AN INVESTIGATION OF SPELLING SKILLS IN TURKISH: THE ROLE OF PHONOLOGICAL ENCODING AND RAPID NAMING IN THE LITERACY SKILLS OF THIRD AND FOURTH GRADERS

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DECLARATION OF ORIGINALITY

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ABSTRACT

An Investigation of Spelling Skills in Turkish: The Role of Phonological Encoding and Rapid Naming in the Literacy Skills of Third and Fourth Graders

The present study investigated the role of phonological encoding (PE) skills and rapid automatized naming (RAN) in predicting reading and spelling achievement of Turkish-speaking children. It compared the underlying processes of spelling with those involved in reading with reference to developmental differences across grade levels and the transparent orthography of Turkish. Besides, it explored variations in the spelling errors found in the students' handwritings in word and text level spelling based on grade levels and task modality (copying vs. dictation). The participants were 77 students attending Grade 3 and Grade 4. A number of literacy tests were used to collect data, and the data were analyzed both quantitatively and qualitatively. Although the fourth graders had similar levels of PE skills with the third graders, they performed significantly better in RAN, word reading and word spelling tests. Regression results showed that RAN was a strong precursor of reading while PE was a significant predictor of spelling in Turkish. Still, RAN made significant contributions to spelling skills beyond PE at both grade levels. In addition, PE significantly contributed to the reading skills of the third graders while it did not account for significant amounts of variance in the reading skills of the fourth graders. As the grade level increased, the effect of phonological knowledge tended to decrease whereas automatization gained more importance in predicting reading and spelling performance. The results of the error analysis revealed some variations in the error patterns across modalities, but no striking differences were found across grade levels.

ÖZET

Türkçede Yazma Becerilerinin İncelenmesi: Fonolojik Kodlama ve Hızlı Otomatik İsimlendirmenin 3. ve 4. Sınıf Öğrencilerinin Okuma Yazma Becerilerindeki Rolü

Bu çalışma, fonolojik kodlama (FK) ve hızlı otomatik isimlendirme (HOTI) becerilerinin Türkçe okuma yazma başarısındaki belirleyici rolünü araştırmaktadır. Çalışmada, yazma becerisinin altında yatan süreçler, Türkçenin saydam yazı sistemi ve sınıflar arası gelişimsel farklılıklar bağlamında okuma süreçleri ile karşılaştırmalı olarak incelenmiştir. Ayrıca, sözcük ve metin yazma testlerinde, çocukların elyazılarında bulunan yazım hatalarının özelliklerindeki değişimler, sınıf düzeyi ve test türü (kopyalama ve dikte) açısından ele alınmıştır. Çalışmaya ilkokul 3. ve 4. sınıflara devam eden 77 öğrenci katılmıştır. Veri toplamak amacıyla çeşitli testler kullanılmış ve analiz için nitel ve nicel yöntemlerden faydalanılmıştır. Bulgular 4. sınıf öğrencilerinin 3. sınıf öğrencileriyle benzer seviyede FK becerilerine sahip olduğunu, buna karşın HOTI, sözcük yazma ve sözcük okuma testlerinde daha başarılı performans sergilediklerini ortaya koymuştur. Regresyon sonuçları, HOTI'nin Türkçede okuma becerilerini önemli ölçüde yordadığını; FK'nin ise yazma performansını belirleyen önemli bir ölçüt olduğunu göstermiştir. Buna rağmen HOTI, FK becerilerinden bağımsız olarak, yazma başarısını belirleyici bir rol üstlenmiştir. Ayrıca, FK'nin 3. sınıf öğrencilerinin okuma başarısına katkıda bulunduğu, ancak 4. sınıfta okuma performansını önemli düzeyde etkilemediği görülmüştür. Sınıf düzeyi arttıkça, okuma yazma becerilerini belirlemede fonolojik bilginin etkisi azalırken, otomatikleşmenin öneminin arttığı gözlemlenmiştir. Hata analizi sonuçları, yazım hataları örüntüsünde test türüne bağlı bazı değişimlerin olduğunu, ancak sınıf düzeyi açısından önemli bir fark bulunmadığını göstermiştir.

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CHAPTER 1

INTRODUCTION

The purpose of this chapter is to provide a rationale for the study, to present the statement of the problem, and to discuss the significance of the study. First, a short introduction is made regarding the position of spelling skills in literacy research. Then, PA (phonological awareness), RAN (rapid automatized naming) and orthographic depth are reviewed as the central components of literacy acquisition. Lastly, the purpose of the study is presented.

1.1 What is spelling?

Literacy is a fundamental trait that a person needs in order to communicate, gain access to information, share knowledge, and make a successful living. To become literate, one must learn two basic skills: reading and writing. Although both of these aspects of literacy have been studied as a part of educational and linguistic research so far, the number of studies investigating writing skills has remained rather limited when compared to research in reading (Treiman, 1993).

Spelling is one of the key components in developing writing skills, and it is simply defined as "the association of alphabetic symbols called graphemes with speech sounds called phonemes, the smallest identifiable sounds in speech" (Montgomery, 2007, p. 7). Spelling entails several psycholinguistic and cognitive processes, and understanding these processes may shed light on how phonological representations in the mind of a learner and the orthographic system of a specific language interact with each other. Analyzing children's spellings may provide valuable insight into the features of their phonological systems (Treiman, 1993), and highlight the relationship between the acquired features of the spoken language and the knowledge attained through formal literacy instruction at school.

Despite its potential to reveal many unknown aspects of language, cognition and learning, spelling has been mostly considered a "school subject" and its scientific basis is commonly underestimated (Perfetti, 1997, p. 21). This attitude towards spelling may be an outcome of the early view that spelling is a developmental extension of reading acquisition (Gentry, 2004). In the same vein, past linguistic theories of writing suggested that writing is not language, but a means to recode language by transcription (Bloomfield, 1970). Arfe, De Bernardi, Pasini and Poeta (2012) argue that even today, modern accounts such as the hierarchical model of writing contribute to this attitude. According to the hierarchical model, linguistic processes underlying writing skills are divided into two categories. These are high-level processes, which entail generating linguistic information in order to write words, sentences or texts, and low-level processes, which involve the transcription of the linguistic content (i.e. spelling). Two features of transcription may be leading to the misconception that spelling is a simple, mechanical task: (1) it is associated with minimal linguistic units such as graphemes, bases, affixes or words, and (2) transcription might be automatized (Arfe et al., 2012, p. 359). As a consequence, the complex cognitive and linguistic processes underlying spelling skills are neglected. However, empirical evidence coming from spelling research can yield several implications for improving literacy instruction, establishing appropriate objectives, facilitating better learning outcomes and enhancing material design not only for normally developing children, but also for students who suffer from learning difficulties.

1.2 The role of phonological awareness in literacy

In the literature, *phonological awareness* (PA) is considered to be a central component of literacy development (Adams 1990; Anthony & Francis, 2005; Gillon, 2007; Wagner & Torgesen 1987; Whitehurst & Lonigan, 1998). PA refers to the explicit knowledge of the sound structure of words. More specifically, PA is the knowledge that any spoken word can be segmented into smaller units such as syllables and phonemes, and these units can be altered or combined in several different ways. It is defined as the ability to hear, identify, reflect on and manipulate phonological units within a spoken word (Gillon, 2007). It follows a developmental route throughout a child's literacy acquisition (Anthony & Francis, 2005; Ziegler & Goswami, 2005), moving from the knowledge of larger segments (e.g. words, syllables) to the awareness of smaller sound units (e.g. onsets, rimes and phonemes). Numerious studies have consistently revealed that PA plays a significant role in predicting reading and spelling achievement across languages (Adams, 1990; Ball & Blachman 1991; Bradley & Bryant, 1983; Caravolas, Hulme, & Snowling, 2001; Caravolas, Volin, & Hulme, 2005; Goswami & Bryant, 1990).

1.3 The role of rapid automatized naming in literacy

Besides PA, which constitutes an important linguistic aspect of literacy development, automatization plays a major role in the cognitive dimension of reading and spelling development. As in many other areas of learning, once the learner attains a certain level of automatization in literacy tasks, cognitive paradigms underlying reading and spelling skills start to change and affect the way in which information is recognized, retrieved and produced. In literacy research, one of the most common ways of measuring automatization is *rapid automatized naming* (RAN) tasks (Denckla, 1972; Denckla & Rudel, 1974, 1976a, 1976b). In RAN tasks, participants are asked to

name familiar objects, colors, letters or numbers as accurately and quickly as possible. Performance in RAN tasks is considered to be a good predictor of reading performance across languages (Cornwall, 1992; Norton & Wolf, 2012; Wolf & Bowers, 1999). According to Wagner et al. (1997), RAN measures the efficient retrieval of phonological representations of words from the long term memory.

Most of the time, RAN is considered to be an index of reading fluency (Bowers, 1993; Savage & Frederickson, 2005), which is achieved through a strategy called *sight word reading*. During sight word reading, target words are recognized as whole units, and the reader does not resort to word decoding strategies (Ehri, 1992). Although RAN is consistently documented to be a very strong predictor of reading achievement (Bowers & Wolf, 1993; Cornwall, 1992; Wolf & Bowers, 2000), the relationship between RAN and spelling has remained less clear. Some recent studies aiming to see whether RAN is also linked to rapid and accurate retrieval of word specific orthographic knowledge found that RAN predicted spelling performance in the deep orthography of English (Savage, Pillay, & Melidona, 2008; Stainthorp, Powell, & Stuart, 2013). This finding suggests that RAN may be assessing the ability to retrieve letter chunks automatically in order to spell a word without resorting to phoneme-grapheme conversion strategies. In order to decide whether such conclusions can be extended to transparent orthographies or to detect any language specific differences, more spelling research conducted in languages with transparent orthographies seems necessary.

1.4 The role of orthographic depth in literacy

In addition to phonological knowledge and automatization skills, the orthographic system of a language plays an important role in literacy development. It is often stated that literacy acquisition is highly influenced by the orthographic characteristics

of languages (Liberman, Mattingly, & Shankweiler, 1980). According to Babayiğit (2009), Perfetti and Bolger (2004), different orthographies may demand different cognitive requirements by information processing systems, and influence the cognitive mechanisms of the brain in a different way. Thus, in order to understand the complex relationships between language specific properties underlying literacy skills and the universal processes of human cognition, it is important to conduct cross-linguistic research including languages with different orthographies (Babayiğit, 2009).

In transparent orthographies such as German or Turkish, the regularity of the orthographic system facilitates and accelerates literacy acquisition, and the role of phoneme-grapheme conversion strategies becomes fundamental (Aro & Wimmer, 2003; Durgunoğlu & Öney, 1999; Ellis & Hooper, 2001; Öney & Durgunoğlu, 1997; Seymour, Aro, & Erskine, 2003; Wimmer & Goswami, 1994; Wimmer & Hummer, 1990). As a result, it is suggested that children learning to read and write in transparent orthographies mostly rely on their phonological knowledge. Once they apply phoneme-grapheme conversion strategies in order to spell a word in these languages, they receive positive feedback, and continue to use phoneme-grapheme knowledge as their basic linguistic sources. In deep orthographies, on the other hand, due to the lack of regularity in phoneme-grapheme correspondences, children might use more holistic strategies in order to retrieve letters for spelling a target word. For example, in order to spell the word *cake*, which has a silent *–e* at the end, besides their phonological encoding skills in English, children may resort to their word specific orthographic knowledge, since using phoneme-grapheme conversion strategies alone is not sufficient to spell this word correctly. To this end, Ziegler and Goswami (2005) highlight the influence of the orthographic consistency on the

possible cognitive operations taking place during a literacy task. They suggest that since larger units such as syllables and rimes have higher consistency than single graphemes in the opaque orthography of English, children who learn to read and write in English use both large (i.e. letter chunks) and small (i.e. phonemes and graphemes) grain size units. In languages with transparent orthographies, however, since the utilization of larger units is not obligatory, children might perform a literacy task by relying on smaller units only (i.e. phonemes and graphemes).

Turkish has a nearly perfect orthographic transparency, in which phonemes have one-to-one correspondence with graphemes (Aydın, 2012). This regularity is observed not only in phoneme-to-grapheme direction but also in grapheme-to-phoneme direction. Due to this consistent mapping of sounds onto letters, it is commonly stated that normally developing children master phonological skills quite early in Turkish (Durgunoğlu & Öney, 1999).

1.5 The purpose and the significance of the present study

Although Turkish provides a rich platform for literacy research owing to its distinctive orthographic features, there are very few studies investigating the role of PA and RAN in spelling achievement in Turkish (e.g. Babayiğit & Stainthorp, 2010). In their longitudinal design, Babayiğit and Stainthorp (2010) followed first graders into Grade 2, and found that early RAN performance did not predict later spelling achievement in Turkish. However, the relationship between PA, RAN and spelling at more advanced stages of literacy remains unknown. The present study aims to fill this gap by investigating the role of phonological encoding (PE) skills and RAN in word reading and word spelling performance of Turkish speaking children attending Grade 3 and Grade 4. It is anticipated that the findings will have significant implications about the role of phoneme-grapheme mappings and automatization

processes underlying reading and spelling skills in languages with transparent orthographies.

In addition, the present study seeks to outline the most common types of spelling errors found in the children's handwritings in word level and text level spelling tasks, and to make a comparison between the error patterns across grade levels and task modality (copying vs. dictation). Furthermore, the current study provides explanations about the nature of the common spelling errors with reference to the language specific properties of Turkish. It is expected that the findings will help literacy researchers, educational policy makers and teachers gain an insight into the dynamics of spelling development, and adopt a comparative approach to reading and spelling skills of Turkish speaking children. The implications are supposed to contribute to the improvements in the quality of literacy instruction, material design and assessment in Turkey.

In this chapter, a brief introduction regarding the key issues of the current study has been presented. The following chapter provides a comprehensive review of the literature.

CHAPTER 2

LITERATURE REVIEW

This chapter consists of three sections. The first section provides a discussion on reading and spelling skills and elaborates on the scientific approaches to spelling development. The second section presents information about the cognitive operations underlying spelling skills with a focus on RAN. Lastly, the third section provides the findings of the previous studies which investigated the role of PA an RAN in literacy skills across different languages. In addition, it presents the findings of several studies reporting on the most common spelling errors made by Turkish speaking children.

