or non-existent identical priming for some of the conditions in the study. Further studies need to take these factors into consideration to further validate the present findings, or to disprove them.

While there were two fixed suffixes for the transparent condition, the pseudo-suffixes in the opaque condition were many and could not be checked for their frequencies due to the lack of this feature in the Turkish corpus. A future design to overcome this problem and the problem of activating two stems in the opaque condition (Beyersmann et al., 2015b) can include an opaque non-word condition, in which a legitimate stem and a legitimate affix creates a non-word. Such a design using the same affixes in a transparent condition and in an opaque non-word condition can prevent the cautions related to affix frequencies and other between-items related factors.

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APPENDICES

A. Primes and Targets in the Semantic Condition

UNRELATED		TEST		TARGET	
Flüt	*Flute*	Çatı	*Roof*	Ev	*House*
Kargo	*Cargo*	Çürük	*Rotten*	Diş	*Tooth*
Maske	*Mask*	Tavuk	*Chicken*	Yumurta	*Egg*
Ördek	*Duck*	Kalem	*Pencil*	Silgi	*Eraser*
Simit	*Bagel*	Cesur	*Brave*	Korkak	*Coward*
Havlu	*Towel*	Orman	*Forest*	Ağaç	*Tree*
Sınav	*Exam*	Emzik	*Pacifier*	Bebek	*Baby*
Parfüm	*perfume*	Defter	*Notebook*	Kitap	*Book*
Dudak	*Lip*	Sınıf	*Classroom*	Okul	*School*
Pano	*Panel*	İnek	*Cow*	Süt	*Milk*
Bukle	*Curl*	Hasta	*Sick*	İlaç	*Medicine*
Priz	*Socket*	Soru	*Question*	Cevap	*Answer*
Demir	*Iron*	Bıyık	*Moustache*	Sakal	*Beard*
Zebra	*Zebra*	Bilet	*Ticket*	Uçak	*Plane*
Dans	*Dance*	Kedi	*Cat*	Köpek	*Dog*
İnci	*Pearl*	Doğu	*East*	Batı	*West*
Modem	*Modem*	Damat	*Groom*	Gelin	*Bride*
Zincir	*Chain*	Yastık	*Pillow*	Yorgan	*Quilt*
Fidan	*Sapling*	Limon	*Lemon*	Ekşi	*Sour*
Dürbün	*Binoculars*	Fındık	*Nut*	Ceviz	*Walnut*
Takla	*Tumble*	Siyah	*Black*	Beyaz	*White*
Elzem	*Essential*	Tırnak	*Nail*	Makas	*Scissors*
Losyon	*Lotion*	Bayrak	*Flag*	Kırmızı	*Red*
Berrak	*Clear*	Zürafa	*Giraffe*	Uzun	*Tall*

B. Primes and Targets in the Opaque Condition

UNRELATED		TEST		TARGET	
Ocak	*Cooker*	Elma	*Apple*	El	*Hand*
Tünel	*Tunnel*	Yazık	*Pity*	Yaz	*Summer*
Çile	*Suffering*	Kapı	*Door*	Kap	*Vessel*
İmla	*Spelling*	Etek	*Skirt*	Et	*Meat*
Serçe	*Sparrow*	Tamir	*Reparing*	Tam	*Whole*
Fıçı	*Barrel*	Bela	*Trouble*	Bel	*Waist*
Ders	*Lesson*	Toka	*Buckle*	Tok	*Satiated*
Küpe	*Earing*	Sıra	*Line*	Sır	*Secret*
Tost	*Toast*	Kira	*Rent*	Kir	*Dirt*
Pide	*Chapati*	Cami	*Mosque*	Cam	*Glass*
Saat	*Clock*	Film	*Movie*	Fil	*Elephant*
Sembol	*Symbol*	Yüksek	*High*	Yük	*Burden*
Demet	*Bunch*	Kaşık	*Spoon*	Kaş	*Eyebrow*
Kemer	*Belt*	Bitki	*Plant*	Bit	*Louse*
Perde	*Curtain*	Çayır	*Meadow*	Çay	*Tea*
Hobi	*Hobby*	Kare	*Square*	Kar	*Snow*
Omlet	*Omelet*	Beşik	*Crib*	Beş	*Five*
Şort	*Shorts*	Bina	*Building*	Bin	*A thousand*
Dilek	*Wish*	Tuzak	*Trap*	Tuz	*Salt*
Ceket	*Jacket*	Sağır	*Deaf*	Sağ	*Right*
Kekik	*Thyme*	Sazan	*Carp*	Saz	*Sedge*
Gitar	*Guitar*	Kuşak	*Belt*	Kuş	*Bird*
Serum	*Serum*	Kızak	*Sled*	Kız	*Girl*
Sayfa	*Page*	Tekme	*Kick*	Tek	*Sole*

C. Primes and Targets in the Formal Overlap Condition

UNRELATED		TEST		TARGET	
Kilo	*Kilogram*	Arap	*Arab*	Ara	*Call*
Teyze	*Aunt*	Balon	*Balloon*	Bal	*Honey*
Kaba	*Rude*	Turp	*Turnip*	Tur	*Tour*
Kibir	*Arrogant*	Telaş	*Rush*	Tel	*Wire*
İklim	*Climate*	Çekiç	*Hammer*	Çek	*Pull*
Ense	*Nape*	Ayva	*Quince*	Ay	*Moon*
Piyano	*Piano*	Devlet	*Government*	Dev	*Giant*
Yunus	*Dolphin*	Masaj	*Massage*	Masa	*Table*
İrmik	*Semolina*	Hapis	*Prison*	Hap	*Pill*
Kivi	*Kiwi*	Ateş	*Fire*	At	*Horse*
Tarçın	*Cinnamon*	Dikkat	*Attention*	Dik	*Vertical*
Korse	*Bodice*	Pilav	*Pilaf*	Pil	*Battery*
Baraj	*Dam*	Silah	*Weapon*	Sil	*Erase*
Kuğu	*Swan*	Ters	*Reverse*	Ter	*Sweat*
Düğün	*Wedding*	Kasap	*Butcher*	Kasa	*Safe*
Tepsi	*Tray*	Kılıç	*Sword*	Kıl	*Hair*
Pırasa	*Leek*	Koltuk	*Armchair*	Kol	*Arm*
Tilki	*Fox*	Şubat	*February*	Şu	*That*
Sosis	*Sausage*	Günah	*Sin*	Gün	*Day*
Püre	*Mash*	Kalp	*Heart*	Kal	*Stay*
Naz	*Coyness*	Suç	*Crime*	Su	*Water*
Şapka	*Hat*	Kutup	*Pole*	Kutu	*Box*
Rimel	*Mascara*	Kanat	*Wing*	Kan	*Blood*
Bidon	*Bin*	Külah	*Cone*	Kül	*Ash*

D. Primes and Targets in the Transparent Condition

UNRELATED		DERIVED		INFLECTED		TARGET	
Dikiş	*Stitch*	Sesli	*Noisy*	Sesle	*With sound*	Ses	*Sound*
Çilsiz	*Freckless*	Öfkeli	*Angry*	Öfkeyle	*With anger*	Öfke	*Anger*
Kuyuda	*In the well*	Renkli	*Colorful*	Renkle	*With color*	Renk	*Color*
Kokusuz	*Unscented*	Bilgili	*Wise*	Bilgiyle	*With knowledge*	Bilgi	*Knowledge*
Dertsiz	*Untroubled*	Çiçekli	*Floriferous*	Çiçekle	*With flower*	Çiçek	*Flower*
İzinsiz	*Unauthorized*	Güneşli	*Sunny*	Güneşle	*With sun*	Güneş	*Sun*
Kargada	*At the crow*	Güvenli	*Safe*	Güvenle	*Securely*	Güven	*Safety*
Uğursuz	*Ominous*	Keyifli	*Joyous*	Keyifle	*With joy*	Keyif	*Joy*
Aslandan	*From the lion*	Peynirli	*Cheesy*	Peynirle	*With cheese*	Peynir	*Cheese*
Rahatsız	*Disturbed*	Sevinçli	*Happy*	Sevinçle	*With happiness*	Sevinç	*Happiness*
Çimden	*From the grass*	Acılı	*Bitter*	Acıyla	*With bitterness*	Acı	*Bitterness*
Bilge	*Wise*	Hızlı	*Fast*	Hızla	*With speed*	Hız	*Speed*
Çölde	*At the desert*	Yağlı	*Oily*	Yağla	*With oil*	Yağ	*Oil*
Cücede	*At the dwarf*	Işıklı	*Lightened*	Işıkla	*With light*	Işık	*Light*
Keneden	*From the tick*	Yazılı	*Written*	Yazıyla	*With writing*	Yazı	*Writing*
Müdürde	*At the principle*	Sayılı	*Numbered*	Sayıyla	*With number*	Sayı	*Number*
Nohutta	*In the chickpea*	Meraklı	*Curious*	Merakla	*With curiosity*	Merak	*Curiosity*
Çömlekten	*From the pot*	Başarılı	*Successful*	Başarıyla	*With success*	Başarı	*Success*
Sepetten	*From the basket*	Rüzgarlı	*Windy*	Rüzgarla	*With wind*	Rüzgar	*Wind*
Açılar	*Angles*	Neşeli	*Cheerful*	Neşeyle	*With cheer*	Neşe	*Cheer*
Bekçi	*Guard*	Zorlu	*Hard*	Zorla	*Hardly*	Zor	*Hard*
Kupasız	*Without a cup*	Çocuklu	*A person who has children*	Çocukla	*With child*	Çocuk	*Child*
Akılsız	*Foolish*	Gururlu	*Proud*	Gururla	*With pride*	Gurur	*Pride*

D. Primes and Targets in the Transparent Condition (cont.)

Çobanda	*At the shepherd*	İstekli	*Desirous*	İstekle	*With desire*	İstek	*Desire*
İlgisiz	*Irrelevant*	Şekerli	*Sugary*	Şekerle	*With sugar*	Şeker	*Sugar*
Harften	*From the letter*	Bıçaklı	*A person armed with a knife*	Bıçakla	*With knife*	Bıçak	*Knife*
Cepsiz	*Without a pocket*	Uykulu	*Sleepy*	Uykuyla	*With Sleep*	Uyku	*Sleep*
Hatasız	*Faultless*	Korkulu	*Frightening*	Korkuyla	*With fear*	Korku	*Fear*

E. Fourth Grade Spelling Test

İsim : **Numara:**
Sınıf: 4-

Yazımı doğru olan kelimeyi **yuvarlak** içine alınız.