2.1 Reading and spelling skills

2.1.1 Approaches to spelling development

Pollo, Treiman and Kessler (2008) explain that there are three main perspectives on the nature of spelling development. These are phonological, constructivist and statistical learning accounts. Phonological perspective has been the basis of literacy research especially in English speaking countries following the seminal work by Read (1971), who found that English speaking children made phonologically oriented errors in their spellings in a systematic way. For instance, they tended to spell *came* as KAM, making use of the letter names in the English alphabet, and chose substitutes which were acoustically similar to the sounds required to spell a word correctly. Read stated that children consistently adjusted their spellings according to the conventions as they became more proficient, and they developed spelling skills in a rule-governed way. This discovery led several other researchers to investigate spelling patterns emerging in children's handwritings in English, which contributed to the development of several stage models for spelling (e.g. Frith, 1985;

Gentry, 1982; Henderson, 1985). Despite minor variations in their theoretical structure, all of these stage models adopt a phonological perspective, and focus on the acquisition of the skills that are required to map phonemes to graphemes in an appropriate way. They suggest that children benefit from different types of information at different stages of literacy development. Accordingly, learners move from a nonphonological stage where they produce random letter strings to a phonologically mediated stage at which they start to spell words more correctly. During the phonological stage, children tend to make phonologically plausible errors until they reach full competency in skilled spelling.

Another approach to spelling development is the constructivist perspective (Ferreiro & Teberosky, 1982; Martins & Silva, 2001), which adopts a Piagetian view for literacy acquisition by focusing on early concepts of print and what children already know about writing before they start schooling. Here, apart from children's knowledge of phonology and orthography, their early exposure to print, everyday experiences with texts in the environment, and their way of perceiving the relationships between objects and their written names constitute an important part of literacy development (Tolchinsky & Teberosky, 1998). As the child continuously acquires some knowledge about writing, he or she operates several mental constructions about how words are written. Spellings produced at this time are not randomly arranged letter strings as described by the phonological perspective. Instead, they are the outcomes of the ongoing constructions taking place in the child's mind. Even before the child learns the alphabetic principle, he or she has some idea about how to spell a word.

As the third account, statistical learning approach proposes that children extract information from statistical regularities and use this knowledge to make

decisions about how to spell words just as they do to distinguish between sounds in speech during language acquisition (Saffran, Aslin, & Newport, 1996). Therefore, the frequency of the input plays an influential role in the course of a child's spelling development. Young children may acquire knowledge about spelling conventions by being exposed to print in signs, books, clothes or toys. This approach supports the constructivist view in that young children do not randomly produce letters as they start spelling. Instead, they generate and test some hypotheses about word spellings well before learning the alphabetic principle. However, statistical learning account predicts that these hypotheses are based on letters' frequency of appearance in the child's environment rather than being generated by the child's mental operations. Another proposal made by this account is that children do not necessarily learn information about spelling conventions at distinct stages as suggested by phonological approach theorists. Rather, they can learn different principles of correct spelling simultaneously or in an order which is not predictable (Pollo et al., 2008). Statistical learning account also predicts that the writing system and orthographic features specific to a language play an important role in children's strategy use for spelling. Therefore, as the graphotactic frequencies differ from one language to another, one should expect different spelling tendencies and strategies used by children coming from different linguistic backgrounds.

2.1.2 A comparison of reading and spelling skills

There are different views about the distinct and shared components of reading and spelling processes in the literature. Gentry (2004) reports that in early times, there was a belief that spelling skills developed as an epiphenomenal aspect of reading, and the alphabet method used for teaching reading was also used to promote spelling development. This account has had a long lasting influence on the methods of

teaching spelling for many years. While such accounts considered spelling as a developmental extension of reading, others (i.e. Chomsky, 1971; Clay, 1989) claimed that since writing is not as abstract as reading, early attempts to write emerge earlier than the signs of reading in children. More recently, Scharer and Zutell (2013) suggest that there is a "mutually supportive" relationship between reading and spelling skills (p. 467). Accordingly, spelling reinforces phonemic awareness used for decoding in early reading, and reading improves vocabulary knowledge which will be utilized at the later stages of spelling development.

A common view regarding the comparison of reading and spelling skills is that spelling is more difficult than reading, and it entails more complex and sensitive phonological processes (Bosman & Van Orden, 1997; Caravolas et al., 2001; Ehri, 1997; Frith, 1980; Perfetti, 1997). Frith (1985) suggests that phonological knowledge has a more prevalent role in predicting spelling skills, and its influence lasts longer for spelling development than for reading development. Evidence showing that good spellers are generally good readers whereas good readers do not always turn out to be good spellers (Frith, 1980) supports the notion that spelling, by nature, is more difficult than reading. In addition, studies investigating literacy skills of dyslexic participants show that although such learners improve their reading skills, they continue having spelling difficulties (Bruck & Waters, 1988) regardless of the characteristics of their alphabetic languages (Landerl, Wimmer, & Frith, 1997). Even in the transparent orthographies such as Turkish, spelling may pose difficulties for learners who are at ceiling levels of skilled reading (Babayiğit & Stainthorp, 2007).

While reading, a person recognizes the graphemes in a word (Perfetti, 1997), and matches them with plausible phonemes stored in the lexicon. Then, he or she reaches the target word and its meaning by eliminating possible other words located

in a similar cohort. Thus, reading can be achieved despite incomplete word representations. More specifically, incomplete lexical representations of a word (e.g. T_BL_) may be adequate to facilitate identification of the given word (i.e. table) in reading (Tainturier & Rapp, 2001, p. 277). During a spelling task, on the other hand, the individual is expected to have complete lexical representations to produce the whole letter string in the appropriate way. This time, he or she retrieves the graphemes that correctly match the phonemes involved in that specific word. The retrieval process may be hindered by low-quality memory representations or the interference resulting from competing letter sequences (Perfetti, 1997, p. 30). As Fulk and Stormont-Spurgin (1995) state, spelling requires more decision-making about the plausible grapheme-phoneme correspondences, and unlike reading, it does not benefit from contextual features of a given text. In the same vein, Ehri (1997) states that although reading and spelling skills rely on the same sources of knowledge, they differ from each other in terms of response complexity. Accordingly, spelling entails "multiple responses" (p. 264), and memory requires larger amounts of information for spelling than for reading. In summary, when compared to reading, spelling is considered to be more phonologically oriented and to utilize fewer compensatory mechanisms.

Frith (1985) proposed a stage model of literacy development stating that reading and spelling skills develop in a separate but overlapping manner, and there are three main stages in a child's literacy acquisition. These are logographic, alphabetic and orthographic stages:

Logographic Stage

During this first stage, children recognize familiar words quickly with the help of the cues provided by their visual properties. Children do not pay attention to the letter

sequences and their phonological representations yet. They pronounce a word if they recognize it, otherwise they do not respond to prompts.

Alphabetic (Phonological) Stage

Children start to rely on letter sequences and phonological features of words. They can decode words in a systematic way by focusing on each letter. They keep developing strategies for decoding, and sometimes they may fail in reading nonwords or unfamiliar words.

Orthographic Stage

At this stage, phonological strategies are replaced by skills used for recognizing words as orthographic units. Students process larger units such as letter strings or meaningful morphemes instead of decoding words into their individual graphemes or phonemes. At this point, instruction may influence the way the learners use their reading and spelling strategies.

Based on the three stages of literacy acquisition, Frith developed a six-step model, in which each stage included two substages for reading and spelling skills separately. Due to the differences in their nature, reading and spelling may develop at different paces. According to the model, there is an ongoing change of balance between the strategies used for reading and spelling. At the time when orthographic strategies are utilized for reading, alphabetic (phonological) strategies might be in use for spelling. During the last stage, orthographic knowledge becomes a primary source for reading skills whereas phonological knowledge remains influential for spelling skills for a longer period of time. Table 1 presents the features of these substages.

Table 1. Frith's (1985) Model of Reading and Spelling Development.

Step	Reading	Spelling
1a	Logographic	Symbolic
1b	Logographic	Logographic
2a	Logographic	Alphabetic
2b	Alphabetic	Alphabetic
3a	Orthographic	Alphabetic
3b	Orthographic	Orthographic

Frith accounted for the developmental problems faced by dyslexic learners based on this six-step model. Accordingly, dyslexic learners do not manage to shift from the logographic stage into the alphabetic stage. Supporting evidence came from the early study conducted by Makita (1968), who found that developmental dyslexia was not common in Japan due to the fact that Kanji required learners to rely on logographic and syllabic skills. Based on this model, it is possible to account for the discrepancy between reading and spelling skills among early learners. For instance, a student can spell a regular word alphabetically, but if she is still at the logographic stage in her reading skills, she may not read this regular word correctly (Bradley, 1980). At the following stages, the learner may attain skilled orthographic reading. However, if she fails to integrate automatization into her spelling skills at the orthographic level, then she may try to write the word alphabetically. This condition might yield spelling errors in the case of irregular words in the deep orthography of English. Frith (1985) stated that mastering orthographic reading skills was not a guarantee that the learner would acquire the same orthographic skills for spelling; and that could be the reason why some good readers remained poor spellers.

Frith's stage model provides a useful framework for handling reading and spelling skills in English-speaking countries. However, it is not certain whether such models might account for the developmental features of literacy acquisition in other

languages with more transparent orthographies (Lehtonen, 2006). Therefore, conducting spelling research in different languages is highly important in order to discover the universal processes underlying literacy development and to define the role of language specific characteristics (i.e. phonology and orthography) in literacy acquisition.

2.2 Cognitive processes in reading and spelling

2.2.1 Dual-route models in reading

In literacy research, a commonly addressed psycholinguistic question is how phonological and orthographic information is stored and accessed in order to read and write words. Regarding word recognition, one of the most-cited cognitive theories belongs to Coltheart (1978), who developed a *dual-route model of reading*. According to the model, readers follow a *phonological route* (nonlexical route) in order to read regular words which have one-to-one phoneme-grapheme correspondences. They also tend to read unfamiliar words or nonwords by using the phonological route. In this way, after graphemes are decoded into their corresponding phonemes, these phonemes are combined and then the meaning of the word is accessed. For irregular words which do not have consistent phoneme-grapheme mappings, on the other hand, readers use another mechanism called the *orthographic route* (lexical route). By using this strategy, readers can recognize a word by sight, and read it without decoding its graphemes. The lexical route enables learners to recognize the letters in words as chunks whose representations are stored in the long term memory. Once the word in the cognitive dictionary is recognized, the system gets into contact with its semantic functions in a more automatized way. When compared, it was found that irregular words took more time to be recognized in comparison to regular words (Paap & Noel, 1991). The explanation for this

finding is that for an irregular word, both of these mechanisms become activated and present conflicting information. When the reader encounters a regular word, however, using the phonological route yields positive feedback without conflicting with the orthographic route, thus facilitating quicker decision making about the words' pronunciation.

It could be stated that based on the orthographic route in the dual-route model of reading, the concepts of *orthographic awareness* and *orthographic processing* have emerged as the alternative components of literacy skills. Although the role of phonological awareness has proved to be highly influential over reading and spelling achievement, the term orthographic awareness is relatively new, and its assessment is facing several methodological drawbacks (Burt, 2006). Stanovich and West (1989) described orthographic awareness as "the ability to form, store and access orthographic representations" (p. 404). Similarly, Reitsma (1983) stated that orthographic processing entails "the recognition of unique letter sequences of words" (p. 335), which is not automatically achieved by relying on phonological decoding skills.

The relationship between the phonological and the orthographic routes is a complex one. Although these two mechanisms seem to be distinct cognitive pathways, they are in a constant interaction (Paap & Noel, 1991). For instance, as an unknown word becomes familiar to the reader and appears frequently in texts, despite its being regular, the reader might switch from using the phonological route to using the orthographic route in order to read it in a more automatized and effortless way. Thus, phonological mechanism may serve as an early strategy which then gives way to sight word reading via the orthographic route. This model is in line with Share's (1995) *self-teaching hypothesis*, which proposes that learners use their

phonological skills as a self-teaching mechanism and read newly encountered words by relying on their phonological knowledge. After sufficient practice in reading and spelling, these words will be moved to the orthographic vocabulary of the cognitive dictionary (Backman, Bruck, Hebert, & Seidenberg, 1984; Doctor & Coltheart, 1980; Waters, Seidenberg, & Bruck, 1984).

As previously stated, the orthographic route enables the learner to process a word as a whole unit and not to rely on word decoding strategies that demand more attention for the correspondence between phonemes and graphemes. This strategy may well be used either for an entire word (sight word reading) or parts of the word (Plaut, McClelland, Seidenberg, & Patterson, 1996). For example, while reading the word *cat*, if the reader is using the phonological route, he decodes the graphemes first (c-a-t), converts them into their corresponding phonemes (k-æ-t), and assembles these phonemes to access the target word and its semantic representation. However, if this word is among the most frequent words in the mental lexicon, once the word is seen, a direct access to its meaning is achieved through the orthographic route (Ehri, 1992). An alternative way is to process the word by using the phonological route for the initial sound and processing the rime as a whole unit (k-æt). Such strategies of orthographic processing reduce the cognitive load, and help learners recognize words by making analogies with words that have similar endings. This interaction between the phonological and orthographic routes suggests that rather than operating separately, these two pathways co-develop and cooperate during literacy acquisition (Holland, McIntosh, & Huffman, 2004).

In contrast to what is proposed by the self-teaching hypothesis, some studies found that even first and second graders may read words by directly using the orthographic route without resorting to phonological decoding. (Barron & Baron,

1977; Bradley &, Bryant, 1983; Condry, McMahon-Rideout, & Levy, 1979; Kimura & Bryant, 1983). However, this phenomenon is strongly related with word frequency factor (Burt & Tate, 2002; Holmes & Carruthers, 1998). High frequency words do not require much time to be transferred into the orthographic vocabulary, and they can be easily read via the orthographic route at very early stages. In these studies, high frequency words were used in the tasks, and it is possible that these words were already transferred from the phonological route to the orthographic route at a much faster pace in comparison to any other word with a lower frequency count (Reitsma, 1990).

In addition to the word frequency factor, the orthographic system of a language is another component which may affect the use of cognitive strategies in literacy tasks. According to the *orthographic depth hypothesis* (ODH), which was developed in line with the dual route model of reading, individuals adjust their strategy use regarding whether to follow lexical or nonlexical route based on the orthographic characteristics of a language (Frost, Katz, & Bentin, 1987; Katz & Feldman, 1983).

The ODH suggests that due to the inconsistency in phoneme-grapheme mappings in deep orthographies, phonological (nonlexical) route does not always provide learners with correct outcomes, and learners realize that they cannot make generalizations about the spellings of irregular words. For instance, the consonant cluster in the word *chair* corresponds to the sound / tʃ / while the same cluster in the word *chemistry* is represented by the sound /k/ in English. Therefore, readers utilize the orthographic (lexical) route for a more efficient performance in word recognition. In transparent orthographies, on the other hand, readers tend to rely on the

phonological route to a greater extent thanks to the direct and clear mappings between phonemes and graphemes.

Parallel to the suggestions proposed by the ODH, Siegler (2007) accounts for the relationship between the two cognitive strategies in the *dynamic systems theory*, according to which any change in learner strategies emerges as a result of inconsistency. That is, for an individual who uses the phonological route to recognize words and receives positive feedback, the system is in balance, and there is no need to apply further strategies such as using the orthographic route. However, once the phonological route provides negative feedback, the importance of phonological strategies starts to decline, and the balance of the system starts to change with the orthographic strategies gaining more credit. This inconsistency may lead English speaking learners to use the orthographic route more often than the learners of a more transparent orthography.

Similarly, Goswami, Ziegler, Dalton and Schneider (2003) suggest that as the transparency of the orthography increases, students rely more on phonological decoding skills, and the role of orthographic route becomes less influential. By simply following the regular phoneme-grapheme correspondences through the phonological route, learners of transparent orthographies may not need to store and retrieve word spellings as chunks. This difference between strategy-use among learners coming from different linguistic backgrounds has become the focus of the *phonological grain size theory* developed by Ziegler and Goswami (2005). Accordingly, readers develop different psycholinguistic units in reaction to the differing orthographic demands of languages. For instance, English speaking children use large units such as syllables or rimes in addition to smaller units such as graphemes and phonemes as they read words. For learners of more transparent

orthographies, on the other hand, relying on small units is the dominant strategy as phonemes and graphemes provide consistent mappings throughout their performances in literacy tasks.

In their study which compared literacy development across different orthographies, Seymour et al. (2003) found that in languages which have opaque orthographies such as English, reading skills develop twice less slowly than it does in languages with transparent orthographies. This finding might be explained by the assumption that readers of opaque orthographies have to learn switching between the two routes while readers in transparent orthographies primarily follow the nonlexical route and they conduct relatively less complicated processes during word recognition. However, when the interplay between orthography and word frequency is taken into consideration, it is possible that even in transparent orthographies, highly familiar words might be read and spelled by the active involvement of the orthographic route. To this end, Seidenberg (1985) argues that as long as the target item is a high-frequency word, individuals can recognize the item by utilizing the lexical pathway without resorting to the use of phoneme-grapheme correspondences across languages, regardless of their orthographic depth.

2.2.2 Dual-route models in spelling

The dual-route model was originally developed in order to explain the cognitive processes underlying word reading. Although not in a direct way, its early connections with spelling can be traced back to an early study conducted by Simon and Simon (1973), who developed an information processing modelling for spelling. Their model is one of the first accounts which focused on the interplay between cognitive and linguistic paradigms underlying spelling production. Accordingly, once students start to produce phonetically accurate spellings based on their

phonemic knowledge, some alternative sources of information get involved in the process as well. For example, an individual may benefit from the partial information available in his visual memory in order to choose the correct spelling of a target word. Parallel to Simon and Simon's suggestions, Marsh, Freidman, Welch and Desberg (1980) argued that skilled spellers relied on visual information to a greater extent than those with lower spelling performance. They proposed a stage model of spelling strategies according to which spellers rely on different mechanisms depending on their proficiency levels. At the first stage, beginning spellers conduct sequential encoding. That is, they process words in a serial fashion before spelling them. Later, they develop a hierarchical coding strategy based on the conditional rules such as the features of vowels or consonants in a syllable. At the last stage, they start to use analogy, which enables them to determine the orthographic structure of unknown words via their existing knowledge of rhyming words. On this basis, they select the most appropriate combination of letters as they spell unfamiliar words (e.g. spelling the word *sake* by making an analogy with *cake*). Marsh et al. report that the tendency to use analogies in literacy tasks increases between Grade 2 and Grade 5 in English speaking children.

In the following years, the dual route model of reading was adopted for spelling skills (Brown & Loosemore, 1994; Caramazza, 1988; Ellis, 1989; Tainturier & Rapp, 2001; Valle-Arroyo, 1990). Accordingly, conventional spellings are produced based on two cognitive pathways called the *assembled* (phonological) route and the *addressed* (orthographic) route. Along the assembled route, learners conduct the same operation as they do for reading through the phonological route. This time, however, the process works in the opposite direction: each phoneme belonging to the target word is converted into its corresponding grapheme and then the learner starts

to write. This route is followed in order to spell unfamiliar words and nonwords since they do not have word specific orthographic representations already available in the mental lexicon. The addressed route, on the other hand, is followed when the speller intends to write a familiar word which holds specific orthographic representations stored in the long term memory. By using this strategy, the speller retrieves the sequence of letters which constitute the target word in a more holistic and automatized manner. Familiar words are spelled with the help of the addressed route, and this reduces cognitive load by allowing the speller to shift his attention from the mechanics of spelling to other task requirements.

Tainturier and Rapp (2001) name the two routes of spelling as *the sublexical route* and *the lexical route.* They state that the two routes are independent but interacting strategies in the light of the evidence they report from the cases of brain damaged participants in several neurocognitive studies. They treat spelling as a general concept without addressing to a specific modality. That is, although the input (i.e. auditory input used in dictation tasks or visual input used in written picture naming tasks) and the output (i.e. written or oral spelling) may change (p. 263), all spelling tasks include abstract orthographic representations regardless of the modality. Tainturier and Rapp outline the cognitive components of spelling as in Figure 1.

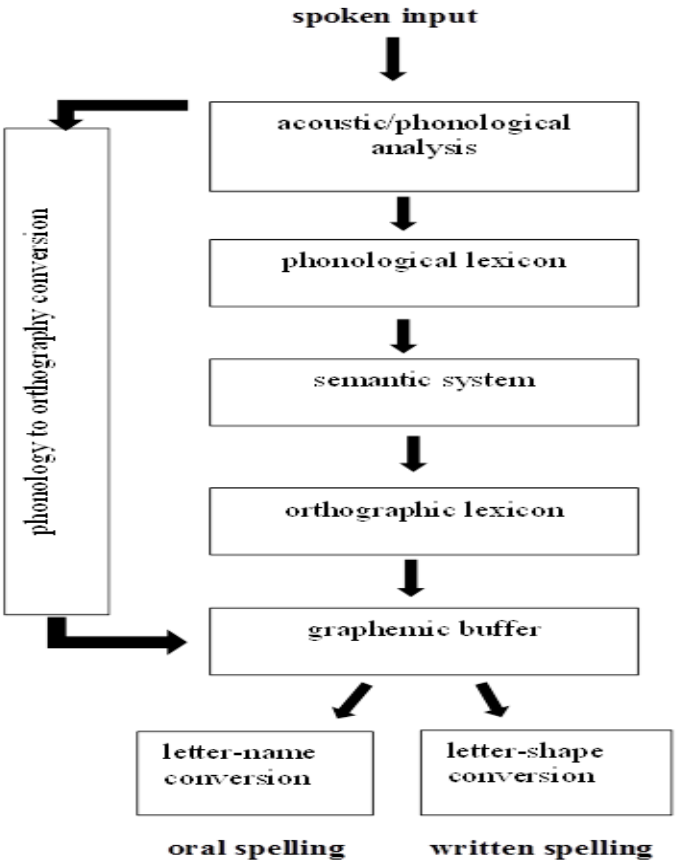

Fig. 1. Components of the spelling system (Tainturier & Rapp, 2001).

In their model, the researchers introduce a component called *phonology to orthography conversion system* (POC) through which individuals may produce phonologically plausible errors as they spell unfamiliar words. This system works for the sublexical route. The process follows three steps:

1. spoken input is analyzed in an acoustic or phonological way, and then it is divided into smaller units such as functional parts, syllables or phonemes.
2. each phonological unit is converted into a corresponding orthographic unit
3. the orthographic units are assembled into an abstract string of letters forming the correct sequence for the target word

Tainturier and Rapp (2001) state that POC benefits from the possible phoneme-grapheme correspondences, their frequency of use, and the appropriate

context for the grapheme production in English. High frequency occurrences have more priority for selection. For example, the sound /s/ can be converted into either C or SS, and the system concludes that SS is a more common match in English words provided that it is not in the initial position (p. 264). The model suggests that use of POC is very appropriate for spelling regular words and nonwords. Regular words such as *dog* may be spelled correctly via the sublexical route as there is no violation of phoneme-to-grapheme consistency. However, applying POC for irregular words such as *phone* may yield phonologically plausible errors such as *FONE*. At this point, *the orthographic lexicon* comes into play (i.e. in the retrieval of familiar but irregular word spellings).

According to the model, the orthographic lexicon is where the spellings of written words are stored. Highly familiar words, regardless of their regularity of phoneme-grapheme mappings, are transferred to the lexical processing. During retrieval, the phonological lexicon, which includes the spoken representation of the word, may cooperate with the orthographic lexicon depending on the task modality (e.g. in spelling to dictation). Normally, it is *the semantic system* which activates the orthographic lexicon. However, during spelling to dictation tasks, a direct connection might emerge between the phonological lexicon and the orthographic lexicon, and such operations are conducted through *the nonsemantic lexical route.* The role of *the graphemic buffer* is to keep the abstract letter sequences activated while waiting for the format specific requirements. Abstract letter sequences are thought to be format independent and they need to be converted into letter names or letter shapes depending on the task modality. Even if the lexical and the sublexical routes might work in a simultaneous way, the output provided by the dominant route will be selected for more peripheral processes of spelling production, and the operations on

the other route will be suppressed by the system. The output may be in the form of typing, cursive writing or oral spelling.

Tainturier and Rapp (2001) suggest that there is strong evidence as to the distinct routes of spelling based on the findings coming from brain–damaged patients who lost their ability to use one strategy or the other. Accordingly, a patient suffering from a lesion involving the orthographic lexicon may have difficulty in writing familiar words while he or she can produce plausible spellings for nonwords due to the intact phonological lexicon. All the same, these two routes are not considered to be totally independent. Instead, it is believed that there exists an interaction and integration between the two processes. Kreiner (1992) states that even though these paths do not affect each other in a direct way, they may get into interaction at an output level.

The model supports the early proposal made by Marsh et al. (1980) in that beginners use a strategy in which they sequentially recode phonemes into their corresponding graphemes while advanced spellers read out the orthographic representation of the word from the mental lexicon. Another claim of this spelling model is that the lexical route might not have a primary role in languages with transparent orthographies. This assumption is supported by the study of Coenen, Van Bon and Schreuder (1997), who found that Dutch beginning spellers tended to use phonological strategies in spelling. However, evidence additionally suggested that word specific orthographic knowledge was also used at the early stages of spelling development in Dutch. As the frequency of the words increased, the students used more lexical information while spelling. Another finding was that good readers made use of word specific orthographic knowledge more than poor readers. As the reading level increased, the role of phonological strategies in spelling production became less

influential. It was concluded that both strategies were used, but orthographic strategies were more often used by more proficient students. Beginning spellers made use of phoneme-grapheme conversion strategies, but very soon, they tended to use their word specific orthographic knowledge as well. This finding is compatible with the findings of the fMRI studies conducted by Shaywitz (2003) who found that beginning readers and skilled readers followed two different neural pathways. The results indicated that while beginning readers applied word decoding strategies, skilled readers managed to recognize the target words instantly. Based on this finding, Gentry (2004) suggests that although neurological evidence is not available for spelling production yet, these interpretations could be extended to the processes underlying spelling production.

2.2.3 RAN as a cognitive component of literacy

Automatization plays an important role for the cognitive operations taking place during a literacy task. Although RAN tasks are basic tools of assessing automatization in literacy research, there exists an ongoing debate about the position of RAN among other components of literacy.

In their review, Wagner and Torgesen (1987) use *phonological processing* as an umbrella term which plays a major role in predicting reading achievement. They state that phonological processing skills include phonological awareness, phonological recoding in lexical access and phonetic recoding in working memory. Accordingly, phonological recoding in lexical access is defined as "getting from a written word to its lexical referent by recoding the written symbols into a sound-based representational system" (p. 192). In this account, as RAN requires a quick mapping between visual stimuli and their corresponding names, RAN performance is considered to be closely associated with the phonological recoding in lexical access

and it is treated as a subcomponent of phonological processing skills. However, Badian (1996) suggested that rather than being a subcomponent of phonological processing skills, RAN is a composite construct which is highly associated with general processing speed. In Badian's (1996) study, children with high IQ but poor reading skills performed better on RAN tasks when compared to those with both low levels of IQ and poor reading skills. Besides, there was a stronger relationship between reading and RAN in the high IQ group. This finding indicated that RAN is mostly related with general processing mechanisms instead of the phonological processing systems.

Another view contrasting with Wagner and Torgesen's (1987) account belongs to Wolf and Bowers (1999), who argue that phonological awareness and naming speed are two separate processes contributing uniquely to different dimensions of reading performance. They state that while the importance of phonological processes in predicting reading changes depending on orthographic transparency, the role of naming speed remains a significant predictor of reading across all languages, regardless of the orthographic regularity. Evidence supporting this statement comes from their studies investigating the causes of reading deficit among dyslexic children (Bowers, 1995; Wolf, 1997). In these studies, it was found that problems of these two components might be existent among dyslexic children separately. That is, there might be dyslexic children whose PA skills are intact but RAN performance is below average, or children with good RAN scores but suffering from PA problems. Additionally, there might be a third group suffering from problems in both domains. Such groups were found to have most severe problems in reading tasks. Therefore, Wolf and Bowers proposed *the double-deficit hypothesis*

(DDH) according to which these two subskills required for literacy tasks should be considered as separate constructs.

It is an established finding that RAN strongly predicts reading achievement across languages (Bowers & Wolf, 1993; Cornwall, 1992; Norton & Wolf, 2012; Wolf & Bowers, 2000). As an index of reading fluency (Bowers, 1993; Savage & Frederickson, 2005), it reveals the efficient use of sight word reading, which enables individuals to recognize words as visual entities without using decoding strategies (Ehri, 1992). To this end, Sunseth and Bowers (2002) argue that RAN might have strong connections with orthographic processing skills. Although Torgesen, Wagner, Rashotte, Burgess & Hecht (1997) found contradictory results in their study, Manis, Seidenberg and Doi (1999) found that RAN contributed to orthographic knowledge at Grade 2 even when initial reading skills were included in their regression model. This interplay between RAN and orthographic processing skills might also manifest itself in spelling production.