Örnek: **a)** Kalen [✓ **b)** Kalem] **c)** Kallem

1. **a)** Yüsük **b)** Yüzsük **c)** Yüzük

2. **a)** Sinek **b)** Siğnek **c)** Sinyek

3. **a)** Çorab **b)** Çorap **c)** Corap

4. **a)** Rüzgar **b)** Rüzkar **c)** Rüzger

5. **a)** Kırnızı **b)** Kımızı **c)** Kırmızı

6. **a)** Elpise **b)** Elbise **c)** Elbize

7. **a)** Çamışır **b)** Çamşır **c)** Çamaşır

8. **a)** Değil **b)** Deil **c)** Degil

9. **a)** Marul **b)** Mağrul **c)** Malrul

10. **a)** Fülüt **b)** Filüt **c)** Flüt

11. **a)** Zeytin **b)** Zeğtin **c)** Zaytin

12. **a)**Saklampaç **b)**Saklanbaç **c)**Saklambaç

13. **a)** İstambul **b)** İstanbul **c)** İslanbul

14. **a)**Matamatik **b)**Madematik **c)**Matematik

15. **a)** Garaş **b)** Garac **c)** Garaj

16. **a)** Kestane **b)** Kesdana **c)** Kestene

17. **a)** Cimri **b)** Çimri **c)** Cimiri

18. **a)** Azlan **b)** Aslan **c)** Ağıslan

19. **a)** Herkez **b)** Herkes **c)** Hekez

20. **a)** Şiyir **b)** Siir **c)** Şiir

21. **a)** Aferin **b)** Aferim **c)** Afferin

22. **a)** Şampuan **b)**Şampuyan **c)**Şampayan

23. **a)** Ispınak **b)** Ispanak **c)** Ispaynak

24. **a)** Soğan **b)** Sovan **c)** Soan

25. **a)** Asfalt **b)** Asvalt **c)** Azfalt

26. **a)** Hağlu **b)** Havlu **c)** Halu

E. Fourth Grade Spelling Test (cont.)

27.	**a)** Sepze	**b)** Sebize	**c)** Sebze
28.	**a)** Çınar	**b)** Çığnar	**c)** Cınar
29.	**a)** Kiprit	**b)** Kibrit	**c)** Kirbit
30.	**a)** Deynek	**b)** Değnek	**c)** Denek
31.	**a)** Bağdem	**b)** Badem	**c)** Baydem
32.	**a)** Çünkü	**b)** Çünki	**c)** Çinkü
33.	**a)** Atmış	**b)** Altmış	**c)** Altımış
34.	**a)** Fiyat	**b)** Fiyet	**c)** Fiyad
35.	**a)** Nalet	**b)** Lanet	**c)** Lenet
36.	**a)** Şemsiye	**b)** Semsiye	**c)** Şemsie
37.	**a)**Maydonoz	**b)** Maydanoz	**c)** Madonoz
38.	**a)** Çiğmen	**b)** Çiymen	**c)** Çimen
39.	**a)** Üçgen	**b)** Üçken	**c)** Üçügen
40.	**a)** Acağyip	**b)** Acaip	**c)** Acayip
41.	**a)** Çenber	**b)** Çember	**c)** Çemper
42.	**a)** Eylence	**b)** Elence	**c)** Eğlence
43.	**a)** Eşki	**b)** Ekşi	**c)** Ekişi
44.	**a)** Anağtar	**b)** Anatar	**c)** Anahtar
45.	**a)** Kurpağa	**b)** Kurba	**c)** Kurbağa
46.	**a)** Satılık	**b)** Satlık	**c)** Satılıg
47.	**a)** Fotoraf	**b)** Fotokraf	**c)** Fotoğraf
48.	**a)** Yalnış	**b)** Yanlış	**c)** Yanalış
49.	**a)** Nağne	**b)** Nane	**c)** Nayne
50.	**a)** Busdolabı	**b)** Buzdolapı	**c)** Buzdolabı
51.	**a)** Mahelle	**b)** Mahille	**c)** Mahalle
52.	**a)** Züryafa	**b)** Zürağfa	**c)** Zürafa
53.	**a)** Teğlik	**b)** Terlik	**c)** Teylik
54.	**a)** Çabuk	**b)** Çapuk	**c)** Cabuk

F. Second Grade Spelling Test

İsim : **Numara:**
Sınıf: 2

Yazımı doğru olan kelimeyi **yuvarlak** içine alınız.

Örnek: **a)** Kalen [✓ **b)** Kalem] **c)** Kallem

1. **a)** Kırnızı **b)** Kımızı **c)** Kırmızı

2. **a)** Ağaç **b)** Agac **c)** Ağac

3. **a)** Çorab **b)** Çorap **c)** Corap

4. **a)** Sebet **b)** Sapet **c)** Sepet

5. **a)** Sebze **b)** Sepze **c)** Sebize

6. **a)** Kalb **b)** Kalp **c)** Kalip

7. **a)** Atmış **b)** Altmış **c)** Altımış

8. **a)** Çabuk **b)** Çapuk **c)** Cabuk

9. **a)** Cicek **b)** Çiçek **c)** Çicek

10. **a)** Rüzgar **b)** Rüzkar **c)** Rüzger

11. **a)**Saklampaç **b)** Saklanbaç **c)**Saklambaç

12. **a)** Sinek **b)** Siğnek **c)** Sinyek

13. **a)** Nağne **b)** Nayne **c)** Nane

14. **a)** Corba **b)** Çorba **c)** Çorpa

15. **a)** Büsküğüt **b)** Büskevi **c)** Büsküvi

16. **a)** İstanbul **b)** İslanbul **c)** İstambul

17. **a)** İne **b)** İğne **c)** İgne

18. **a)** Nalet **b)** Lanet **c)** Lenet

19. **a)** Elpise **b)** Elbise **c)** Elbize

20. **a)** Gurup **b)** Grub **c)** Grup

21. **a)** Yüsük **b)** Yüzsük **c)** Yüzük

22. **a)** Şiyir **b)** Siir **c)** Şiir

23. **a)** Taşan **b)** Tavşan **c)** Tağşan

24. **a)** Kelepek **b)** Kelbek **c)** Kelebek

25. **a)** Azlan **b)** Aslan **c)** Ağıslan

26. **a)** Kestane **b)** Kesdana **c)** Kestene

F. Second Grade Spelling Test (cont.)

27. **a)** Bıcak **b)** Pıçak **c)** Bıçak

28. **a)** Eşki **b)** Ekşi **c)** Ekişi

29. **a)** Piknik **b)** Piğnik **c)** Peknik

30. **a)** Kıral **b)** Kral **c)** Kiral

31. **a)** Sovan **b)** Soan **c)** Soğan

32. **a)** Aız **b)** Ağız **c)** Agız

33. **a)** Zeytin **b)** Zeğtin **c)** Zaytin

34. **a)** Çamışır **b)** Çamsır **c)** Çamaşır

35. **a)** Ayakkapı **b)** Ayakkabı **c)** Ayakabı

36. **a)** Avya **b)** Ayva **c)** Ağva

37. **a)** Cevap **b)** Cevab **c)** Cavap

38. **a)** Aferin **b)** Aferim **c)** Afferin

39. **a)** Zürağfa **b)** Züryafa **c)** Zürafa

40. **a)** Çünkü **b)** Çünki **c)** Çinkü

41. **a)** Kapul **b)** Kabul **c)** Kabül

42. **a)** Çifçi **b)** Çiftçi **c)** Çifici

43. **a)** Üçgen **b)** Üçken **c)** Üçügen

44. **a)** Marul **b)** Mağrul **c)** Malrul

45. **a)** Hağlı **b)** Halığ **c)** Halı

46. **a)** Şemsiye **b)** Semsiye **c)** Şemsie

47. **a)** Filim **b)** Film **c)** Filin

48. **a)** Şindi **b)** Şiymdi **c)** Şimdi

49. **a)** Şampuan **b)** Şampuyan **c)** Şampayan

50. **a)** Patates **b)** Pattes **c)** Pattiz

51. **a)** Fotoraf **b)** Fotokraf **c)** Fotoğraf

52. **a)** Ispınak **b)** Ispaynak **c)** Ispanak

53. **a)** Değil **b)** Deil **c)** Degil

54. **a)** Kurpağa **b)** Kurba **c)** Kurbağa

G. Fourth Grade Vocabulary Test

İsim :

Numara:

Sınıf: 4-

Koyu yazılmış kelimelerin anlamını şıklar arasından seçiniz.

Örnek:

Esra **kocaman** bir pasta aldı.

a) Çok tatlı
[✓ b)] Çok büyük
c) Biraz ekşi

1. Erhan'ın **masum** olduğuna inanıyorum.
a) Suçsuz
b) Yalancı
c) Güçlü

2. Mehmet çok **meşhur** oldu.
a) Zengin
b) Bilgili
c) Ünlü

3. Mızrak **ilkel** bir silahtır.
a) Çok sivri
b) Eskide kalmış
c) Tehlikeli

4. Daha çok **gayret** göstermelisin.
a) Çaba
b) Harcama
c) Sevgi

5. Çok **çetin** bir soruydu.
a) Çözülmesi çok kolay
b) Çözülmesi çok zor
c) Çözülmesi gereksiz

6. Bu **adil** bir karardı.
a) Acele
b) Çok sert
c) Doğru

7. **Sözcüklerini** doğru seçmelisin.
a) Kelimelerini
b) Elbiselerini
c) Yemeklerini

8. Asansör çalışırken **temas etmeyin**.
a) Durdurmayın
b) Hareket etmeyin
c) Dokunmayın

9. Tüm akşam çalışmam **boşuna** mıydı?
a) Yararsız
b) Değerli
c) Yorucu

10. Burası meyve ağaçları için **elverişli**.
a) Uygun
b) Büyük
c) Çamurlu

11. Çok **görkemli** bir törendi.
a) Gösterişli
b) Duygusal
c) Gürültülü

12. **Muhtaç** insanlara yardım etmeliyiz.
a) Hasta
b) Üzgün
c) Fakir

G. Fourth Grade Vocabulary Test (cont.)

13. Pınar maçta **galip geldi**.
  a) Kaybetti
  b) Kazandı
  c) Yaralandı

14. Erdal **seçkin** bir öğrencidir.
  a) Yaramaz
  b) Göze çarpan
  c) Hareketli

15. Olanları **izah edeceğim.**
  a) Açıklayacağım
  b) Saklanacağım
  c) Kabul etmeyeceğim

16. Muhtemelen yağmur yağacak.
  a) Belki de
  b) İnşallah
  c) Büyük ihtimalle

17. Vahşi hayvanları korumalıyız.
  a) Sevimli
  b) Evcil
  c) Yırtıcı

18. İşini **özenle** yapmalısın.
  a) Çabuk
  b) Dikkatle
  c) Ertelemeden

19. Bu çok **muhim** bir olay.
  a) Hüzünlü
  b) Mutlu
  c) Önemli

20. Şu ağaçtaki kuş çok **nadirdir**.
  a) Hızlı uçan
  b) Az bulunan
  c) Güzel öten

21. Hasta olmamak için **önlem** al.
  a) Tedbir
  b) İlaç
  c) Elbise

22. Kamuoyu olaya tepki gösterdi.
  a) Oy verme hakkına sahip kişiler
  b) Halkın genel düşüncesi
  c) Kamuda çalışan memurlar

23. Epeyce ağaç dikti.
  a) Birçok
  b) Yeşil olan
  c) Meyve veren

24. Çocuk **perişan** durumdaydı.
  a) Zavallı
  b) Uykulu
  c) Sağlıklı

25. Yeni telefonum güzel **lakin** pahalı.
  a) Bu yüzden
  b) Hem de
  c) Ancak

26. Engin dağları görebiliyorum.
  a) Uçsuz bucaksız
  b) Karla kaplı
  c) Çok uzakta olan

G. Fourth Grade Vocabulary Test (cont.)

27. Yeni bilgisayarımı **iade ettim.**
   a) Çalıştırdım
   b) Kapattım
   c) Geri verdim

28. **Zarif** bir konuşma yaptı.
   a) Hoş olan
   b) Çok sıkıcı
   c) Bilgi verici

29. **İstikrarlı** bir şekilde kitap okuyorum.
   a) Sessizce
   b) Düzenli
   c) Zorunlu

30. **Hakiki** arkadaşlar önemlidir.
   a) Kibar
   b) Gerçek
   c) Yardımsever

31. Bilgisayarın fiyatı çok **cazipti**.
   a) Pahalıydı
   b) Çekiciydi
   c) Şüpheliydi

32. Bu görevlinin **işlevini** anlamadım.
   a) Görevini
   b) Amacını
   c) Sorununu

33. Bu konuda **eşsiz** bir yeteneği var.
   a) Çok az
   b) Ortalama
   c) Benzersiz

34. **Hür** bir kuş gibi olmak istiyordu.
   a) Renkli
   b) Uçabilen
   c) Özgür

35. Yeni **kuşak** çok çalışkan.
   a) Millet
   b) Nesil
   c) İşçiler

36. **Ulu** bir amaç için toplandık.
   a) Tehlikeli
   b) Gizli
   c) Yüce

37. Bunlar **şahsi** düşüncelerim.
   a) Bireysel
   b) Yeni
   c) Kararsız

38. Bu sabah çok **diri** duruyorsun.
   a) Dinç
   b) Öfkeli
   c) Bitkin

39. Kerem çok **itibarlı** biridir.
   a) Çok parası olan
   b) Aşırı meraklı
   c) Saygı gösterilen

40. **Netice** ne olacak merak ediyorum.
   a) Tartışma
   b) Sonuç
   c) Hikaye

G. Fourth Grade Vocabulary Test (cont.)

41. Bu kitaptan **istifade ettim**.
- a) Yararlandım
- b) Nefret ettim
- c) Ders çıkardım

42. Şule'nin ders çalışmasına **mani oluyor**.
- a) Engelliyor
- b) Yardım ediyor
- c) Sinirlendiriyor

43. Filmin sonu tamamen **meçhul**.
- a) Anlamsız
- b) Belirsiz
- c) Sürükleyici

44. Bugün **gündem** ne peki?
- a) Günün öne çıkan konusu
- b) O gün için yapılan yemek
- c) Gün içindeki görevler

45. Gitar sesinden **mahrum kaldım.**
- a) Çok hoşlandım
- b) Yoksundum
- c) Başım ağrıdı

46. Ufak bir **tebessüm** bile göstermedi.
- a) Kızgınlık
- b) Minnettarlık
- c) Gülümseme

47. **Semaya** doğru bakıyordu.
- a) Ufuk çizgisine
- b) Gökyüzüne
- c) Toprağa

48. Bu işin **koşulları** çok fazla.
- a) Maaşı
- b) Cezaları
- c) Şartları

49. Mahalledeki **yegane** park bu.
- a) Ağaçlı
- b) Biricik
- c) Ücretsiz

50. Duvardaki tablo **çarpık** duruyor.
- a) Büyüleyici
- b) Korkunç
- c) Eğri

51. Bu heykel **sembolik** öneme sahip.
- a) Tarihsel
- b) Sanatsal
- c) Simgesel

52. Dünkü maçta **mağlup olduk**.
- a) Kazandık
- b) Yenildik
- c) Yorulduk

53. Sınavı geçtiğini **tebliğ ettik.**
- a) Gizledik
- b) Bildirdik
- c) İnandık

54. Yazdığı ilaç **tesir etti**.
- a) İşe yaramadı
- b) Hasta etti
- c) Etki gösterdi

H. Second Grade Vocabulary Test

İsim : **Numara:** **Sınıf: 2 -**

Koyu yazılmış kelimelerin anlamını şıklar arasından seçiniz.