The relationship between RAN and spelling skills has only recently started to draw attention in the literature. Savage et al. (2008) suggest that RAN might be indexing orthographic specificity required for spelling production. They state that: "RAN reflects very basic neurological processes that might be assumed to apply equally to reading as to spelling" (p. 236). In other words, if RAN measures the rapid retrieval of phonological representations of words for reading, it may also measure the rapid retrieval of word specific orthographic representations for spelling (Stainthorp et al., 2013). Within the scope of this study, RAN is considered to be an index of the processes taking place in the orthographic pathway.

2.3 Previous findings

2.3.1 Studies investigating the role of PA

Evidence suggests that PA plays a major role in spelling development in different languages (Aidinis & Nunes, 2001; Babayiğit & Stainthorp, 2007; Ball & Blachman 1991; Bradley & Bryant, 1983; Caravolas et al., 2001; Caravolas et al., 2005; Cornwall, 1992; Landerl & Wimmer, 2008; MacDonald & Cornwall, 1995; Maclean, Bryant, & Bradley, 1987; Nikolopoulos, Goulandris, Hulme, & Snowling, 2006).

In an early study, Ball and Blachman (1991) tested 90 English speaking kindergarten children. They divided the participants into three groups which were exposed to different training programs. The first group had phoneme awareness instruction and letter knowledge training. The second group took letter knowledge training only, and the third group remained as the control group. Their findings suggested that after seven weeks of training, phoneme awareness instruction significantly improved reading and spelling skills of the children in the experimental group.

In a longitudinal study, MacDonald and Cornwall (1995) tested PA skills of 58 kindergarten children through a sound-deletion task, and measured their word-level reading and spelling skills eleven years later. They found that early PA skills predicted reading and spelling achievement of English speaking children during their teenage years. Similarly, Maclean et al. (1987) investigated the role of rhyme knowledge in predicting later spelling skills. They followed 65 nursery kids for a three-year period, and found that the performance in nursery rhymes at the age of three accounted for unique variance in the spelling achievement observed at the age of six.

Supporting evidence comes from the study conducted by Landerl and Wimmer (2008), who investigated the developmental course of reading fluency and spelling among German speaking children. They tested the participants at the beginning of Grade 1and at the end of Grade 8. Their findings revealed that early reading and spelling problems persisted into the following years (even up to Grade 8), and RAN predicted reading fluency while PA as indexed by phoneme segmentation was the strongest predictor of spelling in the transparent orthography of German.

Caravolas et al. (2001) followed 153 English speaking children from Grade 1 to Grade 3 by assessing their phoneme awareness skills, letter-sound knowledge, letter-name knowledge, memory, reading and spelling achievement. They found that the performance in phoneme segmentation tasks and letter-sound knowledge predicted early spelling skills, which were the foundations of conventional spelling. In another recent study, Nikolopoulos et al. (2006) followed children who were 7-9 years old for one year, and they found that phoneme awareness as revealed by the performance in phoneme substitution tasks was a strong predictor of reading and spelling in the highly transparent orthography of the Greek language. Based on the similar patterns found in English-speaking samples in the literature, Nikolopoulos et al. claimed that PA played a major role in predicting literacy skills regardless of the orthographic characteristics of languages.

In another study investigating literacy skills in Greek, Aidinis and Nunes (2001) tested 60 normally developing children who were at the ages of 5-7. They found that different levels of PA (syllable awareness and phoneme awareness) made significant contributions to the knowledge of written Greek at different ages. For younger learners, syllable awareness was easier to access in comparison to phoneme

awareness. Both syllable awareness and phoneme awareness made unique contributions to reading achievement whereas syllable awareness was the only significant predictor of spelling skills of Greek speaking participants. The researchers accounted for this finding by the fact that the number of participants was rather small, and the spelling items might have been too easy to demonstrate the separate contributions of syllable and phoneme awareness skills.

In a comparative study, Caravolas et al. (2005) tested phoneme awareness levels of English and Czech speaking children (from Grade 2 to Grade 5) by administering several phoneme deletion tasks. According to their findings, similar patterns of performance were observed in both groups of participants, and phoneme awareness was found to be a unique predictor of reading and spelling skills across the two languages regardless of the difference between their levels of orthographic transparency.

Although Nikolopoulos et al. (2006) and Caravolas et.al. (2005) found the persistent influence of PA in predicting later reading skills regardless of the orthographic transparency, there are also studies reporting that in transparent orthographies such as Turkish (Öney & Durgunoğlu, 1997) and German (Goswami, Ziegler & Richards, 2005), the importance of PA in predicting reading decreases at higher grade levels since children master PA skills very quickly and reach ceiling on PA tasks towards the end of Grade 1. On the other hand, it is reported that RAN continues to be a long term predictor of reading (Furnes & Samuelsson, 2010; Kirby, Parrila, & Pfeiffer, 2003; Landerl & Wimmer, 2008) across languages.

In a study conducted in the transparent orthography of Turkish, Babayiğit and Stainthorp (2007) investigated the role of preliterate PA in the early reading and spelling skills of Turkish speaking children. The participants were followed from

kindergarten to Grade 2, and it was found that although PA failed to make significant contributions to later reading skills, it was a strong predictor of spelling skills in Turkish. In a later study, Babayiğit and Stainthorp (2010) measured the influence of PA, grammar knowledge and RAN as the predictors of reading, spelling and narrative writing skills. They followed 57 Turkish speaking children from Grade 1 to Grade 2, and found that while RAN predicted reading speed, PA made reliable contributions to spelling skills in Turkish. These findings support the notion that PA fails to predict later reading skills in a transparent orthography. In this context, PA is considered as an index of reading accuracy. However, as normally developing Turkish children attain advanced PA skills in a very short time, almost none of them experience any specific difficulty in terms of accuracy. Hence, the pre-requisite of successful reading shifts from reading accuracy to reading fluency. In this situation, especially after Grade 1, PA does not differentiate between good (fluent) readers and poor (dysfluent) readers, and RAN tasks replace PA measures in predicting reading performance (Babayiğit & Stainthorp, 2010). On the other hand, since accuracy is harder to attain for spelling skills both in opaque and transparent orthographies, PA continues to be a significant predictor of later spelling performance across languages. In line with this interpretation, Scharer and Zutell (2013) state that PA plays a major role in predicting spelling skills for a longer period of time than in reading skills. However, they also suggest that as students develop additional mechanisms for spelling production at higher grade levels, the influence of PA might decrease in predicting spelling when compared to its position at the beginning stages of literacy development. At this point, whether RAN makes any significant contributions to spelling performance beyond PA becomes a relevant research question.

2.3.2 Studies investigating the role of RAN

Several studies investigated whether RAN predicts spelling achievement in different languages (Bowers, 1996; Bowers, Sunseth, & Golden, 1999; Moll, Fussenegger, Willburger, & Landerl, 2009; Plaza & Cohen, 2003; Savage et al., 2008; Stainthorp et al., 2013).

In an early study, Bowers (1996) asked individuals to recall several letter strings in flashing nonwords which were demonstrated very briefly. She found a relationship between the facilitative influence of orthographic redundancy (regularities of letter sequences within words) and rapid naming, which was independent of phonological processing. Bowers proposed that "naming speed influences the ability to learn the orthographic patterns of words" (p. 1). That is, although RAN is not a direct measure of orthographic processing skills, it is closely associated with the automatized retrieval of the letter chunks in target words for spelling. In a later study, Bowers et al. (1999) tested English speaking children at Grade 2 and Grade 3, and similarly found that children with poorer RAN skills demonstrated lower performance on letter recognition tasks and identifying orthographically implausible letter strings in their Quick Spell Task. Among the third graders, RAN was the only variable predicting the recognition of letters in implausible strings in nonwords. The researchers stated that when the automatization of letter recognition was not developed sufficiently, it deteriorated the processing of letter strings, and slowed down the development of orthographic knowledge. In this context, RAN was related to rapid orthographic processing of letter chunks.

In another study, Moll et al. (2009) investigated the role of RAN in predicting spelling skills among German speaking kids across three large groups (fourth graders from Germany, third graders from Austria and students diagnosed with learning

difficulties at Grades 2, 3 and 4). They found that PA was a stronger predictor of spelling in German in comparison to RAN. However, RAN still contributed significantly to the spelling performance of German speaking children beyond PA. The researchers doubt that RAN is directly associated with orthographic processing. Instead, they account for their findings by arguing that children with lower RAN performance read smaller number of words in comparison to normally developing children, and as they cannot benefit from their reading experiences, they have less amount of word specific orthographic knowledge. However, given the fact that none of the students were beginning spellers (aged 10-11), it is also possible that in addition to their PA skills, they attained a certain level of automatization in spelling, and made use of their orthographic processing skills while spelling familiar letter chunks in the target words. This finding suggests that even in transparent orthographies, students may resort to alternative sources apart from following regular phoneme-grapheme mappings in their languages.

In a recent study, Stainthorp et al. (2013) investigated the relationship between rapid naming and word spelling to dictation in English. They postulated that RAN may be indexing processes to retrieve visual stimuli attached to spelling just as in reading (Wolf & Bowers, 1999), and this could be closely related to retrieving fully specified orthographic representations of words. The researchers tested 146 children and divided them into two groups based on their RAN performance. The findings showed that RAN made a unique contribution to spelling performance (spelling accuracy) in English. Among their participants, those with low naming skills demonstrated poorer spelling skills and had more difficulty in spelling irregular words. In addition, there were no significant correlations between PA and RAN scores of the participants, which supported the DDH.

In the opaque orthography of French, Plaza and Cohen (2003) investigated the influence of PA, syntactic knowledge and RAN on reading and spelling skills of first graders. According to their results, all of these three variables were found to make significant contributions to reading and spelling skills at the end of Grade 1. They also found that object naming task, although not related to literacy, remained as a significant variable in the regression analyses. Hence, in line with the arguments of Stainthorp et al. (2013) the researchers supported the DDH by stating: "These findings confirm that naming speed is not subsumed under phonological processes, and that the processes underlying naming speed represent a potent second core deficit in children with reading and spelling difficulties" (p. 292).

In another study, Savage et al. (2008) tested 65 children with poor spelling skills, and found that alphanumeric RAN (digits and numbers) made a significant contribution to spelling performance in English after controlling for chronological age, reasoning ability, and spelling of nonwords. The researchers stated that RAN may be indexing the retrieval of phonology to orthography connections for the task of spelling. In contrast to Plaza and Cohen's findings, nonalphanumeric RAN (colors and objects) did not predict spelling performance in their study. The researchers interpreted this result by arguing that the relationship between RAN and spelling could not be explained by general processing speed but a more specific process during which individuals accessed abstract stimuli verbally and processed the available information very quickly.

In methodological terms, Savage et al. suggested that including nonword spelling instead nonword reading as a control variable is an important advantage in order to understand RAN-spelling associations better. They state:

> Therefore, before drawing strong conclusions about the specificity of strong RAN effects in spelling, it may be necessary to control for the variability and

> learning processes associated with pseudoword spelling rather than pseudoword reading. Such controls clearly have implications for attempts to link RAN quite specifically to orthographic processing abilities. (p. 238)

Their analyses demonstrated that when PA measured via pseudoword reading rather than pseudoword spelling tasks was included as the control variable in the regression model, the unique contribution of alphanumeric RAN was attenuated, and failed to show statistical significance.

In another study, Christo and Davis (2008) tested 65 English speaking students (from Grade 2 to Grade 5) who were reported to have literacy-related problems. They investigated the relationships between phonological processing skills, RAN (digit naming), word reading, word spelling, and reading comprehension. Their results suggested that digit naming was a stronger predictor of word reading, reading comprehension and spelling to dictation than phonological processing skills among the participants. They accounted for this result by referring to the finding that RAN is a more powerful predictor of literacy skills for participants with learning difficulties when compared to normally developing children (Scarborough, 1998). Another finding of the study was that phonological processing and RAN strongly correlated with literacy measures independently from each other. The researchers interpreted this result as supporting evidence for the DDH and claimed that these two skills might rely on separate processes.

Evidence provided by several studies consistently shows that in addition to PA, RAN is a significant predictor of spelling achievement in opaque orthographies such as English and French. As for transparent orthographies, while several studies found that RAN did not predict spelling accuracy in languages such as Turkish (Babayiğit & Stainthorp, 2010), Finnish (Georgiou, Torppa, Manolitsis, Lyytinen, & Parrila, 2012) and German (Landerl & Wimmer, 2008), there is also evidence supporting the unique contribution of RAN to spelling skills in languages such as

Dutch (Verhagen, Aarnautse & Van Loewe, 2010), Portuguese (Dos Santos & Befi-Lopes, 2012) and Greek (Georgiou et al., 2012).

In a recent study, Wimmer and Mayringer (2002) investigated the role of PA, phonological memory (PM) and RAN in predicting later reading and spelling performance in German. The researchers informed that German has more consistency in the phoneme-grapheme direction (forward regularity) when compared to the grapheme-phoneme direction (backward regularity). High regularity in the grapheme to phoneme direction was considered to enable German learners to master reading accuracy at very early stages. Accordingly, it was reported that whereas English speaking dyslexics struggled with reading accuracy, German speaking dyslexics often had problems related to reading fluency. In the study, the participants were followed from Grade 1 to Grades 3 and 4, and it was found that children who had poor PA and PM skills at school entrance demonstrated spelling deficits while those with poor naming speed had reading fluency problems. In other words, RAN was a strong precursor of reading fluency, and PA was a more important index of spelling accuracy in German.

In another study, Verhagen et al. (2010) found that RAN predicted the speed and accuracy required for the access to orthographic representations both in word reading and word spelling in Dutch. Their findings suggested that when compared to naming speed and vocabulary, PA was a stronger predictor of spelling skills at the beginning of Grade 1. Still, RAN made significant contributions to spelling at this stage, although with a lower coefficient value than that of PA. At the end of Grade 1 and Grade 2, however, PA and RAN were found to make equal amounts of significant contributions to word spelling. This finding might be explained by the development of fully specified orthographic knowledge with the increase of grade

level. That is, as the students became more proficient spellers, their reliance on phonological knowledge might have decreased, while their automatization to retrieve orthographic units might have increased. That could be the reason why RAN accounted for more variance in spelling at more advanced stages of literacy.

In Portuguese, Dos Santos and Befi-Lopes (2012) investigated the literacy skills of 82 children (aged 9-10) by administering tests of expressive vocabulary, RAN (objects), PA, spelling and written composition. Their findings revealed that those who had higher levels of vocabulary knowledge made fewer spelling errors and performed better in written composition tasks. In addition, high levels of both PA and RAN correlated with higher scores in spelling accuracy. The researchers interpreted the relationship between RAN and spelling skills as follows:

> This result may indicate that the lexical access involved in the rapid naming task would influence the writing of high-frequency words, which are expected to be written from a memory strategy, being therefore strongly dependent of the quality of this lexical access. It is also possible to speculate that the subprocesses of visual integration involved in the RON task would be related to the establishment of orthographic mental pictures of the HFW [high frequency words]. (p. 272)

In a longitudinal study, Furnes and Samuelsson (2011) compared the literacy skills of English speaking children with those of Norwegian and Swedish speaking participants. They followed the students from kindergarten to Grade 2, and measured their PA skills along with RAN performance. The findings of the study revealed that RAN was more strongly associated with reading skills whereas PA had stronger relationships with spelling skills across orthographies. However, the influence of PA on spelling skills was found to last longer in the transparent orthographies of Norwegian and Swedish.