Örnek:

Esra **kocaman** bir pasta aldı.

a) Çok tatlı

[✓ b)] Çok büyük

c) Biraz ekşi

1. Ali'nin söyledikleri **bilimsel** değil.
a) Bilim ile ilgili
b) Herkesin bildiği şeyler
c) Bilinmeyen sırlar

2. **Öteki** kalem daha güzeldi.
a) Yeni
b) Diğer
c) Pahalı

3. Bu **yaygın** bir kitap.
a) Çoğu kişinin duyduğu
b) Bir silah türü
c) Heyecanlı

4. Şu yeni filmi **tercih etti**.
a) Sevdi
b) Satın aldı
c) Seçti

5. Ayşe kitabı **teslim etti.**
a) Geri verdi
b) Yırttı
c) Okudu

6. **Bazen** denize yüzmeye gidiyorum.
a) Sürekli
b) Hiçbir zaman
c) Ara sıra

7. Ahmet'in **tahmini** yanlıştı.
a) Bir şey hakkında bilgisi
b) Önceden düşündüğü şey
c) Yalan olan şey

8. **Modern** uçakları seviyorum.
a) Hızlı
b) Ucuz
c) Çağdaş

9. Yeni pantolonun çok **geniş.**
a) Bol
b) Uzun
c) Güzel

10. Zeynep **bireysel** sınavlarda başarılı.
a) Bir tane olan
b) Tek bir kişi ile çözülen
c) Birinci olunan

11. Aslı koşma konusunda **üstün**.
a) Çok kötü
b) Diğer kişilerden daha iyi
c) Yukarı doğru tırmanabilen

12. Bugün **tuhaf** davranıyorsun.
a) Anlaşılamaz
b) Yavaş
c) Üzgün

H. Second Grade Vocabulary Test (cont.)

13. Rekabeti sevmiyorum.
a) Kavga etmeyi
b) Koşmayı
c) Yarışmayı

14. Kahvaltı **vakti** geldi.
a) Sofrası
b) Zamanı
c) Tabağı

15. Nihayet ödevimi bitirdim.
a) Kolayca
b) Hızlıca
c) Sonunda

16. Spor yapmak çok **yararlıdır**.
a) Eğlencelidir
b) Faydalıdır
c) Yorucudur

17. Bu **yerli** telefon çok sağlam.
a) Yerde kullanılan
b) Kendi ülkesinde yapılan
c) Kablolu

18. Okulumuz çok **emniyetli** bir yerdir.
a) Güvenli
b) Sıkıcı
c) Eğlenceli

19. Bu resim çok **estetik** duruyor.
a) Renkli
b) Karışık
c) Güzel

20. Elif çok **içten** konuştu.
a) Samimi
b) Yüksek sesli
c) Fısıldayarak

21. Erdal ödevini **zorla** yaptı.
a) Severek
b) İstemeyerek
c) Bilgisayarla

22. Bu soru **hatalı.**
a) Zor
b) Uzun
c) Yanlış

23. Birinci olma **ümidim** devam ediyor.
a) Şansım
b) Umudum
c) İsteğim

24. Ödevini yapmama **sebebin** nedir?
a) Nedenin
b) Cezan
c) Amacın

25. İstediğin kalemi **temin edeceğim.**
a) Satın almak
b) Tamir etmek
c) Bulup getirmek

26. Derhal kitaplarınızı çıkarın!
a) Hemen
b) Bütün
c) Ders

H. Second Grade Vocabulary Test (cont.)

27. Fatma **hariç** herkes ödevini yaptı.
a) İle beraber
b) Dışında
c) Sayesinde

28. Erhan'ın **masum** olduğuna inanıyorum.
a) Suçsuz
b) Yalancı
c) Güçlü

29. Mehmet çok **meşhur** oldu.
a) Zengin
b) Bilgili
c) Ünlü

30. Kılıç **ilkel** bir silahtır.
a) Çok sivri
b) Tehlikeli
c) Eskide kalmış

31. Daha çok **gayret** göstermelisin.
a) Çaba
b) Harcama
c) Sevgi

32. Çok **çetin** bir soruydu.
a) Çözülmesi çok kolay
b) Çözülmesi çok zor
c) Çözülmesi gereksiz

33. Bu **adil** bir karardı.
a) Acele
b) Çok sert
c) Doğru

34. Asansör çalışırken **temas etmeyin**.
a) Durdurmayın
b) Hareket etmeyin
c) Dokunmayın

35. Yavuz çok **öfkeli**.
a) Mutlu
b) Sinirli
c) Üzgün

36. Tüm akşam çalışmam **boşuna** mıydı?
a) Yararsız
b) Değerli
c) Yorucu

37. Bu bahçe meyve ağaçları için **elverişli.**
a) Uygun
b) Büyük
c) Çamurlu

38. Çok **görkemli** bir törendi.
a) Gösterişli
b) Duygusal
c) Gürültülü

39. **Muhtaç** insanlara yardım etmeliyiz.
a) Hasta
b) Üzgün
c) Fakir

40. Pınar maçta **galip geldi**.
a) Kaybetti
b) Kazandı
c) Yaralandı

H. Second Grade Vocabulary Test (cont.)

41. Erdal **seçkin** bir öğrencidir.
a) Yaramaz
b) Göze çarpan
c) Hareketli

42. Olanları **izah edeceğim.**
a) Açıklayacağım
b) Saklayacağım
c) Kabul etmeyeceğim

43. Muhtemelen yağmur yağacak.
a) Belki de
b) İnşallah
c) Büyük ihtimalle

44. Vahşi hayvanları korumalıyız.
a) Sevimli
b) Evcil
c) Yırtıcı

45. İşini **özenle** yapmalısın.
a) Çabuk
b) Dikkatle
c) Ertelemeden

46. Bu çok **muhim** bir olay.
a) Hüzünlü
b) Mutlu
c) Önemli

47. Şu ağaçtaki kuş çok **nadirdir.**
a) Hızlı uçan
b) Az bulunan
c) Güzel öten

48. Hasta olmamak için **önlem** al.
a) Tedbir
b) İlaç
c) Elbise

49. Kamuoyu olaya tepki gösterdi.
a) Oy verme hakkına sahip kişiler
b) Halkın genel düşüncesi
c) Kamuda çalışan memurlar

50. Epeyce ağaç dikti.
a) Yeşil olan.
b) Birçok
c) Meyve veren

51. Çocuk **perişan** durumdaydı.
a) Zavallı
b) Uykulu
c) Sağlıklı

52. Yeni telefonum güzel **lakin** pahalı.
a) Bu yüzden
b) Hem de
c) Ancak

53. Engin dağları görebiliyorum.
a) Uçsuz bucaksız
b) Karla kaplı
c) Çok uzakta olan

54. Yeni bilgisayarımı **iade ettim.**
a) Çalıştırmak
b) Kapatmak
c) Geri vermek

I. Fourth Grade Comprehension Questions

1. İdilya krallığı nasıl bir yermiş?
2. Kraliçenin ismi neymiş?
3. Kraliçenin nasıl saçları varmış?
4. Kraliçe neden genellikle yeşil giysiler giyermiş?
5. Kraliçenin güzelliğinin başka hangi özellikleri varmış?
6. Kraliçenin anne ve babasına ne olmuş?
7. Kraliçe neden dağların doruklarına gözlemevleri yaptımış?
8. Tiyatroda sergilenen oyunlar hangi yaşlar için uygunmuş?
9. Kraliçe çocukların hepsinin eğitim görmesini nasıl garanti altına almış?
10. Kraliçenin yaptığı ikinci meslek neymiş?

J. Second Grade Comprehension Questions

1. Hikayedeki balığın ismi nedir?
2. Küçük kara balığın gördüğü köydeki kadınlar ne yapıyorlardı?
3. Küçük kara balık nerede uyudu?
4. Küçük kara balık ne zaman uyandı?
5. Küçük kara balık uyanınca kimle konuştu?
6. Küçük kara balık ayın nesini en çok seviyordu?
7. Ayın kendi ışığı var mıydı?
8. Küçük balık insanların aya gideceğine inandı mı?
9. Ay neden sözünü bitiremedi?
10. Küçük balık hikayenin sonunda ne yaptı?

K. Word Recognition Test

İsim : **Numara:**
Sınıf: 2

Anlamını bilmediğiniz kelimenin üzerine çarpı atınız. Örnek: ~~Ekseriyet~~

1)	Ses	Sesli	Sesle
2)	Azim	Azimli	Azimle
3)	İlgi	İlgili	Ilgiyle
4)	Neşe	Neşeli	Neşeyle
5)	Öfke	Öfkeli	Öfkeyle
6)	Renk	Renkli	Renkle
7)	Bilgi	Bilgili	Bilgiyle
8)	Çiçek	Çiçekli	Çiçekle
9)	Güneş	Güneşli	Güneşle
10)	Güven	Güvenli	Güvenle
11)	Heves	Hevesli	Hevesle
12)	İstek	İstekli	İstekle
13)	Keyif	Keyifli	Keyifle
14)	Şeker	Şekerli	Şekerle
15)	Dikkat	Dikkatli	Dikkatle
16)	Peynir	Peynirli	Peynirle
17)	Sevinç	Sevinçli	Sevinçle
18)	Şiddet	Şiddetli	Şiddetle
19)	Acı	Acılı	Acıyla
20)	Hızlı	Hızlı	Hızla
21)	Karlı	Karlı	Karla
22)	Yağlı	Yağlı	Yağla
23)	Yaşlı	Yaşlı	Yaşla
24)	Araç	Araçlı	Araçla

25)	Boya	Boyalı	Boyayla
26)	Işık	Işıklı	Işıkla
27)	Yazı	Yazılı	Yazıyla
28)	Sayı	Sayılı	Sayıyla
29)	Bıçak	Bıçaklı	Bıçakla
30)	Kaygı	Kaygılı	Kaygıyla
31)	Merak	Meraklı	Merakla
32)	Sabır	Sabırlı	Sabırla
33)	Saygı	Saygılı	Saygıyla
34)	Başarı	Başarılı	Başarıyla
35)	Rüzgar	Rüzgarlı	Rüzgarla
36)	Yıldız	Yıldızlı	Yıldızla
37)	Tuz	Tuzlu	Tuzla
38)	Zor	Zorlu	Zorla
39)	Umut	Umutlu	Umutla
40)	Uyku	Uykulu	Uykuyla
41)	Çocuk	Çocuklu	Çocukla
42)	Gurur	Gururlu	Gururla
43)	Huzur	Huzurlu	Huzurla
44)	Korku	Korkulu	Korkuyla

45)	El	Elma	At	Ateş
46)	Yazmak	Yazık	Bal	Balon
47)	Sen	Sene	Ev	Evlat
48)	Sürmek	Süre	Av	Avuç
49)	Bir	Birden	Çekmek	Çekiç
50)	Çam	Çamur	Dev	Devlet
51)	Kan	Kanat	Dik	Dikkat

K. Word Recognition Test (cont.)

52)	Kap	Kapı	Kar	Karpuz	80)	Hak	Hakim	Kuş	Kuşku
53)	Et	Etek	Kıl	Kılıç	81)	Kaş	Kaşık	Sel	Selvi
54)	Tam	Tamir	Bulmak	Bulut	82)	Öz	Özür	Sermek	Sert
55)	Tuz	Tuzak	Gün	Güney	83)	Saz	Sazan	Şu	Şubat
56)	Zar	Zarar	Ad	Adres	84)	Şiş	Şişe	Tur	Turgut
57)	Doğmak	Doğa	Ağ	Ağaç	85)	Beş	Beşik	Un	Unutmak
58)	Sır	Sıra	Demek	Ders	86)	Çay	Çayır	Yemek	Yedek
59)	Takmak	Takım	En	Enerji	87)	Ay	Ayıp	Il	Ilk
60)	Kol	Koli	Hap	Hapis	88)	Ay	Ayna	Bakmak	Baklava
61)	Bitmek	Bitki	İp	Iptal	89)	Batmak	Batı	Ün	Ünlem
62)	Çil	Çilek	İş	Işaret	90)	Binmek	Bina	Kurmak	Kurbağa
63)	Yap(mak)	Yaprak	Itmek	Itiraz	91)	Boy	Boya	Kutu	Kutup
64)	Düş(mek)	Düşman	Kaymak	Kayıt	92)	Dam	Damla	Orta	Ortak
65)	Yük	Yüksek	Kül	Kültür	93)	Göz	Gözleme	Sal	Salata
66)	Far	Fare	Masa	Masal	94)	Az	Azim	Sol	Solucan
67)	Tek	Tekme	Ot	Otobüs	95)	Naz	Nazik	Top	Toplantı
68)	Bel	Bela	Sos	Sosis	96)	Sağ	Sağır	Av	Avuç
69)	Boğmak	Boğa	Tel	Telefon	97)	Su	Suna	El	Elif
70)	Kir	Kira	Kaba	Kabak	98)	Top	Toplu	Ok	Okul
71)	Cam	Cami	Kutu	Kutup	99)	Üzmek	Üzüm	Kas	Kasap
72)	Sarmak	Sarı	Pil	Pilav	100)	Konmak	Konuk	Akmak	Akıl
73)	Tok	Toka	Silmek	Silah	101)	Yakmak	Yaka	Kar	Kardeş
74)	Çan	Çanta	Ter	Ters	102)	Kalmak	Kalın	Demek	Dert
75)	Fil	Film	Yan	Yanıt	103)	Kar	Kare	Konmak	Kontrol
76)	Dün	Dünya	Dağ	Dağınık	104)	Düşmek	Düşman	At	Ateş
77)	Dam	Damar	Kol	Koltuk	105)	Kızmak	Kızak	Ağ	Ağır
78)	Dem	Demir	Kel	Kelebek	106)	Bal	Balık	Fal	Falan
79)	Er	Erken	Kırmak	Kırmızı	107)	Ol(mak)	Olta	Fil	Filan

L. Word Association Test

İsim:
Sınıf: 2- ......

Aşağıdaki kelimeleri okuyunca, aklınıza ilk gelen kelimeyi karşısına yazınız. **Parantez** içinde kelime varsa, bu kelimeler **yasak**, bunları **yazmayın**.

Örnek: Göz: Kirpik
(**Gözlük** yazma)

* Burada **gözlük** yazma dediği için, gözlük yazamayız.

1) Hasta : ....
(**Hastane** yazma)
2) Çürük : ....
(**Çürümüş** yazma)
3) Tavuk : ....
4) Biber : ....
(**Biberli** yazma)
5) Kanat : ....
6) Yağmur : ....
(**Yağış** yazma)
7) Kalem : ....
(**Kalemtraş** yazma)
8) Soğuk : ....
9) Bardak : ....
10) Saç : ....
(**Saçlı**, **saçsız** yazma)
11) Cesur : ....
12) Ayran : ....
13) Peynir : ....
14) Orman : ....
15) Tahta : ....
16) Çorap : ....
17) Emzik : ....
18) Yıldız : ....
(**Yıldızlı**, **yıldızsız** yazma)
19) Defter : ....
20) Çanta : ....
21) Makas : ....
22) İnek : ....
23) Toprak : ....
24) Patates : ....
25) Soru : ....
(**Sorun** yazma)
26) Dakika : ....
27) Telefon : ....
28) Şapka : ....
(**Şapkalı** yazma)
29) Müzik : ....
30) Tırnak : ....
31) Bıyık : ....
32) Köy : ....
(**Köylü** yazma)
33) Kuyruk : ....
34) Sivri : ....
35) Eski : ....
(**Eskimiş** yazma)
36) Kolay : ....
37) Kedi : ....
38) Doğu : ....
39) Damat : ....
40) Yastık : ....
41) Futbol : ....
(**Futbolcu** yazma)
42) Sıkıcı : ....
43) Sınıf : ....
44) Bayrak : ....
45) Bilet : ....
46) Çatı : ....
47) Limon : ....
48) Araba : ....
49) Balık : ....
50) Sevgi : ....
51) Masa : ....
52) Kaşık : ....
53) Çay : ....
(**Çaydanlık**, **çaycı** yazma)
54) Fındık : ....
55) Yüzük : ....
56) Uçak : ....
(**Uçmak** yazma)
57) Siyah : ....
58) Tavşan : ....
59) Sıcak : ....
60) Zürafa : ....
61) Arı : ....

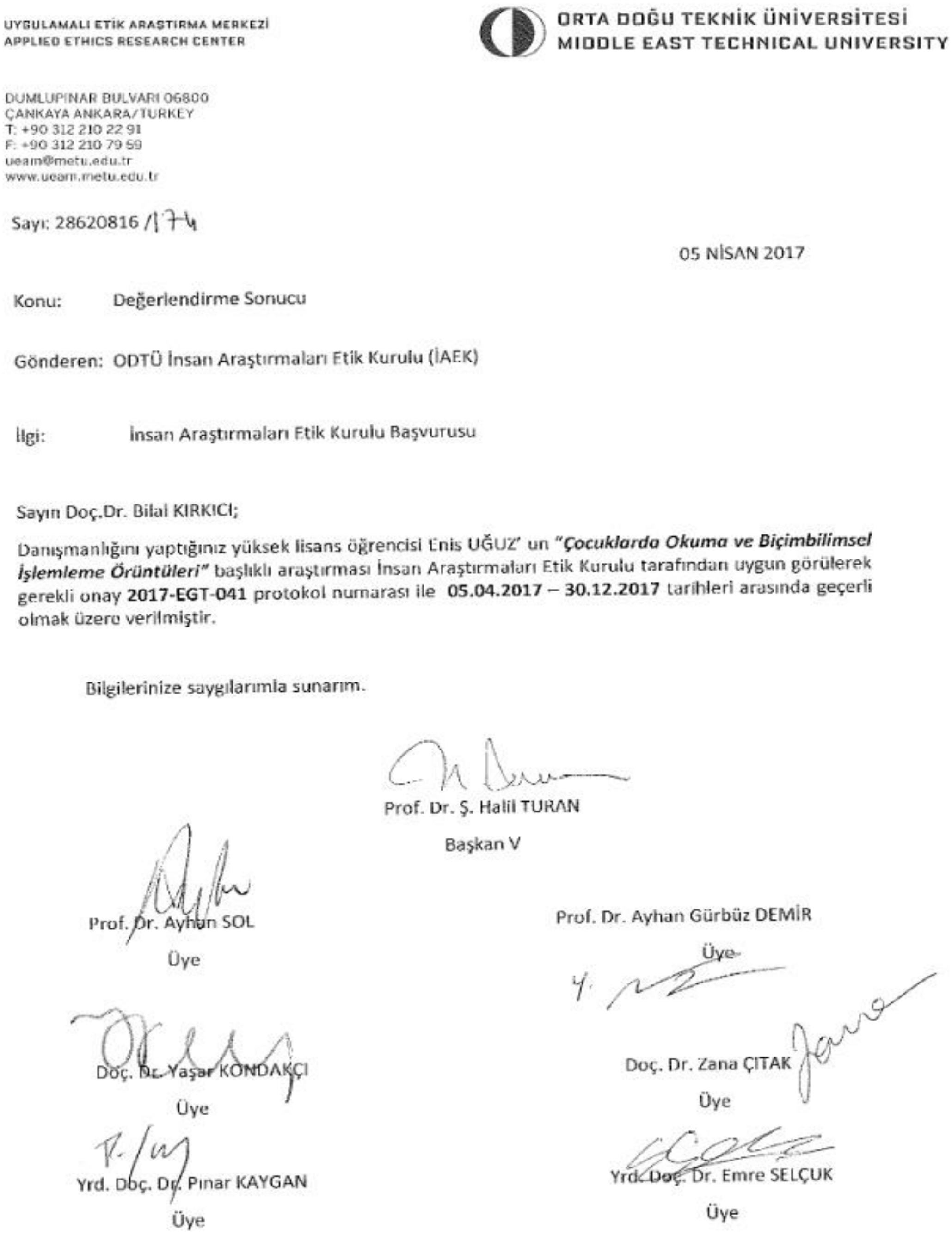
M. Trial Items Recognition Test

İsim: Sınıf: Test Listesi: Tarih:

Deneme esnasında aşağıdaki kelimelerden hangilerini gördünüz? Yanlarına çarpı atınız.

Söğüt……… Kartal……… Gömlek……… Çatal……… Yağmur………
Bahçe……… Tava……… Yeşil………
Bardak……… Zeki……… Enginar……… Kuru……… Tatlı………
Geniş……… Tren………

N. Ethics Committee Approval



UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
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05 NİSAN 2017

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Doç.Dr. Bilal KIRKICI;

Danışmanlığını yaptığınız yüksek lisans öğrencisi Enis UĞUZ' un "*Çocuklarda Okuma ve Biçimbilimsel İşlemleme Örüntüleri*" başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2017-EGT-041** protokol numarası ile **05.04.2017 – 30.12.2017** tarihleri arasında geçerli olmak üzere verilmiştir.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Ş. Halil TURAN
Başkan V

Prof. Dr. Ayhan SOL
Üye

Prof. Dr. Ayhan Gürbüz DEMİR
Üye

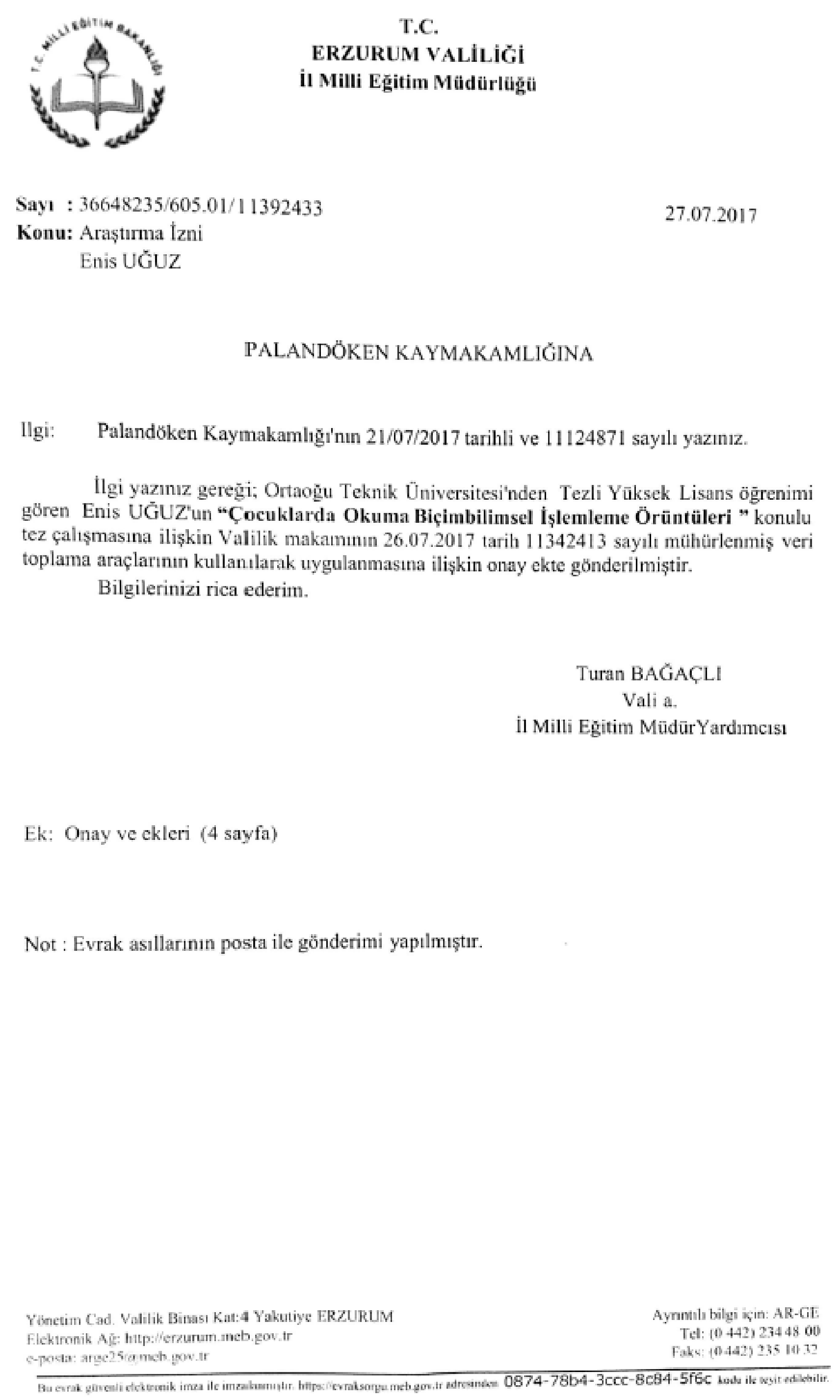
Doç. Dr. Yaşar KONDAKÇI
Üye

Doç. Dr. Zana ÇITAK
Üye

Yrd. Doç. Dr. Pınar KAYGAN
Üye

Yrd. Doç. Dr. Emre SELÇUK
Üye

P. The Provincial Directorate for National Education Approval



T.C.
ERZURUM VALİLİĞİ
İl Milli Eğitim Müdürlüğü

Sayı : 36648235/605.01/11392433 27.07.2017
Konu: Araştırma İzni
Enis UĞUZ

PALANDÖKEN KAYMAKAMLIĞINA

İlgi: Palandöken Kaymakamlığı'nın 21/07/2017 tarihli ve 11124871 sayılı yazınız.