Torppa, Georgiou, Salmi, Eklund, and Lyytinen (2012) conducted a study with Finnish speaking participants. They divided the students into two groups based

on the literacy status of their parents. Accordingly, if the participants had parents with reported reading difficulties, they were placed in the high risk group. If there was no sign of reading difficulty in neither of the parents, then the children were included in the low risk group. The researchers followed the students from kindergarten to Grade 3. Their findings revealed that the percentage of children who had PA deficits and/or RAN problems was higher in the high risk group. The second finding of the study was that while low performance in PA predicted spelling deficits in the high risk group, poor naming speed predicted problems both in reading fluency and spelling after Grade 1. The researchers suggested that since phoneme-level sensitivity was important for spelling in the regular orthography of Finnish, PA appeared as a good predictor of spelling. For the contribution of RAN to spelling, they suggested: "The naming speed deficit may impact the development of reading fluency and of spelling through its effects on the formation of orthographic representations, which are essential in the development of both skills" (p. 311). Finally, it was argued in the study that because PA and RAN indexed different processes across reading and spelling skills, the DDH was supported.

In another longitudinal study, Georgiou et al. (2012) compared the predictors of literacy skills across Finnish, Greek, and English. The participants were followed from kindergarten (at the age of 5) to Grade 2. The findings demonstrated that letter knowledge was a strong predictor of spelling across languages. While early PA was a predictor of later spelling skills only in Finnish, RAN predicted spelling achievement both in Greek and English. The researchers explained the relationship between RAN and orthographic processing by stating: "The slow integration results in decreased sensitivity to commonly occurring orthographic patterns, thereby preventing the development of an efficient orthographic lexicon. In other words, slow RAN

performance affects the quality of the orthographic representations and, subsequently, spelling" (p. 340). Georgiou et al.'s (2012) findings are interesting in that although both Finnish and Greek have transparent orthographies, RAN predicted spelling skills in Greek but not in Finnish. The researchers account for this result by arguing that Greek is somewhere between English and Finnish in terms of orthographic transparency. It is more regular than English but not as transparent as Finnish, since it has some inconsistencies in the phoneme-to-grapheme direction.

In conclusion, robust evidence supports the predictive power of PA in spelling performance across languages, with a more persistent influence in transparent orthographies. The role of RAN in predicting spelling, on the other hand, is not as clear. Although RAN has been consistently found to make unique contributions to spelling in opaque orthographies (especially in English), there are controversial findings regarding is contributions to spelling skills in more transparent orthographies. At this point, word frequency and spelling proficiency become highly relevant issues. As proposed by Dos Santos and Befi-Lopes (2012), although PA is the dominant predictor of spelling in transparent orthographies, high frequency words could be accessed in an automatized way without resorting to phoneme-grapheme mappings during spelling production, and this quick retrieval of word specific orthographic information might be reflected by the performance in RAN tasks. Similarly, as students gain more experience in literacy tasks and move to the skilled stages of spelling, their automatization in spelling production will naturally increase. This means that testing advanced spellers by using high frequency words might reveal the possible unique contribution of RAN to spelling achievement beyond PA, even in the highly transparent orthography of Turkish.

In the design of the present study, in line with Savage et al.'s (2008) methodological suggestions, PA was measured through a nonword spelling task (defined as phonological encoding skills) and it was included as a control variable in the regression model. Phonological encoding (PE) skills were considered to represent the processes taking place in the sublexical route while the performance in RAN was taken as an index of orthographic processing, as conducted by the lexical route of spelling.

2.3.3 Studies investigating spelling errors in Turkish

Children do not develop successful spelling skills right from the beginning. Until they master conventional spelling rules, they go through some developmental stages at which they make several types of spelling errors (Henderson, 1981). Read (1975; 1986) views these errors as beneficial guidelines for researchers to see the metalinguistic and cognitive dynamics involved in literacy acquisition. Similarly, Henderson (1981) highlights the importance of spelling errors in determining the developmental stage of a child. He points to the similarities between the processes emerging in the course of language acquisition and the ones taking place during literacy development. For instance, children first learn and use irregular verb forms such as *went*, and then the regular forms such as *walked* while speaking. Later, they start to produce overgeneralization errors such as *goed* until they start to use the correct form. Here, it is not the word but the rule which is being learnt, and this demonstrates that the child is handling a cognitive task and learning the language (Henderson, 1981). In the same vein, during literacy development, since young learners have incomplete word specific knowledge and misconceptions about print, they tend to overgeneralize the rules they have acquired. For instance, they exploit their knowledge of letter names while spelling a word (e.g. TIGR instead of *tiger*).

To this end, Henderson suggests that literacy acquisition can be traced with the help of the characteristics of developmental spelling errors, and error analysis may provide researchers with an understanding about a learner's "progressive conceptual knowledge of English orthography" (p. 44).

In Turkish, several studies have investigated the nature of spelling errors emerging in the handwritings of elementary school children. One such study belongs to Erden, Kurdoğlu and Uslu (2002), who examined the reading speed and spelling performance of 2572 Turkish speaking children from Grade 1 to Grade 5 at elementary school. For the spelling section of the study, the researchers asked the participants to write three sentences in a dictation task, and then, they categorized the common spelling errors based on a spelling rubric. The findings of the study showed that 30 % of the students made at least one punctuation error. Other common errors were grapheme substitution (25 %), word addition (19 %), word omission (15 %) and grapheme omission (13 %).

In another study, Çapan (1989) studied with two students (from Grade 3) who had learning difficulties although they had high IQ levels. She found that the students made errors mostly when spelling long and multimorphemic words. In addition, they had difficulty in using punctuation marks properly. In another study, Bektaş (2007) conducted a survey about the most common spelling errors made by Turkish first graders. According to the observations and reports provided by 172 teachers, the most common error type in spelling was grapheme omission in dictation tasks.

Similarly, Demir (2003) investigated the nature of spelling errors made by Turkish speaking children, and interviewed with some teachers who were teaching first and second graders. The teachers stated that besides having some formational problems with the cursive style, the students also had difficulty in using diacritics.

Accordingly, they tended to either omit or overuse the diacritics of the letters. In addition, grapheme substitution and punctuation problems were reported to be the common errors found in the children's handwritings. Demir argued that the reason underlying the persistence of spelling errors into the second grade might be the deficiencies in spelling instruction provided at the first grade. The researcher suggested that special teacher training programs for teaching spelling could be a solution to this problem.

In another study, Kasapoğlu (2010) examined the spelling performance of 39 first graders and found that in addition to letter formation problems, grapheme omission errors were also observed. Another finding was that 18 % of the children made grapheme substitution errors while spelling *y* and *ğ.* In a similar study, Maraşlı (2010) studied the spelling patterns of 185 first graders, and found that nearly all the students (97 %) made grapheme omission errors while spelling words. They also had difficulty in using capital letters (99 %) and punctuation marks (17 %) appropriately.

Yıldız and Ateş (2010) compared the features of the spelling errors made by third graders who were trained through different methods of literacy instruction (phonic based sentence method vs. sentence analysis method). Both groups of the participants were asked to write a short text to dictation. The findings suggested that regardless of the instruction type, many students misspelled target words, and they had the most difficulty in differentiating between the word-boundaries and using the punctuation marks properly.

In summary, despite the transparent nature of the Turkish orthography, spelling problems persist in Turkish speaking children's handwritings. Overall, punctuation errors, grapheme omission/substitution errors, and problems with *soft g*

seem to constitute a big proportion of the spelling problems faced by Turkish speaking children.

This chapter presented a detailed discussion of reading and spelling skills, the cognitive processes underlying spelling production, and a review of the related studies from the literature. The next chapter will introduce the orthographic and phonological properties of the Turkish language.

CHAPTER 3

PROPERTIES OF THE TURKISH LANGUAGE

This chapter focuses on the characteristics of the letters in the Turkish alphabet, the phonological features of Turkish consonants and vowels, and the basics of Turkish syllable structure. First, the letters of the alphabet are introduced. Next, information about the phonological units (i.e. consonants and vowels) in Turkish is provided. Finally, the properties of Turkish syllable structure are reported.

3.1 The Turkish alphabet

There are 29 letters in the Turkish alphabet, 21 representing the consonants and 8 representing the vowels. The letters of the alphabet and their pronunciations based on the speech tendencies of native speakers of British English are presented in Table 2.

As previously stated, Turkish has a highly transparent orthography. However, spelling rules are not entirely phonological and there are cases when a conflict emerges between the phonological and morphological knowledge about word spellings (Menz & Schroeder, 2008). These conflicts may appear due to some variations taking place in the spoken language out of several cases such as the irregularity in the spellings of borrowed words, vowel shift or vowel lengthening imposed by *soft g* (ğ), and destressing consonant doublets. For instance, although written as *geleceğim (I will come),* this word might be pronounced as *gelicem* in spoken Turkish. Similarly, while speaking, the expression *teşekkürler (thanks)* might be pronounced as *teşekürler*. *Soft g* appears in the spelling of words such as *çağ (era),* but it is not pronounced in standard Turkish: /tʃa: /.

Table 2. The Turkish Alphabet.

Letter	Example in Turkish	Pronunciation Equivalent in English
A, a	At (horse)	*a* as *u* in ‘c*u*p’
B, b	Baş (head)	*b* as in ‘*b*it
C, c	Cam (glass)	*j* as in ‘*j*am’
Ç, ç	Çocuk (child)	*ch* as in ‘*ch*ip’
D, d	Duvar (wall)	*d* as in ‘*d*eep’
E, e	El (hand)	*e* as in ‘t*e*n’
F, f	Fil (elephant)	*f* as in ‘*f*it’ or ‘full’
G, g	Gün (day)	*g* as in ‘*g*et’ or ‘gull’
Ğ, ğ	Dağ (mountain)	lengthens the sound of preceding vowel/silent between two vowels
H, h	His (feeling)	*h* as in ‘*h*ope’; sometimes silent between two vowels
I, ı	Işık (light)	*a* as in ‘*a*mong’, ‘*a*lone’
İ, i	İnci (pearl)	a shorter form of *ee* as in ‘b*ee*t’ or *i* as in ‘b*i*t’
J, j	Jeton (token)	*s* as in ‘lei*s*ure’
K, k	Kat (floor)	*k* as in ‘*k*ept’, ‘*c*ure’ and ‘*c*alf’
L, l	Limon (lemon)	*l* as in ‘*l*amp’, ‘bu*ll*’ or ‘*l*urid’
M, m	Mor (purple)	*m* as in ‘*m*ilk’
N, n	Nokta (point)	*n* as in ‘*n*o’
O, o	Okul (school)	*o* as in ‘off’
Ö, ö	Ördek (duck)	*e* as in ‘b*e*t’ is pronounced with the lips rounded
P, p	Pilav (rice)	*p* as in ‘*p*in’
R, r	Renk (color)	produced with the tip of the tongue touching the alveolar ridge
S, s	Ses (sound)	*s* as in ‘hi*ss*’
Ş, ş	Şarkı (song)	*sh* as in ‘*sh*eep’
T, t	Top (ball)	*t* as in ‘*t*ime’
U, u	Uçak (plane)	*u* as in ‘c*u*te’ or p*u*t’
Ü, ü	Üst (top)	*i* as in ‘b*i*t’ is pronounced with the lips rounded
V, v	Vazo (vase)	*v* as in ‘*v*ery’
Y, y	Yer (place)	*y* as in ‘*y*ou’
Z, z	Zil (bell)	*z* as in ‘zig*z*ag’

Note. Adapted from the work of Göksel and Kerslake (2005, p. xxii).

Without sufficient morphological and orthographic knowledge required to spell words in accordance with the Turkish writing conventions, one can make several spelling errors under the influence of such phonological variations. Hence, it would not be appropriate to state that Turkish is a language in which words are spelled exactly the same way as they are pronounced and vice versa.

3.2 Turkish phonology

3.2.1 The consonants of Turkish

Words are articulated by combining strings of different phonological units, namely consonants and vowels. Consonants are produced when the air flowing into the vocal tracts is exposed to some degree of constriction (Erguvanlı-Taylan, 2007). The consonants of Turkish are distinguished from each other based on whether they are voiced or voiceless, the place of articulation and the manner of articulation. The voiced and voiceless consonants of Turkish are demonstrated in Table 3.

Table 3. Voiced and Voiceless Consonants in Turkish.

Voiceless consonants	Voiced consonants
/p/ /t/ //k/ /c/(k) /ʧ/(ç) /f/ /s/ /ʃ/(ş) /h/	/b/ /d/ /g/ /ɟ/(g) /dʒ/(c) /v/ /z/ /ʒ/(j) /ɣ/(ğ) /m/ /n/ /ɬ/(l) /l/ /r/ /j/(y)

According to the place of articulation, Turkish consonants are classified as bilabial, labiodental, dental, alveolar, alveopalatal, velar, and glottal. As far as the manner of articulation is concerned, consonants are divided into seven categories, which are stops, plosives, affricates, fricatives, nasals, laterals, and glides (see Table 4).

Table 4. Turkish Consonants.

	Bilabial	Labio-dental	Dental	Alveolar	Alveo-palatal	Palatal	Velar	Glottal
Plosives	*p* *b*		*t* *d*			*c* *ɟ*	*k* *g*	
Affricates					*tʃ* *dʒ*			
Fricatives		*f* *v*	*s* *z*		*ʃ* *ʒ*		*ɣ*	*h*
Nasals	*m*		*n*					
Tap (Flap)				*ɾ*				
Lateral			*ɬ*		*l*			
Glide						*j*		

Source: Erguvanlı-Taylan (2007, p.17).

Based on the place of articulation, Turkish consonants are categorized as follows:

Bilabials

Bilabial consonants (*b, p, m*) are produced by the contact of upper and lower lips. The initial sounds in the words *bebek (baby), pilav (rice)* and *mavi (blue)* belong to this category.