İlgi yazınız gereği; Ortaoğu Teknik Üniversitesi'nden Tezli Yüksek Lisans öğrenimi gören Enis UĞUZ'un **"Çocuklarda Okuma Biçimbilimsel İşlemleme Örüntüleri "** konulu tez çalışmasına ilişkin Valilik makamının 26.07.2017 tarih 11342413 sayılı mühürlenmiş veri toplama araçlarının kullanılarak uygulanmasına ilişkin onay ekte gönderilmiştir.

Bilgilerinizi rica ederim.

Turan BAĞAÇLI
Vali a.
İl Milli Eğitim MüdürYardımcısı

Ek: Onay ve ekleri (4 sayfa)

Not : Evrak asıllarının posta ile gönderimi yapılmıştır.

Yönetim Cad. Valilik Binası Kat:4 Yakutiye ERZURUM
Elektronik Ağ: http://erzurum.meb.gov.tr
e-posta: arge25@meb.gov.tr

Ayrıntılı bilgi için: AR-GE
Tel: (0 442) 234 48 00
Faks: (0 442) 235 10 32

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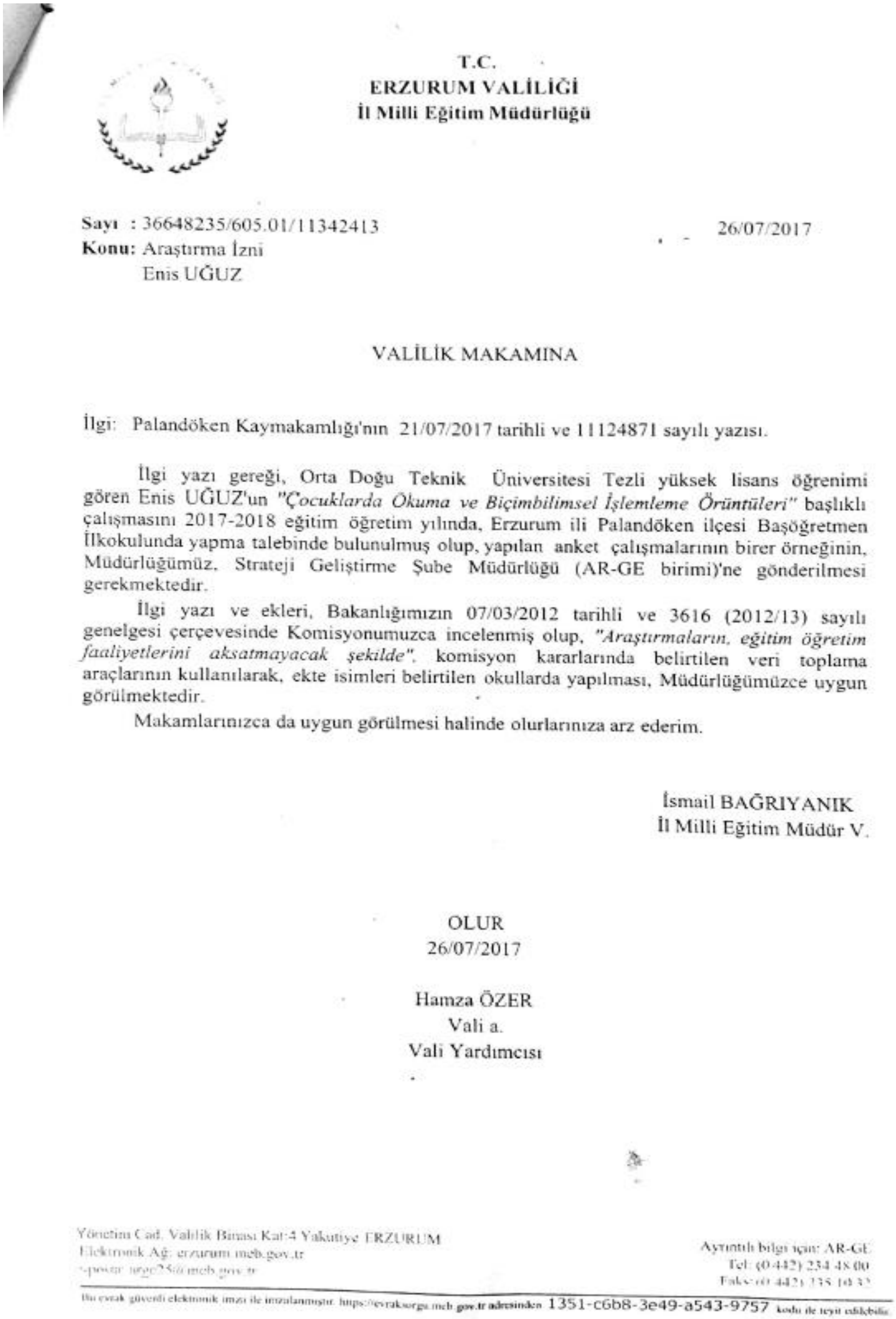
P. The Provincial Directorate for National Education Approval (cont.)



T.C.
ERZURUM VALİLİĞİ
İl Milli Eğitim Müdürlüğü

Sayı : 36648235/605.01/11342413 26/07/2017
Konu: Araştırma İzni
Enis UĞUZ

VALİLİK MAKAMINA

İlgi: Palandöken Kaymakamlığı'nın 21/07/2017 tarihli ve 11124871 sayılı yazısı.

İlgi yazı gereği, Orta Doğu Teknik Üniversitesi Tezli yüksek lisans öğrenimi gören Enis UĞUZ'un *"Çocuklarda Okuma ve Biçimbilimsel İşlemleme Örüntüleri"* başlıklı çalışmasını 2017-2018 eğitim öğretim yılında, Erzurum ili Palandöken ilçesi Başöğretmen İlkokulunda yapma talebinde bulunulmuş olup, yapılan anket çalışmalarının birer örneğinin, Müdürlüğümüz, Strateji Geliştirme Şube Müdürlüğü (AR-GE birimi)'ne gönderilmesi gerekmektedir.

İlgi yazı ve ekleri, Bakanlığımızın 07/03/2012 tarihli ve 3616 (2012/13) sayılı genelgesi çerçevesinde Komisyonumuzca incelenmiş olup, *"Araştırmaların, eğitim öğretim faaliyetlerini aksatmayacak şekilde"*, komisyon kararlarında belirtilen veri toplama araçlarının kullanılarak, ekte isimleri belirtilen okullarda yapılması, Müdürlüğümüzce uygun görülmektedir.

Makamlarınızca da uygun görülmesi halinde olurlarınıza arz ederim.

İsmail BAĞRIYANIK
İl Milli Eğitim Müdür V.

OLUR
26/07/2017

Hamza ÖZER
Vali a.
Vali Yardımcısı

Yönetim Cad. Valilik Binası Kat:4 Yakutiye ERZURUM
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Q. Parent Consent Form

Veli Onay Mektubu

Sayın Veliler, Sevgili Anne-Babalar,

Orta Doğu Teknik Üniversitesi İngiliz Dili Eğitimi Bölümü lisansüstü öğrencisi olarak yüksek lisans tezim kapsamında “İlkokul ve ortaokul öğrencilerinin okuma gelişimleri nasıl ilerliyor?” başlıklı araştırma projesini yürütmekteyim.

Bu çalışmanın amacı nedir? Bu çalışma ilkokul öğrencilerinin okuma gelişimlerini nicel bir araştırma kapsamında deneysel metod kullanarak detaylı bir şekilde incelemeyi amaçlamaktadır. Çalışmada “Türk öğrencilerinin okuma gelişiminde geçtikleri süreçler nelerdir ve bunlar diğer diller ile yapılan çalışmalar ile karşılaştırıldığında ne gibi benzerlikler ve farklılıklar göstermektedir?" sorularına cevap verilmeye çalışılacakdır. Hem üniversitenin etik kurulundan, hem de Erzurum İl Milli Eğitim Müdürlüğünden tüm izinler alınmıştır.

Sizin ve çocuğunuzun katılımcı olarak ne yapmasını istiyoruz? Çalışmanın amacını gerçekleştirebilmek için çocuğunuz sınıf arkadaşlarıyla bir sözcük testi ve bir imla bilgisi testi çözecektir. Daha sonra tek başına yaklaşık 40 dakika sürecek bir bilgisayar testi tamamlayacaktır. Bu kısa test süresince çocuğunuz yalnızca ekranda çıkan sözcüklere “Doğru” veya “Yanlış” cevaplarından birini verecektir. Katılmasına izin verdiğiniz takdirde çocuğunuz okulumuzda uygun bir odada derslerini etkilemeyecek bir saat belirlenerek okul saatleri içinde testi çözecektir. İsterseniz izleyici olarak siz de çocuğunuzu kontrol edebilirsiniz ya da gelme imkanınız yoksa isterseniz çocuğunuzun bilgisayar testini çözerken bir videosu alınıp size ulaştırılabilir. Bu sayede eğer şüpheniz varsa, çocuğunuzun olumsuz hiçbir şey ile karşılaşmayacağından emin olabilirsiniz. Sizden çocuğunuzun katılımcı olmasıyla ilgili izin istediğimiz gibi, çalışmaya başlamadan çocuğunuzdan da sözlü olarak katılımıyla ilgili rızası mutlaka alınacak. Zarf içinde gönderilecek formu, sizin ve eşinizin birlikte doldurması gerekmektedir.

Çocuğunuzdan alınan bilgiler ne amaçla ve nasıl kullanılacak? Çocuğunuzla yapılacak test sonuçları şifreli bir bilgisayarda tutulacak ve katılımcının kimliği gizli tutulacaktır. Çocuğunuzun ismi ve kimlik bilgileri, hiçbir şekilde kimseyle paylaşılmayacaktır. Çalışmada çocuğunuzun ismi, sınıfı, okulu, ve hatta şehri bile hiçbir şekilde belirtilmeyecek ve gizli kalcaktır. Bu çalışmanın amacı hiçbir şekilde başarı ölçmek değildir; değişik sözcük türlerinin nasıl işlendiği araştırılmaktadır. Bu yüzden çocuğunuzun düşük performans göstermesinden korkmanıza gerek yoktur, tek tek çocukların başarısı yerine yaş gruplarının değişik kelimeleri işleme süresi incelenecektir. Araştırma sonuçlarının özeti tarafımızdan okula ve size ulaştırılacaktır. Dolduracağınız bu formla birlikte çocuğunuzun bize sağlayacağı bilgiler, ilkokul öğrencilerinin okuma gelişimlerinin anlaşılmasına önemli bir katkıda bulunacaktır.

Çocuğunuz ya da siz çalışmayı yarıda kesmek isterseniz ne yapmalısınız? Çocuğunuzun cevaplayacağı soruların onun psikolojik gelişimine olumsuz etkisi olmayacağından emin olabilirsiniz. Yine de, bu formu imzaladıktan sonra hem siz hem de çocuğunuz katılımcılıktan ayrılma hakkına sahipsiniz. Katılım sırasında herhangi bir nedenden ötürü çocuğunuz kendisini rahatsız hissettiğini belirtirse, ya da kendi belirtmese de araştırmacı çocuğun rahatsız olduğunu öngörürse, bilgisayar testine tamamlanmadan ve derhal son verilecektir. Şayet siz çocuğunuzun rahatsız olduğunu hissederseniz, böyle bir durumda çalışmadan sorumlu kişiye çocuğunuzun çalışmadan ayrılmasını istediğinizi söylemeniz yeterli olacaktır.

Bu çalışmayla ilgili daha fazla bilgi almak isterseniz: Araştırmayla ilgili sorularınızı aşağıdaki e-posta adresini kullanarak yada telefon numarasından bana yöneltebilirsiniz.

Saygılarımızla,

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Lütfen bu araştırmaya katılmak konusundaki tercihinizi aşağıdaki seçeneklerden size en uygun gelenin altına imzanızı atarak belirtiniz ve bu formu çocuğunuzla okula geri gönderiniz.

A) Bu araştırmaya tamamen gönüllü olarak katılıyorum ve çocuğum ....’nın da katılımcı olmasına izin veriyorum. Çalışmayı istediğim zaman yarıda kesip bırakabileceğimi biliyorum ve verdiğim bilgilerin bilimsel amaçlı olarak kullanılmasını kabul ediyorum.

Baba Adı-Soyadı................................. Anne Adı-Soyadı.....................................

İmza .... İmza ....

B) Bu çalışmaya katılmayı kabul etmiyorum ve çocuğum ....’nın da katılımcı olmasına izin vermiyorum.

Baba Adı-Soyadı................................. Anne Adı-Soyadı.....................................

İmza .... İmza ....

R. Turkish Summary / Türkçe Özet

Giriş

Dilin kökeni ile ilgili tartışmalar uzun süredir devam etse de (Wind, Chiarelli, Bichakjian, Nocentini & Jonker, 2013), insanların yüzlerce sözcüğü bir dakikada konuşabildiği ve aynı hızla aynı miktarda sözcük algılayabildikleri aşikardır. Benzer şekilde, insanlar yüksek hızlarda okuyabilirler. Bu hergün kullanılan iletişim yolunu açıklamak kolay değildir ve birçok farklı görüş, sav, ve itirazın oluşmasına sebebiyet vermiştir.

Kendi aralarında farkılıkları olmakla beraber, ikili mekanizma görüşleri (dual-mechanism views) sözcük işlemlemede en az iki mekanizma olduğunu savunur. Bu mekanizmalardan bir tanesi biçimbilimsel açıdan karmaşık kelimeleri ekleri ve köklerine ayırır, bu bileşenlerin ayrı ayrı anlamlarına ulaşır, ve kelimenin bütün anlamını çıkarır. Bu sayede tüm biçimbilimsel açıdan karmaşık kelimeleri bütün halde zihinsel sözlükte tutmaya gerek yoktur. İkili mekanizma görüşleri arasında tüm biçimbilimsel açıdan karmaşık kelimelerin ayrıştırılıp ayrıştırılmadığı konusunda ortak bir görüş yoktur; genellikle, karşılaşma sıklığı gibi etkenlerin bir kelimenin bütün halde mi saklanacağı yoksa ayrıştırılacağı mı konusunda etkili olduğu öne sürülür (ör. Xu & Taft, 2015). Bu ayrıştırma örüntülerine etki ettiği düşünülen bir diğer konu ise kelimenin yapım ya da çekim eki almış olmasıdır. Dağıtılmış Biçimbilim görüşüne göre (Harley & Noyer, 1998) yapım ve çekim eki almış sözcükler arasında keskin bir ayrım yoktur. Gerçekleştirme-tabanlı Biçimbilim görüşü ise (Spencer, 2016) yapım ve çekim eklerinin farklı şekillerde işlemlendiğini savunur.

Tek mekanizma görüşleri (single mechanism views) ise sözcük işlemleden sorumlu tek bir mekanizma olduğunu öne sürer. Bu görüşün eklerin ayrıştırdığını tamamen reddettiğini söylemek yanlış olur, kurala dayalı modeller (ör. Taft &Forster, 1975) tek bir mekanizmanın aynı zamanda biçimbilimsel açıdan karmaşık kelimelerdeki ekleri ayrıştırdığını da savunur. Tek mekanizma görüşünü savunan çağrışımcı modeller ise (ör. Seindenberg & McClelland, 1989) biçimbilimsel açıdan karmaşık olan ve basit olan sözcükler arasında işlemle arasında bir fark olmadığını savunur; tüm sözcükler insan beyninde bütün olarak temsil edilir.

Sözcük işlemleme ile ilgili önemli konulardan bir tanesi de okuma edinimidir. Bu konuda çok farklı görüş ve kuramlar olmakla beraber, mevcut çalışmada 3 tanesi ayrıntılı olarak incelenmiştir. Ehri (1991, 2005) oluşturduğu görüş okuma modelinde (sight reading model) insanların okuma edinimi sırasında sesler ve harfler arasında bağlantı kurduğunu söylemiştir (phonological recoding); bu bağlantılar oluşturulup okuma tecrübesi arttıkça sözcükler direk görüldüğü anda okunabilecektir. Bu görüş anında okumanın temelinde nispeten küçük birimler olan sesbirim-yazıbirim bağlantılarının (grapheme-phoneme correspondances) hece, biçimbirim, sözcük (syllable, morpheme, word) gibi daha büyük bağlantılara yerini bırakmasıdır. Ehri (1991) yetişkin okumada uzun, az rastlanılan, ya da bilinmeyen/var olmayan kelimelerin başka yöntemlerle okunabilme ihtimali olsa da, okumanın genelinde çok büyük oranda ilk görüşte okuma kullanıldığını savunmuştur. Derin yazıma sahip (deep orthographic) olan dillerle derin yazıma sahip olmayan (shallow orthographic) diller arasında çok fazla bir fark yoktur; önemli tek fark derin yazıma sahip dillerde yazıbirim ve sesbirimler arasındaki bağlantılar oluşturulurken bazı sembollerin bağlantılara dahil edilmemesidir (*Listen* kelimesinde *t* harfi bağlantılara dahil edilmez).

Benzer bir teori olan Psikodilbilimsel Tane Büyüklüğü Teorisi (Psyholinguistic Grain Size Theory) (Ziegler ve Goswami, 2005) temelinde yine sesbilimsel yeniden-kodlama ve sesbirim–yazıbirim bağlantıları vardır. Teoride sesbirim-yazbirim bağlantıları yetişkin okumada bir önceki modelde olduğu gibi önemli bir yere sahiptir. Bu teoriye göre insanların okumayı edinebilmesi için üç problemi çözmeleri gereklidir. İlk problem, ulaşılabilirlik (availability), sesbirim gibi çok küçük sesbilimsel birimlerin en azından biraz okuma edinilmeden ulaşılamamasıdır. İkinci problem, tutarlılık (consistency), bir sesbirimin birden fazla harf ile sembolize edilmesi (digraph) ya da bir sesbirimin birden fazla sesbirimciği (phone) temsil etmesi gibi durumlarda oluşan zorluklardır. Son problem, öğe boyu (granularity), dilin yazımsal derinliği ile ilişkilidir. Sesbilimsel sistemi nispeten daha büyük öğe boyları (hece, hece başlangıcı, biçimbirim gibi) üzerine kurulu dillerde öğrenilmesi gereken yazımsal öğeler, sesbilimsel sistemi daha küçük (sesbirim gibi) olan dillerde öğrenilmesi gereken yazımsal öğelerden çok daha fazladır. Bu üç problemin üstesinden gelen kişiler okuma edinimini gerçekleştirir.

Grainger ver Ziegler'in ikili-yol modeli (2011) her ne kadar sesbilimsel yeniden kodlama konusunda önceki iki teori ile benzerlik gösterse de, hem okuma ediniminde hem de yetişkin okumada büyük farklılıklar iddia eder. Bu modelde okuma edinimine başlayan kişiler öncelikle bir harf-ses eşleştirme yöntemi (phonological recoding) izlerler. Bu yöntem Ehri (2001, 2005) ve PGST ile benzeşmektedir; ancak, önemli olan fark, okuma yeteneği geliştikçe bu yöntem tamamen terkedilerek sözcükler iki yeni yol ile okunur. Bu iki yolun kullanılma şekli harf birleşimleri (letter combinations) karşılaşma sıklıkları ile alakalıdır. Eğer sözcük karşılaşma sıklığı nadir bir harf birleşimi barındırıyorsa (Bu birleşimin ardışık olmasına gerek yoktur, araya harfler girebilir), bu az rastlanırlık kelimenin belirlenmesini kolaylaştırır; mevcut aday sözcükler az rastlanır harf birleşimi sayesinde sınırlıdır. Bu tip sözcükler, iri-taneli yol (coarse-grained route) kullanımı denilen yolun gelişmesini ve kullanılmasını sağlar. Her ne kadar diğer yol da harf birleşimi karşılaşma sıklığı ile yakın bir ilişki içerisinde olsa da, bu sıklığının etkisi tamamen farklıdır. Ardışık olan ve bu defa sık karşılaşılan harf birleşimleri (biçimbirimler gibi) bu yol tarafından hızlı bir şekilde tanımlanır ve kelimenin işlenmesine yardımcı olur. Bu yola ince-taneli yol (fine-grained route) adı verilir.

Okuma ediniminden sonra kelimelerin nasıl işlendiği ile ilgili kesin bir sonuca varılamamıştır. Biçimsel işlemleri tanımlamak için kurgulanan görüşlerin tek mekanizma görüşü ve ikili mekanizma görüşü olarak iki gruba ayrıldığı daha önce belirtilmişti. Tek mekanizma görüşleri, özellikle son yıllarda yapılan çalışmalar ile eleştirilmiştir ve genel kabulde ikili mekanizma görüşlerinin gerisinde kalmıştır. Örneğin, tek mekanizma görüşünün ses getiren modellerinden birinin sahibi Taft, sonradan ikili mekanizma ihtimalini kabul etmiş ve modelini güncellemiştir (Taft, 2003, 2004).

Sözcük işlemlenin erken aşamaları ile ilgili daha kapsamlı bir anlayış elde etmek için deneysel çalışmalara bakmak faydalı olacaktır. Mevcut çalışma ilkokul çocuklarına odaklansa da, hem yetişkinlerle hem de çocuklarla yapılan çalışmaları incelemek konu üzerinde kapsamlı bir incelemeye olanak verecek ve farklı yaş gruplarındaki çalışmalar karşılaştırılarak muhtemel gelişimsel örüntülerin görülmesine olanak verecektir.

Yetişkinlerde sözcük işleme çalışmalarında en çok tartışılan konulardan biri sözcük işlemenin ilk aşamalarında anlamsal şeffaflığın (semantic transparency) etkisidir. Rastle vd. (2004) anlamsal şeffaflığın bir etkisi olup olmadığını bir maskeli hazırlama deneyi ile test etmiştir. Deneydeki hazırlama etkisi reddedilemez olmasına karşın, anlamsal şeffaflık bir fark oluşturmamıştır ve araştırmacılar biçimbirimsel işlemlemede anlamsal şeffaflığın bir etkisi olmadığı sonucuna varmışlardır. Başka bir çalışmada McCormick vd. (2008) yine anlamsal şeffaflık etkisinin incelendiği 4 deney yapmışlardır. Anlamsal şeffaflığın etkisi tekrar gözlenememek ile birlikte, türetilme sırasında değişikliğe uğrayan sözcükler (adorable, writer, metallic gibi) hazırlık etkisi göstermişlerdir. İlginç bir diğer bulgu ise gerçekten ek almamış sahte ekli kelimelerin bile bu tür değişikliklere rağmen hazırlama etkisi göstermesidir (fete-fetish gibi). Bu bulgu, sözcüksel-öncesi yazımsal eksik belirtme olayının (pre-lexical orthographic underspecification phenomena) geçmiş yazımsal gövde değişimi tecrübelerine dayanmadığı konusunda bir kanıt olarak algılanmıştır. Geniş bir literatür derlemesinde, Rastle ve Davis (2008) 19 tane maskelenmiş hazırlama tekniği kullanılan çalışmayı incelemiştir. Çalışmalar 60 ms maske gösterme süresi ya da daha altındadır. Sonuçların genel olarak önce-biçim görüşünü desteklediği iddia edilmiştir. Bu noktada önce-biçim (form-first) görüşü ve anlamsal-şeffalık etkisi ilişkisi ile ilgili bir hatırlatma yapmakta fayda var. Önce-biçim görüşleri, anlsamsal-şeffaflığın sözcük işlemlede bir etkisi olmadığını savunmaz; sadece sözcük işlemenin ilk aşamalarının yanlızca biçime dayalı olduğunu iddia ederler.