Labiodentals

Labiodentals are produced by the contact of the upper teeth with the lower lips. In Turkish, the labiodental consonants are *f* and *v*, which are the initial sounds in the words *fare (mouse)* and *veda (farewell).*

Dentals

To produce dentals, the tip of the tongue touches the back of the upper teeth. The dentals of Turkish are *t, d, s, z, n, ɬ.* The final sounds in the words *et (meat), ses (voice), güz (fall), ben (me), sol (left)* can be given as examples of the dental consonants. If not in a borrowed word, the sound *d* does not take the final position in Turkish words.

Alveolars

Alveolar sounds are articulated as the speaker raises his tongue tip to the alveolar ridge behind the upper teeth. The sound *ɾ* in the word *renk (color)* is a tap alveolar sound in Turkish.

Alveopalatals

The speaker raises his tongue to the back of alveolar ridge. These sounds are *tʃ, dʒ, ʃ, ʒ, l* as in the words *çocuk (child), can (life), şeker (sugar), jüri (jury), bile (even).*

Palatals

Palatal sounds are produced as the front of the tongue raises up to the hard palate. The palatal sounds in Turkish are *c, ɟ,* and *j,* which appear as the initial sounds in the words *kağıt (paper), gavur (infidel), and yeşil (green).*

Velars

Velars are articulated as the back of the tongue raises to the velum. The initial sounds *k* and *g* as in the words *kafa (head)* and *gaz (gas)* are velars of Turkish. These sounds are articulated as velars when they are together with back vowels. However, they can be palatalized when with front vowels as in the words *kedi (cat), yenge (aunt).*

Glottals

The closure of glottis during the air flow produces glottal sounds in the larynx. The sound *h* as in the word *hava (air)* is a glottal consonant in Turkish.

Apart from their place of articulation, consonants are categorized with regard to the manner of articulation. Accordingly, the sounds are classified based on the degree of air stricture produced in the vocal tract (Erguvanlı-Taylan, 2007). The categorization of the Turkish consonants according to the manner of articulation is as follows:

Stops

Stop sounds are produced when the air which is totally blocked in the vocal tract is suddenly released. Stops sounds include oral stops and nasal stops. In Turkish words, voiced oral stops *(b, c, d, g)* do not emerge in the word final position. Oral stops become plosives if they are produced with an eggressive pulmonic air stream mechanism. According to their place of articulation, *b, p,* and *m* are the bilabial stops, *t, d, n* are dental stops, and *k, g* are velar stops of Turkish. When voiceless plosives *p, t, k, c* and voiceless affricate *tʃ* are produced with force, they may become aspirated depending on the following sounds, preceding pauses or their position within a word. For instance, the sound *p* is an aspirated plosive in the words *para (money)* or *top (ball),* but it is unaspirated in the word *tıpkı (just like)* (Göksel & Keslake, 2005).

Affricates

Affricate sounds are produced when the airflow which is completely blocked in the vocal tract is released slowly. The two affricate sounds in Turkish are *tʃ* and *dʒ* as in the words *çok (abundant)* and *can (life).*

Fricatives

To produce fricative sounds, the speaker applies partial obstruction to the airstream. The air flow yields some degree of friction that can be heard. In Turkish, there are labiodental (*f, v),* dental *(s, z),* alveopalatal *(ʃ, ʒ),* velar (*ɣ) and* glottal *(h)* fricatives. These sounds are exemplified in different positions in the words *defter (notebook), vatan (homeland), süt (milk), zaman (time), güneş (sun), garaj (garage), dağ (mountain),* and *ahır (barn).*Non-nasal stops, affricates and fricatives belong to the group of obstruents while nasal stops, glides and liquids are included in the group of sonorants in Turkish.

Approximants

Liquids and glides are classified as approximants in Turkish. The sound *l* is a lateral approximant and *r* is a non-lateral liquid. The lateral *l* becomes a velarized dental sound (*ɬ*) if it appears with a tautosyllabic back vowel as in the example *hala (aunt),* and it is palatalized when it appears with a tautosyllabic front vowel as in the word *bile (even).*

Glides (semi-vowels)

Glides are articulated in a similar way to vowels. However, they do not produce separate syllables. The sound *j* in the word *kaya (rock)* is a palatal semi-vowel in Turkish.

The special case of soft g

As stated earlier, the letter ğ (*soft g*) has a distinctive phonological property among other sounds in Turkish. Even though it is articulated as a voiced velar fricative in some regional dialects of Turkish, it is not pronounced in the standard Turkish. *Soft g* does not appear in word-initial positions. When used in a syllable–final position where it cannot be resyllabified by a following vowel, it lengthens the preceding vowel (Kornfilt, 1997) as in the word *çağdaş* /tʃa:daʃ/*(contemporary).* Due to its role in producing phonological effects, it is included in the phonemic inventory of the Turkish consonants and represented by /ɣ/. Ergenç (1991) defines *soft g* as a phenomenon which causes vowel shift and vowel lengthening.

3.2.2 The vowels of Turkish

Vowels are produced in the vocal tract without any obstruction to the air flow. Turkish has eight vowels which are categorized based on the height of the tongue, position of the tongue and position of the lips.

Vowels are classified as high, mid or low according to the height of the tongue. The distance between the tongue and the roof of the mouth determines the tongue height. If the tongue is close to the roof, a high vowel (e.g. *i, u*) is produced. If the tongue is midway between the rest position and the roof of the mouth, a mid vowel such as /*e/* or /*o/* is produced. When the tongue is in its rest position and the jaw is wide open, a low vowel such as /*a*/ is articulated.

The position of the tongue determines whether a vowel is front or back. When the tongue is extended to the front part of the oral cavity, front vowels such as */i/* or */e/* are produced. When the tongue is in a retracted position, back vowels such as */a/* or */u/* are produced.

The last categorization regarding the vowels is made according to the lip position, which distinguishes between rounded and unrounded vowels. Vowels such as */o/* are rounded whereas vowels such as */e/* are unrounded. Table 5 demonstrates the classification of the Turkish vowels.

Table 5. Turkish Vowels.

	Front		Back	
	Non-round	Round	Non-round	Round
High	*i*	*y (ü)*	*ɯ (ı)*	*u*
Mid	*e*	*œ (ö)*		*o*
Low	*ɛ*		*a*	

Source: Erguvanlı-Taylan (2007, p. 10).

Vowels may appear in different positions in words, and vowel sequences are not allowed in Turkish except in some borrowed words such as *saat (clock)* or *penguen (penguin).*

In native Turkish, the pronunciation of the vowels is lax. That is, the vowels in native Turkish words are short. However, as previously stated, vowels may be lengthened if they are followed by *soft g*. Phonemically long vowels might also be found in some borrowed words such as *badem* /ba:dem/ *(almond)* which is a Persian-

origin word. Vowel lengthening in such words is not usually reflected in the Turkish orthography. If a meaningwise discrimination between two homographs is necessary, on the other hand, the use of circumflex is a common practice (e.g. *hala /hała/ 'aunt'* vs. *hâlâ /ha:la/'still'*).

Vowel harmony

Vowel harmony is a well-known phonological property of Turkic languages, which places several constraints on the co-occurrence of vowels within words (Erguvanlı-Taylan, 2007). In vowel harmony, words may include any of the eight vowels in the initial syllable. The vowel characteristics in the other syllables are conditioned by the preceding vowels in a sequential manner. That is, each consecutive vowel is influenced by the preceding vowel in terms of frontness and rounding (Durgunoğlu & Öney, 1999).

In labial vowel harmony, non-round vowels *(a, e, i, ı)* must be followed by non-round vowels, and round vowels *(o, ö, u, ü)* must be followed either by non-round mid-low vowels (*a, e)* or round high vowels *(u, ü)*. Accordingly, the vowels /*o/* and */æ/* (ö) may appear only in the first syllable of a word. However, this rule has an exception for the words which have the imperfective suffix *–(I)yor* (Göksel & Kerslake, 2005).

In palatal vowel harmony, back vowels *(a, ı, o, u)* are followed by back vowels; and front vowels *(e, i, ö, ü)* must be followed by front vowels. Vowel harmony may occur both within morpheme boundaries and across morpheme boundaries. Therefore, the suffix being attached to a word stem generally harmonizes with the characteristics of the vowel in the preceding syllable (e.g. *araba-yla* '*with the car'* vs. *tren-le 'with the train'*) (Kornfilt 1997, p. 214).

There are some cases in which the vowel harmony is violated. For example, the vowels in the constituents of some compound nouns may not harmonize with each other *(e.g. keçi+boynuzu 'carob').*Violation of the vowel harmony may also be observed in borrowed words such as *kitap (book), kalem (pencil), lale (tulip),* and *penaltı (penalty).* In addition, words including the progressive suffix *–(I)yor* do not abide by the rules of vowel harmony as in the example *sev+iyor+du* (love+Prog+Past+3rdP). This suffix violates the harmony, and then assimilates the vowel in the following suffix.

3.3 Turkish syllable structure

Words are formed by smaller units called syllables. In order to compose a word, at least one syllable is needed. Syllables can be divided into subunits called *onset* and *rime (rhyme).* A rime consists of a *nucleus* and a *coda.* The nucleus is the basic component of a syllable. Consonants preceding the nucleus are called onset while consonants following the nucleus are named coda. Whereas the nucleus is the obligatory component of a syllable, other components remain optional. For example, the word *sen (you)* is made up of an onset (*s*) and a rime (*en*). Within the rime, *e* is the nucleus, and *n* is the coda.

Turkish roots are usually monosyllabic, which means that they consist of one syllable including a single vowel as in the words *at (horse), ol- (be),* and *üç (three)* (Göksel & Kerslake, 2005). When compared to English, there are fewer syllable types in Turkish. Nearly all (98 %) Turkish syllables are composed of four basic syllable types which are in the form of V, VC, CV, and CVC (Durgunoğlu & Öney, 1999). Most of these syllables include two letters (56 %) and the most frequent syllable structure is CV (51 %) (Aşlıyan, Günel, & Filiz, 2006). Since Turkish words have more salient syllabic boundaries than English words, it is easier to divide them

into syllables. Moreover, unlike in English, the most common syllable types do not include consonant clusters in Turkish. This feature makes it easier to distinguish between the phonemes within the syllables. These characteristics of Turkish are believed to facilitate word decoding among beginning readers and enable them master reading skills faster and earlier when compared to their English speaking peers (Durgunoğlu & Öney, 1999).

Turkish is an agglutinative language, and inflections are attached to the end of words. Upon the attachment of new morphemes, the syllable structure at the end of a word is reconstituted (e.g. *su 'water', su+suz 'waterless', su+suz+luk 'thirst'*). Another property of Turkish syllable structure is that consonant clusters are not allowed in the word initial position. This might be observed in borrowed words only, such as *tren (train), plan (plan)* or *krem (cream).* Words such as *kral (king), klüp (club)* are pronounced commonly by using an epenthetic high vowel in accordance with vowel harmony conventions. *Plan* can be pronounced as /p^{h} ilan/, and *kral* can be pronounced as /kɯral/, but the original pronunciation /kral/ may well be retained in the westernized pronunciation (Kornfilt, 1997). The use of epenthetic vowels may emerge in the pronunciation during speech; however, they are not reflected in the Turkish orthography.

Consonant clusters may appear in word or syllable-final positions (e.g. *kurt 'wolf')* in Turkish. However, no more than two consonants may form a cluster within a syllable. In addition, consonant clusters in such positions entail certain phonotactic requirements to occur (Erguvanlı-Taylan, 2007):

I. Sonorant +Obstruent:

a. Liquid/nasal/glide + Stop:

kent (city), renk (color), kalp,(heart)

b. Liquid/nasal/glide + Fricative:

şans (luck), ders (lesson), zarf (envelope)

II. Obstruent +Obstruent

a. Fricative + Plosive

üst (top), çift (pair), aşk (love)

b. Plosive (k) + Fricative (s)

boks (boxing), lüks (luxury), faks (fax)

III. r/z + Nasal

modern (modern), turizm (tourism), faşizm (fascism)

This chapter has provided general information about the orthographic and phonological properties of the Turkish language with reference to the letters in the alphabet, consonants, vowels and the syllable structure. The next chapter will introduce the methodology, and present information regarding the research design, participants, data collection instruments, procedure and the data analysis of the current study.

CHAPTER 4

METHODOLOGY

The present chapter consists of five sections: research questions and hypotheses, participants, instruments, procedure, and data analysis. In the first section, the research design is introduced along with the research questions and the hypotheses of the current study. The following parts present detailed information about the participants, the tests utilized for the data collection, and the test administration procedure. Lastly, the sixth section explains the methods used in order to analyze the data.

4.1 Research questions and hypotheses

This study has a cross-sectional research design, which investigates the role of phonological encoding (PE) skills and RAN in predicting word reading and word spelling performance of Turkish-speaking children who attend Grade 3 and Grade 4 at an elementary school. In addition, the study aims to outline the most common types of spelling errors emerging in the handwritings of Turkish speaking children with reference to the grade level and task modality. The research questions are as follows:

1. Is there a significant difference between Grade 3 and Grade 4 in terms of PE skills, RAN performance, word reading and word spelling achievement?
2. What are the correlations of PE skills and RAN with word reading and word spelling performance in Turkish? Is the pattern of correlations among the measures different in Grade 3 compared to Grade 4?
3. Do RAN and PE skills make significant contributions to word reading skills in Turkish? How much variance is explained by these variables at Grade 3 and Grade 4?

4. Do PE skills and RAN make significant contributions to word spelling skills in Turkish? How much variance is explained by these variables at Grade 3 and Grade 4?
5. What kinds of spelling errors are prevalent in the handwritings of the students? Are the observed error characteristics subject to any variation depending on the grade level and task modality?

Based on the research questions of the present study, the following outcomes are hypothesized:

1. Since phonological skills reach ceiling levels at very early ages in Turkish and the students at both grade levels are considered to be skilled readers and spellers, it is hypothesized that there will be no statistically significant difference between Grade 3 and Grade 4 in terms of PE, RAN, word reading and word spelling scores.
2. Given the transparent orthography of Turkish and the nature of spelling processes, PE skills will have strong correlations with spelling achievement whereas RAN will demonstrate high levels of correlations with reading achievement regardless of the grade level. As the grade level increases, the learners will become less reliant on phonological skills both for reading and spelling, and they will develop more advanced automatization skills. Therefore, at Grade 4, PE will have lower correlations with reading and spelling skills in comparison to Grade 3. On the other hand, RAN will have higher correlations with reading and spelling skills at Grade 4 than at Grade 3.
3. Since phonological knowledge is mastered very early in Turkish, and reading performance is better explained by rapid naming at skilled stages of literacy

acquisition, RAN will make a significant contribution to reading achievement of the participants. As for PE, it is expected that PE skills will make an additional and significant contribution to the reading achievement of the students beyond RAN. Since the fourth graders have more experience in literacy tasks, they are expected to integrate their linguistic sources with automatization to a greater extent than the third graders during reading. Therefore, across grade levels, the amount of variance explained by RAN in reading will be higher at Grade 4 than at Grade 3. Although it is predicted that the contribution of PE to reading will be smaller than RAN at both grade levels, it is hypothesized that PE will have a more influential role in the reading performance of the third graders in comparison to the fourth graders.

4. By nature, spelling processes are more phonologically oriented in comparison to reading processes. The involvement of phonological knowledge in spelling skills is even more prevalent in transparent orthographies. Thus, it is highly likely that PE skills will make a significant contribution to spelling achievement of the students. As for RAN, it is believed that both groups of participants have attained a certain level of automatization in spelling high frequency words. Hence, it is predicted that beyond PE skills, RAN will make significant contributions to the spelling skills of the students. Across grade levels, PE skills will account for greater amount of variance in the spelling achievement of the third graders in comparison to the fourth graders. On the other hand, the fourth graders will utilize automatization to a greater extent than the third graders as they spell words. Therefore, the amount of variance explained by RAN in spelling will be higher at Grade 4 than at Grade 3.

5. Based on the previous findings, it is predicted that diacritic errors, grapheme substitution errors and grapheme omission errors will be more common than other types of spelling errors in the students' handwritings. In addition, it is predicted that many of the students will have difficulty in using punctuation marks properly. It is hypothesized that the third graders and the fourth graders will not make qualitatively different spelling errors. On the other hand, the characteristics of the spelling errors are expected to change depending on the task modality because dictation is a more challenging task than copying.

4.2 Participants

The participants were all from a state school in the district of Sarıyer, İstanbul. They had middle-to-low socioeconomic backgrounds in general. There were 90 children (54 students from the third grade, 36 students from the fourth grade) available at the beginning of data collection. However, there were some participants who dropped out of the study due to several reasons such as illness, changing schools or unwillingness to complete all the tests. In addition, there were a few students who seemed to experience some learning difficulties, as acknowledged by their teachers. Once these students were excluded from the sample, 77 students were left; the exact numbers being 46 for the third graders, and 31 for the fourth graders. Table 6 presents demographic information about the participants.

Table 6. Participant Demographics.

Grade	Gender		Age (Months) $\bar{X}$	SD
3	Male	19 (41.3 %)	106.76	3.719
	Female	27 (58.7 %)		
	Total	46		
4	Male	17 (54.8 %)	119.29	3.900
	Female	14 (45.2 %)		
	Total	31		

As for the educational backgrounds of the participants' parents, out of 77 children, parental information was available for 55 students on the school system. As demonstrated in Table 7, most of the parents had primary school education followed by high school, secondary school, and university education.

Table 7. Parental Educational Background.

Educational Level	Overall		3rd Grade		4th Grade	
	Mother N= 55 %	Father N=52 %	Mother N= 34 %	Father N= 32 %	Mother N=21 %	Father N=20 %
Illiterate	1.8	0	2.9	0	0	0
Primary School	50.9	42.3	58.8	46.9	38.1	35
Secondary	12.7	19.2	8.8	21.9	19	15
School	20	21.2	17.6	15.6	23.8	30
High School	1.8	0	2.9	0	0	0
College	12.7	17.3			19	20
University			8.8	15.6		

At the first grade, the participants of this study had literacy training mostly through the phoneme based sentence approach, which has been used in Turkey since 2005. In this method, the teacher focuses on phonemes instead of letter names in words. Thus, students first learn the sounds of letters. Then they blend these sounds into syllables, words and sentences. The teaching is programed in a way that students can make up

sentences using the sounds they have learned. They read and spell words simultaneously (MEB, 2005). This method is believed to facilitate students' language development, proper pronunciation, and their ability to distinguish between sounds. It is believed that with the help of this method, students shift from spoken language to written language in a smoother way, and make fewer spelling errors. Based on the teaching guidelines which are regulated by the Ministry of National Education, elementary school children learn letter sounds in a specified order. Accordingly, children learn *e, l, a, t* as the first group of letters, which are then followed by *i, n, o, r, m, t.* These sounds are systematically practiced in a way that students are exposed to them in different words and combinations both in reading and writing (e.g. *e, l, el, ele, el ele; a, al, ala, al ala; t, at, ata, et, ete*). After reaching an average of 500 words and 100 sentences, children learn the remaining sounds. At this time, they learn the letters *u, k, ı, s, y, d* and *ö, b, ü, ş, z, ç,* followed by *g, c,p,h,* and *ğ, v, f, j* (Erol et al., 2006).

In line with the introduction of phoneme based sentence approach, a regulation in the Turkish Teaching Program suggested that spelling should be taught in the cursive style (MEB, 2005, p. 15). Cursive handwriting is believed to promote success in writing as it requires students to spell words in a continuous manner. As learners do not pause between each grapheme, they can focus on the shape of letters more easily (Early, 1976; Ott, 1997). Furthermore, cursive is considered to facilitate left to right movement, increase fluency, help learners integrate spelling, speaking and writing processes, and enhance multisensory learning (Montgomery, 2007). Blumenfeld (1997) suggests that grapheme substitution errors are not common in cursive writing thanks to the continuous hand movement. Başaran and Karatay (2005) state that cursive writing is an activity which helps students process words as

whole units by facilitating word retrieval. In the same vein, Fitzgerald (2004) suggests that thanks to its continuation, the cursive style helps students keep focused on their ideas during writing.

The participants of the present study had received training in cursive writing since school entrance. However, some students asked whether they were allowed to use print style during the tasks. They were told to use the writing style at which they felt the most comfortable. For this reason, although most of the handwriting data was in cursive, there were some instances of print writing as well.

Gentry (2004) argues that learning to spell and skilled spelling are two different processes, and they may rely on different mechanisms. Accordingly, children learn to spell in English starting from pre-kindergarten years until the end of first grade. Then they move into a phase at which they master skilled spelling from second to sixth or eighth grade. As they learn to spell, children learn the alphabetic principle and mapping between the graphic features and the spoken forms of words. This period lasts for 2 years, and children become ready to master spelling skills at the second grade. At this stage, they master spelling conventions such as consonant doubling or e-drop principle in English. They add up new entries about correct spellings of words to their mental dictionaries, and their word specific knowledge becomes more sophisticated. In Turkish, it is highly likely that skilled spelling might start earlier due to the transparency of the orthographic system. Hence, students from Grade 3 and Grade 4 were chosen as the participants who were considered to be skilled spellers of Turkish with high levels of automatization.

4.3 Data collection instruments

4.3.1 Data collection instruments for quantitative analysis

For quantitative data analysis, four tests were used: letter/word identification, spelling of sounds, Rapid Automatized Naming tasks developed for Turkish (HOTI: Hızlı Otomatik İsimlendirme, Bakır & Babür, 2009), and a test of word spelling to dictation developed by the researcher.

4.3.1.1 Letter/word identification

This test aimed to assess word recognition skills involved in reading. Although it was an untimed test, the scoring was based not only on reading accuracy but also on reading fluency. The tests started with simple items and continued with items that were of increasing difficulty (see Appendix A for the sample items). There were 76 items in the test, and the session was terminated when the participant made 6 consecutive errors. The test was administered individually in a quiet room, and regional variation in the children's accents was not punished. If the participant had difficulty in reading, the researcher advised him or her to read the word silently first and then read it aloud. This instruction was delivered only once throughout the test administration. The participant received 1 point if he or she read aloud an item accurately and fluently. If the participant hesitated in reading a word or misread the word, he or she received 0. The overall internal reliability measure (Cronbach's alpha) of the test was found to be .695.

4.3.1.2 Spelling of sounds

This test was used to assess phonological encoding skills of the students. During the test, the researcher read out 30 nonwords and asked the students to listen to the nonwords carefully and write them down. The test items (see Appendix B for the sample items) ranged from short, monomorphemic non-words *(öş)* to long,

multimorphemic ones *(şeyebiliyorduydu),* which were ordered in increasing difficulty. Each item was read out twice by the examiner and the students were told to start writing after they heard the nonwords for the second time. The test was administered in groups of 5 due to time limitations, and the students were supervised so that they worked individually. The rater did not score the answers coming after 4 consecutive errors. The first seven items of the test were given 1 to 3 points depending on the accuracy level of spelling. The remaining items were scored by using a 0-1 rating scale. The internal consistency of the test was found to be .648.

Nonword tests are considered a direct way of measuring the ability to implement phonological subskills to print (Rack, Snowling, & Olson, 1992), and nonword spelling is a tool for assessing the strategies used by children to convert spoken words into written ones when they have no cues other than phonological knowledge (Arfe et al., 2012). Therefore, it was expected that this test would reveal valuable information about the students' phoneme-grapheme conversion abilities.

4.3.1.3 HOTI (digits)

Bakır and Babür (2009) developed the HOTI tests based on the standardized RAN tasks, and provided evidence for the validity and the reliability of the Turkish versions. The present study made use of serial letter naming and digit naming tasks from the HOTI tests. However, during letter naming, it was observed that although they were provided with a practice sheet prior to the test, several students hesitated over whether to name the letters or sound out their phonemes under time pressure, and they switched between letter names and phonemes throughout the task. This tendency might be a result of the overemphasis placed on phonemes by the teachers as they adopted a phoneme-based approach during the first years of literacy training. Since this state of conflict seemed to interfere with the participants' performance and

attenuated their speed, the researcher did not continue to use the letter naming task, and conducted the digit naming task as the basic measure of RAN.

The HOTI (digits) subtest consisted of five digits (2, 4, 6, 7 and 9) which were repeated in a random order. There were 50 items presented in five rows, each row containing ten items. Before the test started, the participant was given a practice sheet with the same digits on it, and he or she was provided with some training. In this way, the child became familiar with the test items beforehand, and the examiner had the chance to see whether the child had a specific difficulty regarding the given digit names. Then, the participant was asked to name the digits from left to right, as quickly as possible, without making any errors. The test was administered individually in a quiet room. The examiner used a chronometer and kept the records for each child. The time (seconds) spent for completing the task became the score of the participant.

4.3.1.4 Word spelling to dictation

In order to design this task, a mini-corpus was formed based on the most frequent words which were selected from the reading texts used in the elementary level (Grades 1 to 5) Turkish course books. The frequency count was computed via a program called *Fatih Parser* (Zafer, 2011). Then the most frequent words were grouped based on the number of their syllables (from 1 to 9 syllables). In the end, 35 words were selected and ordered in increasing difficulty (see Appendix C for the sample items). The first item was *en (the most)* and the last item was *hatırlamayabilirsiniz (you may not remember).*

Word spelling test was administered collectively in the classroom. Before the task, the students received blank work sheets. Then, the researcher read aloud the target words one by one, and the students wrote down the words carefully. In order to

prevent any misunderstanding, items were read aloud twice. In the scoring procedure, 1 point was given for the correct spelling of each item, whereas words including misspellings received 0. The internal reliability measure of the test turned out to be substantially high (α = .865).

4.3.2 Data collection instruments for qualitative analysis

For qualitative data analysis, which is based on a comprehensive error categorization, four collective spelling tests were administered at word and text levels by using visual and auditory prompts. Since dictation task requires the use of Phonological Memory (PM), it is considered to be more difficult than copying. Hence, it was predicted that the dictation tasks would yield different error patterns when compared to the copying tasks. For word level spelling, the students were given a test of word spelling by copying in addition to the test of word spelling to dictation which was also used in the quantitative part of the data analysis. For text level spelling, tests of text spelling by copying and text spelling to dictation were used. The tests were carried out in the classroom with the help of the teachers. There was a one-week interval between copying and dictation sessions. During the first session, the students were merely asked to copy the given words and the text on the work sheet. After one week, they participated in the second session to write down the same words and the text to dictation.

4.3.2.1 Word spelling to dictation

As previously stated, the students listened to the researcher carefully as she read out 35 target words, and they wrote down the words using their blank worksheets. Each word was read aloud twice.

4.3.2.2 Word spelling by copying

In this test, the participants were simply asked to copy the 35 items to the blank lines on their worksheets.

4.3.2.3 Text spelling to dictation

For the text-level spelling, the short text used in Erden et al.'s (2002) study was utilized (see Appendix D). The text consisted of three sentences and included words such as *tavşan (rabbit)* or *sepet (basket).* These words had several confusing sounds, and they were used to reveal possible grapheme substitution errors (e.g. writing *b* instead of *p*). The researcher read aloud the sentences with pauses between clauses, and the students wrote down the sentences to dictation. The sentences were read out twice so that slow spellers could catch up with the rest of the students.

4.3.2.4 Text spelling by copying

The students were asked to copy the given text to the blank lines on their worksheets.

4.4 Procedure

The tests were administered during the spring semester in 2013-2014 academic year. Thanks to regular school visits, the data collection process started at the beginning of May, and finished by the second week of June. An official permission was received from the Ministry of National Education in order to start collecting data at the school. In addition, the researcher asked for the consent of the parents, teachers and the school administration at the beginning of the procedure.

In the first place, the students participated in the letter/word identification test. After they completed this individual test, the spelling of sounds test was administered in small groups on the same day. When all the participants completed taking these tests in nearly two weeks, the collective spelling tests were administered as the second step, with a one-week interval between the copying and dictation tasks.

In three weeks, this part of the data collection was completed. Lastly, the students were given the HOTI (digit naming) test individually during the last week of the data collection procedure. Test administration, scoring, data entry and analyses were performed by the author of this thesis in order to prevent any inconsistencies. The students were allowed to ask questions if they had difficulty understanding the task requirements. During the administration of the collective tests and the small group tasks, the researcher supervised the students to ensure that they worked individually and produced their own writings.

4.5 Data analysis

The data were analyzed both qualitatively and quantitatively. For quantitative analyses of the test scores, SPSS (Statistical Package for Social Sciences) 20.0 was used. To make an error categorization and examine the spelling errors, a rubric was developed by the researcher.

During data screening, it turned out that PE scores of the third graders did not meet the normality assumption. Hence, before including this variable in the statistical analyses, a nonlinear transformation (reflect and logarithm) was conducted to convert the positively skewed distribution of the scores into a normal distribution. All the other variables were found to be within the acceptable range of normality (their kurtosis and skewedness values ranged between -2 and 2). In the analyses including the whole sample, the transformed version of PE scores was used. In the separate analyses for each grade level, the transformed version of PE skills was used for the third graders only.