Önce-biçim temelli sözcük işleme Feldman vd. (2009, 2012, 2015) tarafından eleştirilmiştir. Öncelikle Feldman vd. (2009) 18 tane maskelenmiş hazırlama tekniği kullanılan çalışmayı incelemiştir. Feldman vd. (2009) bu çalışmalarda anlamsal şeffaflığı olan ve anlamsal şeffaflığı olmayan sözcük grupları arasındaki istatiksel olmayan (non-significant) farkların sözcük işlemenin ilk aşamalarında anlamsal şeffaflığın etkisi olmadığı yönündeki yorumları eleştirmiştir. Rastle ve Davis'in (2008) niteliksel analizine karşı, niceliksel bir metod kullanarak söz konusu 18 araştırmayı incelemiş ve istatiksel (significant) bir anlamsal şeffaflık etkisi bulmuşlardır. Feldman vd. (2009) önceki çalışmalarda farklı ek kullanımının ve dolgu öğelerinin alaka derecelerinin (filler item relatedness degree) anlamsal şeffaflığı olan ve anlamsal şeffaflığı olmayan sözcük grupları arasında istatiksel (significant) bir fark bulunmasının önüne geçme ihtimalinin altını çizmiştir.

Sözcük işlemlemenin erken aşamaları ile ilgili bir diğer tartışma konusu kişisel farklılıkların bu aşamalara nasıl etki ettiğidir. Andrews ve Lo'nun (2013) meşhur çalışmasında sözcük işlemlemede iki farklı belginin değişik sözcük işlemleme örüntülerinden bahsedilmiştir. Söz konusu çalışmada, katılımcılardan sözcük yetenekleri imla yeteneklerinden daha iyi olanlardan bir *anlamsal belgi grubu*, imla yetenekleri sözcük yeteneklerinden daha iyi olanlardan ise bir *yazımsal belgi grubu* oluşturulmuştur. Çalışmada anlamsal belgi grubundaki katılımcılar gerçek ekli hazırlayıcılara daha fazla hazırlama etkisi gösterirken, yazımsal belgi grubundaki katılımcılar ise hem gerçek ekli hazırlayıcılara hem de sahte ekli hazırlayıcılara eşit hazırlama etkisi göstermişlerdir. Feldman vd. (2015) ise kişisel farklılıkların sözcük işlemlemenin erken aşamalarında istatiksel bir etki göstermediği sonucuna varmışlardır.

Çocuklar ile farklı dillerde yapılan çalışmalar farklı bulgular elde etmiştir. İngilizcede yapılan çalışma (Beyersmann vd., 2012) sahte ekli hazırlayıcılar için hazırlama etkisi bulamazken, Fransızcada yapılan çalışmalar ve Felmenkçede yapılan çalışmalar (Casalis vd., 2009; Quémart vd., 2011; Zeguers vd., 2014) erken yaşlardan itibaren sahte ekli olan hazırlayıcılarda da düşük hazırlayıcı sürelerinde hazırlama etkilerini göstermişlerdir. Beyersmann vd. (2012) çalışması yetişkin katılımcıları da içerdiğinden ve çocukların aksine yetişkinler bu çalışmada sahte ekli hazırlayıcılar için hazırlama etkisi gösterdiğinden, söz konusu çalışmanın İngilizcede muhtemel bir gelişimsel örüntüye işaret ettiği düşünülebilir. Bu diller-arası farklılıkları Türkçe ile karşılaştırmak mevcut literatürde çocuklar ile yapılan bir çalışma olmadığından mümkün değildir.

Türkçede yapılan çalışmalar yetişkinlerde anlamsal şeffaflığın etkisini net bir şekilde ortaya koymuştur (Gacan, 2014; Kırkıcı & Clashsen, 2013; Şafak, 2015). Çocuklarla yapılan maskelenmiş hazırlama deneyleri Türkçede mevcut olmadığından Türkçe anadiline sahip çocukların sözcük işlemlemesinde anlamsal şeffaflığın etkisi bilinmemektedir.

Alanyazında süregelen bir diğer tartışma ise yapım ve çekim eklerinin edinimde ve işlemlemedeki farklarıdır. Kimi görüşler yapım ve çekim eklerini kesin bir çizgi ile ayırırken (referans), başka görüşler bu ekleri ayırmamışlardır (referans). Kırkıcı ve Clashsen (2013) yaptıkları çalışmada Türkçe anadiline sahip yetişkinlerin sözcük işlemlemesinde (en azından erken aşamalarda) yapım ve çekim ekleri arasında bir fark bulamamışlardır. Yine bu konu ile ilgili Türkçe'de çocuklarla maskelenmiş hazırlama deneyi kullanılarak yapılan bir çalışma bulunmamaktadır.

Çalışmanın Amacı ve Önemi

Bu çalışma ruhdilbilim alanında onyıllardır tartışılmakta olan sözcük işlemedeki biçimbirimsel örüntüleri ve bunların doğasını çocuklarda incelemiştir. Söz konusu inceleme, sözcük işlemlemenin erken aşamalarında biçimbirimsel, yazımsal, ve anlamsal bilgilerin nasıl kullanıldığı hakkında önemli bilgiler sunmuş, çocuklar ile elde edilecek bilgiler Türkçe için bir ilk olacak ve uluslararası literatürde çok çalışılmayan bir alana hem genel sözcük işleme bakımından, hem de diller arası farklılıklar bakımından katkılar yapmıştır.

Ayrıca 2. ve 4. Sınıf çocuklarından elde edilecek sözcük işlemleme örüntüleri ile bilgiler, okuma edinimi konusunda da varsayımlar yapılmasına olanak sağlayabilecektir. Derin olmayan yazımı ile 1 sene gibi bir sürede iyi bir şekilde okuma edinimine izin veren Türkçe'nin, bu hızlı ediniminden sonra Grainger ve Ziegler (2011) ikili-yol modelinin ihtimal dahilinde belirtiği gibi ince-taneli yolun etkin bir şekilde kullanılması sözcük işleme örüntüleri incelenerek araştırılacaktır.

Bir diğer mesele olan sözcük işlemedeki bireysel farklılıklar konusunda, mevcut projenin bulgularının şu an deneysel kanıta ihtiyaç duyan Andrews ve Lo'nun (2013) *yazımsal belgi* ve *anlamsal belgi* temelli bireysel farklılıklar modelini desteklemesi, ya da Feldman vd. (2015) bireysel farklılıkların sözcük işlemlemede istatiksel bir etki yapmadığı konusundaki iddiasını güçlendirmesi, ruhdilbilim alanında süregelen tartışmaların gerçeğe bir adım daha yaklaşmasına olanak vermiştir. Kullanıcak sözcük testi ve okuma testi ile katılımcılar arasındaki bireysel farklılıklar ölçülecek, bu sayede çocuklarda bu bireysel farklılıkların okuma işlemeye etkileri konusunda bir inceleme yapılabilmiştir.

Alanyazındaki bir diğer tartışmalı alan olan yapım ve çekim eklerinin işlemlenmesi ile ilgili mevcut çalışma anlamsal şeffaflığı olan sözcük setinde (saydam koşul) aynı hedefler için hem yapım eki almış hazırlayıcılar hem de çekim eki almış hazırlayıcılar kullanmıştır. Kullanılan ekler (-li ve -le ekleri) birbirlerine yazımsal, üretkenlik ve karşılaşma sıklığı olarak çok benzemektedir. Bu sayede yapım ve çekim eki almış kelimelerin işlemlenmesinde sadece türetilme sıfına bağlı bir farklılık olup olmadığı incelenmiştir.

Son olarak hem okuma edinimi hem de okuma işlemleme model ve teorilerinin kabul ettiği, ancak etkileri konusunda ortak bir noktada buluşmadığı diller arası farklılıkların doğası ve etkileri konusunda tartışmaya, Türkçe gibi derin-olmayan yazımsal derinlikte ve çok zengin bir biçimbirim üretkenliğine sahip olan bir dildeki bu çalışma ile göz ardı edilemez değerde katkılar yapacaktır. Çalışma, okuma işleme çalışmalarının daha önce hiç çocuk katılımcılarla yapılmadığı Türkçe dilinin bu konuda sunacağı özgün katkılar yanında, aynı zamanda yine Türkçe anadilli ikinci sınıf ve dördüncü sınıf çocuklarda maskelenmiş hazırlama deneyinin ne kadar uygulanabilir olduğunu konusunda önemli sonuçlar vermiştir. Daha önce yapılan Quémart vd.'nin (2011) çalışmasında ikinci sınıf çocukları için benzer bir deneyin zor olacağı belirtilip, üçüncü sınıf ve üzeri sınıflar çalışmaya dahil edilmiştir. Ancak Flemenk dilinde yapılan Zeguers vd.'nin (2014) çalışmasında ikinci sınıflar da benzer bir deney tasarımına sahip çalışmalara dahil edilmiştir. Türkçe dilinde yapılmış bu çalışma, Türkçe anadilli çocuklarının ikinci sınıfta bile maskelenmiş hazırlama deneylerinde incelenebilir veriler verecek kadar başarılı olduklarını ortaya koymuştur.

Denekler

Çalışmaya Erzurumda bulunan iki ilkokuldan Türkçe anadiline sahip 39 ikinci sınıf öğrencisi (yaş ortalaması: 7.45) ve yine aynı okullardan Türkçe anadiline sahip 37 dördüncü sınıf öğrencisi (yaş ortalaması: 9.36) katılmıştır. Çalışmaya katılan öğrencilerin bilinen herhangi bir öğrenme ve ya dil güçlüğü yoktur.

Çalışmayı ODTÜ Etik Komitesi değerlendirerek uygun görmüştür. Ayrıca Erzurum İl Milli Eğitim Müdürlüğü ve Erzurum Valiliği de çalışmayı inceleyerek gerekli izinleri vermiştir. Katılımcıların 18 yaş altında olması sebebiyle ailelerden yazılı izin alınmıştır. Katılımcılara çalışmayı istedikleri zaman bırakabilecekleri bilgisi de ayrıca verilmiştir. Bu çalışmada katılımcılara herhangi bir ücret ödenmemiştir.

Deneylerde Kullanılan Araçlar

Çalışmada kullanılan araçları iki grupta toplamak mümkündür: katılımcıların bireysel dil yeteneği farklılıklarını ortaya çıkarmak için kullanılan araçlar ve katılımcıların dil işlemleme örüntülerini incelemek için kullanılan maskelenmiş hazırlama deneyi.

1. Bireysel Farklılıkların Tespiti

Çalışmada bireysel farklılıkların etkisinin hazırlama etkileriyle ilişkisi inceleneceğinden, söz konusu farklılıkların tespit edilmesi büyük önem taşımıştır. Andrews ve Lo'nun (2013) *yazımsal belgi* ve *anlamsal belgi* fikrini desteklemek ya da yanlışlamak için, benzer şekilde bir sözcük bilgisi testi ve imla bilgisi testi uygulanmıştır. Sözcük testi ve imla bilgisi testi araştırmacı tarafından hazırlanarak, bir pilot test aracılığıyla güvenirlik değerleri ölçülmüş ve asıl çalışmada kullanılmıştır. Testlerde kullanılacak sözcükler 50 milyon sözcükten oluşan Türk Ulusal Derleminin (Aksan vd., 2002) çocuklar için oluşan kısmından seçilmiştir. Benzer şekilde bir adet okuduğunu anlama ve bir adet okuma hızı testi ile de bireysel farklılıkların detaylı bir şekilde ortaya çıkarılması amaçlanmıştır. Kullanılan tüm testler sınıf kademesi farkı gözetilerek ikinci sınıflar için ayrı, dördündü sınıflar için ayrı oluşturulmuştur.

2. Maskelenmiş Hazırlama Deneyi

Katılımcıların sözcük işlemleme örüntülerini incelemek amacıyla sessiz bir odada bireysel olarak maskelenmiş hazırlama deneyin uygulanmıştır. Maskelenmiş hazırlama testi, sözcüksel karar verme testine çok benzemekle beraber, hedef sözcük ekranda belirmeden kısa bir süreliğine (50 ms civarında) hazırlayıcı bir sözcük vermeyi öngörür. Bu deney amacı hazırlayıcı süresini çok kısa tutarak katılımcıların bilinçli ya da stratejik sözcük işleme yapmasının önüne geçmektir (Forster ve Davis, 1984). Katılımcıların değişik türde hazırlayıcılara mağruz kaldıktan sonra ekranda çıkan hedef kelimenin kendi dillerinde olan bir sözcük olup olmadığına karar vermeleri beklenir.

Sonrasında ise karar verme süreleri ölçülerek, hangi tür hazırlayıcıların ne kadar hazırlama etkisi oluşturduğu ya da oluştaramadığı incelenir. Katılımcıların sürekli aynı cevabı vermeye meyil etmelerini engellemek için olmayan-kelimelerin oluşturulması ve sunulacak deneysel öğelerin yarı-rastgele bir şekilde düzenlenmesi önemlidir. Bu deneyde 4 farklı sözcük seti kullanılmıştır. Anlamsal Koşul sözcük seti, aralarında güçlü anlamsal bağlar bulunan ancak yazımsal ve biçimbilimsel ilişkileri bulunmayan hazırlayıcı ve hedef sözcükler kullanılarak oluşturulmuştur (ör: çatı-EV). Opak Koşul sözcük seti, aralarında anlamsal bir bağ bulunmayan ancak yazımsal ve görünüş itibariyle biçmbilimsel ilişkileri bulunan hazırlayıcı ve hedef sözcükler kullanılarak oluşturulmuştur. Bu sözcük setinde kullanılan hazırlayıcıların ek almamış olmalarına rağmen ek gibi gözüken sonları vardır ve bu sahte ekler ayrıldığında ortaya sözcüğün bütünüyle hiçbir anlamsal ilişkisi olmayan anlamlı bir sözcük çıkmaktadır (ör: bina-BİN). Yapısal Koşul sözcük seti, aralarında yazımsal bir ilişki bulunan ancak biçimbilimsel veya anlamsal bir ilişki bulunmayan hazırlayıcı ve hedef sözcükler kullanılarak oluşturulmuştur. Bu sözcük setindeki hazırlayıcılar, sonları Türkçede var olan bir eke benzerlik göstermeyen sözcükler arasından seçilmiştir (ör: hapis- HAP). Saydam Koşul (gerçek ekli) sözcük seti, aralarında anlamsal, yazımsal ve biçimbilimsel ilişki olan hazırlayıcı ve hedef sözcükler kullanılarak oluşturulmuştur. Bu sözcük setindeki her bir hedef sözcük için, farklı deneysel listelerde yer alan bir yapım eki almış hazırlayıcı ve bir çekim eki almış hazırlayıcı kullanılmıştır (ör: gururlu/gururla-GURUR). Sözcük setlerinin bu özelliklerde seçilmesinin sebebi, sözcük işlemlemede sadece anlamın, ek gibi gözüken ‘sahte’ eklerin, başka bir sözcük gibi duran ‘sahte’ gövdelerin, ve gerçek eklerin çocukların sözcük işlemlemelerine etkisini incelemektir.

Mevcut çalışmada hazırlayıcı süresi 50 ms olarak belirlenmiş ve hedef kelimelerin ekranda 5 saniye kadar kalması düşünülmüştür. Katılımcıların ekranda beliren hazırlayıcının ardından gelecek hedef kelimenin Türkçe’de olup olmadığına karar verip, bunu bir tuş ile belirtmeleri için bu 5 saniye kullanmaları gerekmektedir. Evet/Hayır şeklinde hazırlanmış maskelenmiş hazırlama deneylerinde sözcük belirtilen dilde varsa verilen süre içerisinde ‘Evet’ , eğer yoksa yine belirtilen süre içerisinde ‘Hayır’ tuşuna basmaları gerekir.

Maskelenmiş hazırlama deneyinde kullanılacak sözcük yine Türk Ulusal Derleminin (Aksan vd., 2002) çocuklar için oluşan kısmından alınmış ve farklı türdeki hazırlayıcıların karşılaşma sıklığının yakın olmasına dikkat edilmiştir. Hazırlanan deney tüm yaş grubundaki katılımcılara uygulanmıştır. Elde edilen verilen SPSS programı vasıtasıyla uygulanacak betimsel ve çıkarımsal istatiki analizler ile incelenmiştir. Bağımsız değişkenlerin ve bağımlı değişkenlerin aralarındaki ilişki gelişimsel ve bireysel olarak ele alınmıştır.

Yöntem

Çalışmada katılımcılar önce sözcük testlerini ve imla testlerini çözmüşlerdir. Bu testler ayrı günlerde gruplar halinde katılımcıların sınıflarında uygunlanmış ve her test yaklaşık 40 dakika sürmüştür. Öğrencilere her test için yaklaşık 10 dakika mola verilmiştir. Maskelenmiş hazırlama deneyine katılacak katılımcılar tek başlarına sessiz bir odada test edilmişlerdir. Bu deney her katılımcı için yaklaşık 40 dakika sürmüştür ve her katılımcıya 5 dakikadan az olmamak kaydıyla 3 tane mola verilmiştir. Maskelenmiş hazırlama deneyinden sonra katılımcıya sınıf seviyesine göre seçilmiş bir hikayeden alıntılanmış Türkçe bir metin okutulmuş ve sonrasında bu metinle ilgili 10 adet okuduğunu anlama sorusu sorulmuştur. Okuma hızı ve okuduğunu anlama puanları hazırlama etkisine istatiksel bir etki yapmadıklarından, tartışma kısımlarında detaylı incelenmemiştir.

Genel Sonuçlar

Çalışmada elde edilen bulgular anadili Türkçe olan ilkokul çocuklarının sadece saydam koşulda gerçek bir eke sahip hazırlayıcılar için hazırlama etkisi gösterdiklerini ortaya koymuştur. Diğer koşullarda hazırlama etkisi olmayışı, sadece yazımsal veya sadece anlamsal benzerliğin Türkçe anadiline sahip ilkokul çocuklarının sözcük işlemlemenin erken aşamalarında kolaylaştırıcı bir etki yapmadığı gözlemlenmiştir.

İkinci ve dördüncü sınıfların hata yüzdeleri ve tepki süreleri arasında dördüncü sınıfların üstün olduğu oldukça net olarak bulunsa da, sözcük işlemleme örüntülerinin birbirine oldukça benzer olduğu ortaya çıkmıştır. İki grup da sadece saydam koşulda hazırlama etkisi göstermiştir; ayrıca iki grubunda çekim eki almış ve yapım eki almış hazırlayıcılara verdikleri tepkiler arasında istatiksel bir fark bulunamamıştır. Her ne kadar ikinci sınıflar sadece çekim eki almış hazırlayıcılara istatiksel olarak kolaylaştırıcı bir etki gösterseler de, yapım eki almış hazırlayıcıların da rakamsal olarak kolaştırıcı etkisi net olarak görülmektedir. Bu bakımdan bu sonuçların gelişimsel bir örüntüye işaret ettiği ve ikinci sınıfların sadece çekim eki almış hazırlayıcılar için hazırlama etkisi gösterdikleri gibi kesin bir sonuca ulaşmak mümkün değildir. Mevcut görüş, gelecek çalışmalarda katılımcı sayısının arttırılması, bu rakamsal etkinin istatiksel olarak da görülmesini sağlayacağı yönündedir.

Çalışma aynı zamanda katılımcıların sözcük testi puanlarını ve imla testi puanlarını kullanarak ilkokul çocuklarını iki belgi altında incelemiştir. Sonuçlar *yazımsal belgi* ve *anlamsal belgi* modeli ile ilgili olarak mevcut çalışma sözcük ve imla yeteneklerindeki farklılıkların sözcük işlemleme üzerinde etkisi olduğunu ileri sürmektedir. Yazımsal belgiye sahip katılımcıların işlemsel dil becerilerini daha etkili kullanıp ekleri daha hızlı ayrıştırdığı, anlamsal belgiye sahip katılımcıların ise bildirimsel hafızalarını daha iyi kullanarak sözcüklerin bütünsel anlamlarına daha hızlı ulaştıkları düşünülmektedir. Her ne kadar ikinci sınıflar ve dördüncü sınıflar kendi aralarında belgi gruplarına ayrılacak katılımcı sayılarına sahip olmasalar da, mevcut çalışma ilkokul çocuklarının kişisel sözcük ve imla yeteneklerine bağlı sözcük işlemlemenin erken aşamalarındaki farklılıkları bakımından önemli çıkarımlar sunmuştur. Sonraki çalışmalar aynı sınıf kademeleri içinde belgi grupları oluşturarak bu sınırlılığın önüne geçebilirler.

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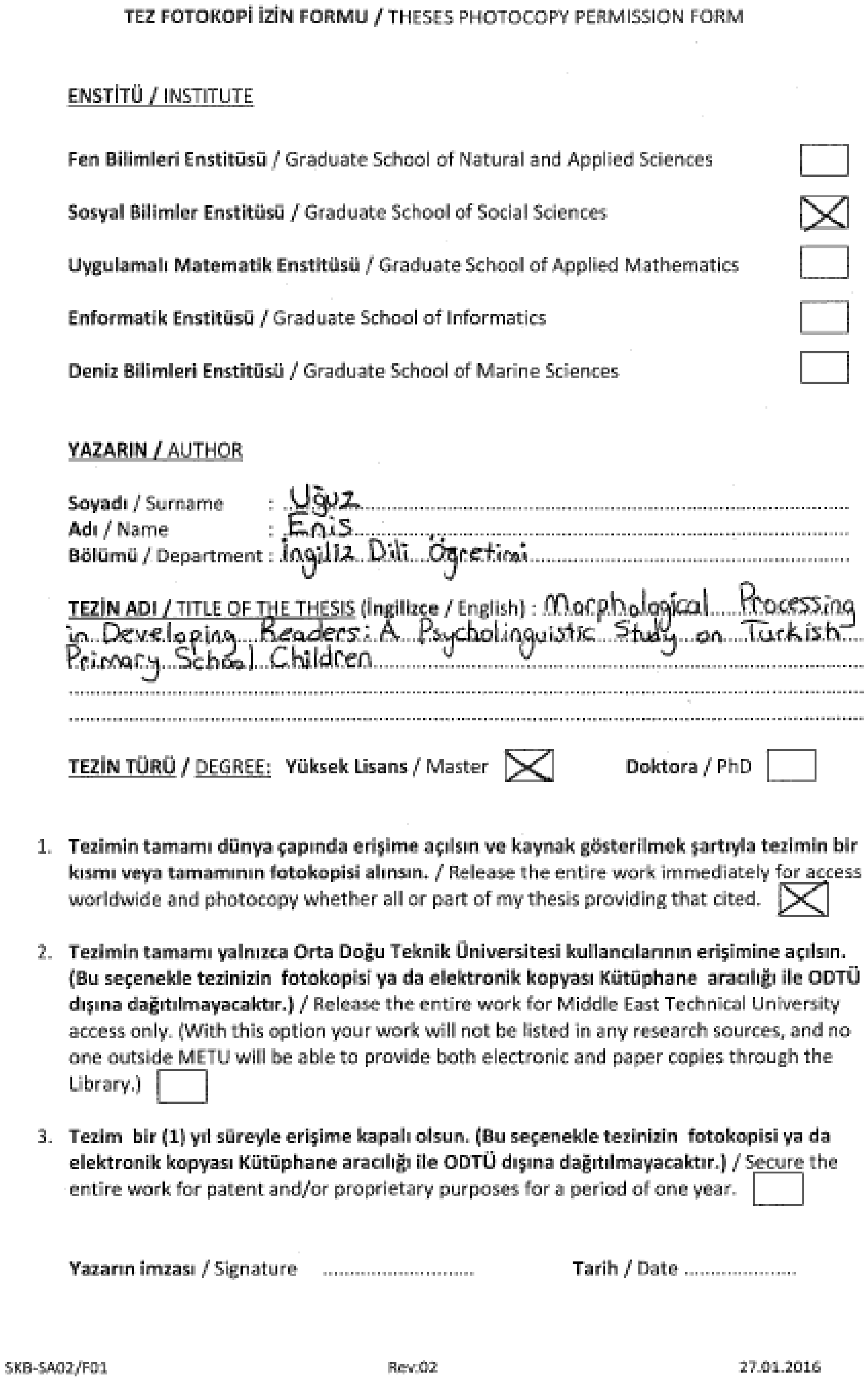

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