In order to see whether there is a significant difference between Grade 3 and Grade 4 in terms of PE, RAN, word reading and word spelling performance, Independent Samples T-tests were conducted. To see the intercorrelations between

PE skills, RAN, word reading and word spelling scores, Pearson product-moment correlations were employed. Lastly, to find out the contributions of PE and RAN to reading and spelling skills, two-step multiple (hierarchical) regression analyses were conducted. Throughout the statistical analyses, the alpha level was set at .05.

For the qualitative data analysis, the errors were counted and categorized based on the spelling rubric (see Table 8). Then, percentages were composed out of the error frequencies, and pie charts were obtained to see and compare the most common error types observed in the students' handwritings. In addition, error characteristics were compared with reference to grade level and task modality (copying vs. dictation).

Table 8. Rubric for Categorizing Spelling Errors.

Error Categorization	Examples
Grapheme omission	(Target word: *arkadaş* 'friend') *akadaş
Grapheme addition	*arkandaş
Grapheme substitution	*arkabaş
Grapheme reversal	*akradaş
Syllable omission	*ardaş
Syllable addition	*arkadaşta
Syllable reversal	*ardaşka
Syllable separation	*arka daş
Diacritic omission	*arkadas
Diacritic addition	(Target word: aşağıdaki 'below') *aşağidaki
Word omission	Text level
Word addition	Text level

After the most problematic words were detected, the potential reasons underlying the nature of the spelling errors were explained with reference to the language specific characteristics of Turkish.

This chapter has provided information about the research questions and the research hypotheses, participants, instruments, data collection procedure, and the data analysis of the present study. The following chapter will present the results of the analyses.

CHAPTER 5

RESULTS

In this chapter, the results of the quantitative and qualitative data analyses are presented. The statistical analyses included independent samples t-test, Pearson product-moment correlations, and hierarchical regression analyses. The error analysis was made on the basis of a comprehensive spelling rubric, and error percentages were obtained out of error frequencies.

Research findings

Descriptive statistics including percentages of mean scores and standard deviations for the scores in PE, word reading and word spelling are presented in Table 9.

Table 9. Descriptive Statistics for Grade 3 and Grade 4.

	Grade Level: 3 (N=46)		Grade Level: 4 (N=31)	
Tests	M (%)	SD (%)	M (%)	SD (%)
Phonological Encoding	87.44	8.924	90.32	6.362
Word Reading	67.15	14.171	75.76	11.691
Word Spelling	76.88	21.308	84.05	15.914

In phonological encoding skills, although the fourth graders performed better than the third graders, their scores were not very different from each other. In word reading and word spelling tests, the fourth graders received higher scores and demonstrated less variability in comparison to the third graders. As for RAN performance, the fourth graders completed the task in a shorter time (M = 23.65, SD = 3.720) than the third graders (M = 27.50, SD = 5.290), which meant that they were processing the visual stimuli at a faster pace in comparison to the third graders.

Research Question 1: Is there a significant difference between Grade 3 and Grade 4 in terms of PE skills, RAN performance, word reading and word spelling achievement?

In order to see whether the performances in PE, RAN, word reading and word spelling significantly differ across grade levels, Independent Samples T-tests were conducted for each variable separately. Since PE scores of the third graders violated the normality assumption, the transformed version of the data was included in the analysis. As for homogeneity of variance, Levene's Test results showed that all the variables met the assumption of equal variances.

According to the results of the t-tests, there was no significant difference between the PE skills of the third graders and the fourth graders t (75) = -1.945, $p >$ .05. This was probably due to the fact that the students mastered phoneme-grapheme conversion skills at the very early stages of literacy acquisition with the help of transparent orthography of Turkish. Therefore, phonological knowledge did not differentiate between the participants at these grade levels. On the other hand, the fourth graders performed significantly better than the third graders in the rapid naming task t (75) = 3.511, $p < .01$. This finding suggested that the fourth graders developed higher levels of automatization in retrieving phonological and orthographical representations. In word reading, the fourth graders again received significantly higher scores when compared to the third graders t (75) = -3.998, $p <$ .001. It is predicted that the fourth graders made use of automaticity to a greater extent and utilized sight word reading more often than the third graders, which enhanced their accuracy and fluency when reading the target items.

Lastly, it was found that the fourth graders performed significantly better than the third graders in word spelling t (75) = -2.020, $p < .05$. This finding might indicate that as in reading performance, higher levels of automatization enabled the fourth graders to retrieve the necessary letter chunks more easily and efficiently in order to spell the target items.

Although both groups were considered to be skilled readers and spellers at similar levels, the fourth graders performed significantly better in RAN, word reading and word spelling tests when compared to the third graders. On the other hand, both groups were similar in terms of their PE skills, as hypothesized. Based on the results of the t-tests, it can be stated that the first research hypothesis of the present study was not fully confirmed.

Research Question 2: What are the correlations of PE skills and RAN with word reading and word spelling performance in Turkish? Is the pattern of correlations among the measures different in Grade 3 compared to Grade 4?

In order to see whether PE and RAN performance correlated with reading and spelling skills in the whole sample, Pearson product-moment correlations were obtained. The results of the analysis are demonstrated by Table 10.

Table 10. Intercorrelations among the Measures.

Variables	1	2	3	4
1. PE	-			
2. RAN	-.234*	-		
3. WREAD	.425**	-.572**	-	
4. WSPELL	.610**	-.437**	.529**	-

Note. PE = Phonological Encoding, RAN = Rapid Automatized Naming, WREAD = Word Reading, WSPELL = Word Spelling. N = 77. *p < .05, ** p < .01.

The correlational analysis among the test scores revealed that all the measures were significantly and in general substantially correlated with each other except for the weak but still significant relationship between RAN and PE skills. PE had a positive relationship with word reading and word spelling which were also positively correlated with each other. However, all three variables were negatively correlated with RAN, which is not surprising since shorter time needed to complete the task meant higher levels of performance. The result that PE skills were strongly associated with spelling while RAN is closely related to reading confirms the second research hypothesis of the current study.

In order to examine the pattern of correlations within each grade level, correlational analyses were separately conducted for each grade level. Table 11 and Table 12 demonstrate the intercorrelations among the test scores of the third and the fourth graders respectively. The results indicated that the relationship between the literacy measures were quite similar across grade levels. It was found that the correlation between PE and RAN was rather weak both at Grade 3 and Grade 4. In addition, PE, RAN, word reading and word spelling had similar correlations at both grade levels. However, there was a pattern showing that PE skills had stronger correlations with reading and spelling skills for the third graders than for the fourth graders.

Table 11. Intercorrelations among the Measures at Grade 3.

Variables	1	2	3	4
1. PE	-			
2. RAN	-.165	-		
3. WREAD	.380**	-.477**	-	
4. WSPELL	.627**	-.358*	.451**	-

Note. PE = Phonological Encoding, RAN = Rapid Automatized Naming, WREAD = Word Reading, WSPELL = Word Spelling. N = 31. *p < .05, ** p < .01.

Table 12. Intercorrelations among the Measures at Grade 4.

Variables	1	2	3	4
1. PE	-			
2. RAN	-.188	-		
3. WREAD	.358*	-.540**	-	
4. WSPELL	.538**	-.474**	.573**	-

Note. PE = Phonological Encoding, RAN = Rapid Automatized Naming, WREAD = Word Reading, WSPELL = Word Spelling. N = 46. *p < .05, ** p < .01.

On the other hand, RAN correlated more strongly with reading and spelling skills at Grade 4 than at Grade 3. This finding suggests that whereas the third graders utilized phoneme-grapheme conversion strategies more often than the fourth graders, the fourth graders integrated automatization into their reading and spelling skills to a greater extent than the third graders. As the grade level increased, phonological knowledge became less influential, and automatization established stronger links with literacy skills. Hence, the related research hypothesis of the study was confirmed.

Research Question 3: Do RAN and PE skills make significant contributions to word reading skills in Turkish? How much variance is explained by these variables at Grade 3 and Grade 4?

To assess whether RAN and PE skills account for unique variance in reading skills, hierarchical regression analyses were conducted. When reading was taken as the dependent variable, RAN was entered into the model in step 1, and PE was added as the second variable in step 2. The decision regarding the order of entry was made

on the basis of the correlations between variables. Before conducting the regression analyses, collinearity statistics were checked for the independent variables, and it was found that variance inflation factor levels (smaller than 10) and tolerance levels (greater than .10) were all within the acceptable ranges. Table 13 illustrates the results of the regression analysis conducted for the whole sample.

Table 13. Summary of Hierarchical Regression for Word Reading.

Dependent Variable: Word Reading (N= 77)

Independent Variable	B	t	R	R^2	ΔR^2
Step 1			.572	.327	.327
RAN	-.572	-6.034***			
Step 2			.645	.417	.090
RAN	-.499	-5.468***			
PE	-.308	-3.376***			

Note. RAN = Rapid Automatized Naming, PE = Phonological Encoding. B = Standardized Beta, ΔR^2 = R Squared Change.*p < .05, **p < .01, ***p < .001.

According to the results, RAN made a significant contribution to reading achievement of the students ($F_{1, 75} = 36.411$, $p < .001$) by accounting for 32 % of the total variance. As for the role of PE skills, it was found that PE accounted for 9 % of the remaining variance and made a unique contribution to reading achievement beyond RAN performance ($F_{change} = 11.394$, $p < .01$).This finding shows that although the participants used sight word reading as their primary strategy, they also utilized phoneme-grapheme conversion skills in order to read the target items. It is highly likely that they needed PE skills for reading the suffixes attached to the familiar roots of the target words. Hence, PE remained as a significant predictor of reading in addition to RAN even at the skilled stages of reading in Turkish. Based on this result, it can be stated that the third research hypothesis of the present study was confirmed.

In order to see grade level differences in the regression results, two separate hierarchical regression analyses were conducted for each grade level. Table 14 and 15 demonstrate the summary of the regression analyses for the third and the fourth graders respectively.

Table 14. Summary of Hierarchical Regression for Word Reading at Grade 3.

Dependent Variable: Word Reading (N= 46)

Independent Variable	B	t	R	R^2	ΔR^2
Step 1			.477	.228	.228
RAN	-.477	-3.604**			
Step 2			.566	.321	.093
RAN	-.426	-3.345**			
PE	.309	2.426*			

Note. RAN = Rapid Automatized Naming, PE = Phonological Encoding. B = Standardized Beta, ΔR^2 = R Squared Change. *p < .05, **p < .01, ***p < .001.

Table 15. Summary of Hierarchical Regression for Word Reading at Grade 4.

Dependent Variable: Word Reading (N= 31)

Independent Variable	B	t	R	R^2	ΔR^2
Step 1			-.540	.292	.292
RAN	-.540	-3.454**			
Step 2			.600	.359	.068
RAN	-.490	-3.182**			
PE	.265	1.723			

Note. RAN = Rapid Automatized Naming, PE = Phonological Encoding. B = Standardized Beta, ΔR^2 = R Squared Change. *p < .05, **p < .01, ***p < .001.

As can be seen in Table 14, RAN accounted for 22 % of the total variance in reading achievement ($F_{1, 44} = 12.988$, $p < .01$) of the third graders. Phonological encoding, which entered next into the model, significantly accounted for an additional 9 % of the variance ($F_{change} = 5.886$, $p < .05$). Overall, the model predicted 32 % of reading achievement with the significant contributions of both RAN and PE skills. Regarding the fourth graders' reading performance, as shown in Table 15, it was found that

RAN accounted for 29 % of the total variance in reading achievement ($F_{1, 29}$ = 11.933, $p < .01$) whereas PE failed to make a significant contribution to reading skills despite accounting for an additional 6 % of the remaining variance (F_{change} = 2.968, $p > .05$). Therefore, the only significant contribution to word reading at the fourth grade was made by RAN. Although involved in the reading processes, the influence of PE, on the other hand, did not reach statistical significance. This finding indicates that as the grade level increased, automatization as indexed by RAN performance accounted for greater amount of variance in word level reading (22 % at Grade 3, 29 % at Grade 4). That is, the fourth graders made use of sight word reading more often than the third graders. Regarding the role of PE, as predicted, PE skills became less influential in predicting reading achievement as the grade level increased. These findings were in line with the related research hypothesis of the current study.

Research Question 4: Do PE skills and RAN make significant contributions to word spelling skills in Turkish? How much variance is explained by these variables at Grade 3 and Grade 4?

To answer this research question, hierarchical regression analyses were conducted by taking word spelling skills as the dependent variable. In this case, PE was entered into the model in step1, and RAN was included in the analysis in step 2. The results of the regression analysis conducted for the whole sample are demonstrated in Table 16.

Table 16. Summary of Hierarchical Regression for Word Spelling.

Dependent Variable: Word Spelling (N= 77)

Independent Variable	B	t	R	R^2	ΔR^2
Step 1			.610	.372	.372
PE	.610	6.671***			
Step 2			.681	.464	.091
PE	.537	6.136***			
RAN	-.311	-3.547***			

Note. PE = Phonological Encoding, RAN = Rapid Automatized Naming. B = Standardized Beta, ΔR^2 = R Squared Change.*p < .05, **p < .01, ***p < .001.

The results of the regression analysis revealed that PE accounted for 37 % of the total variance in spelling achievement in Turkish ($F_{1, 75} = 44.503$, $p < .001$). When RAN was entered into the model as the second variable, it made a significant contribution to spelling performance beyond PE skills by accounting for 9 % of the remaining variance ($F_{change} = 12.582$, $p < .01$). This finding suggests that whereas the participants primarily used phoneme-grapheme conversion strategies when spelling the target items, they also utilized automatization in order to retrieve the orthographic information of the familiar words. That is, phoneme-grapheme level operations were not necessarily the only way of retrieving word spellings even in the transparent orthography of Turkish. Altogether, these outcomes confirmed the fourth hypothesis of the current study.

In order to explore the role of PE and RAN in predicting spelling achievement across grade levels, two hierarchical regression analyses were conducted for each grade separately. The results of the analyses for Grade 3 and Grade 4 are demonstrated in Tables 17 and 18 respectively.

Table 17. Summary of Hierarchical Regression for Word Spelling at Grade 3.

Dependent Variable: Word Spelling (N= 46)

Independent Variable	B	t	R	R^2	ΔR^2
Step 1			.627	.393	.393
PE	.627	5.340***			
Step 2			.678	.460	.067
PE	.584	5.137***			
RAN	-.262	-2.302*			

Note. PE = Phonological Encoding, RAN = Rapid Automatized Naming. B = Standardized Beta, ΔR^2 = R Squared Change. *p < .05, **p < .01, ***p < .001.

Table 18. Summary of Hierarchical Regression for Word Spelling at Grade 4.

Dependent Variable: Word Spelling (N= 31)

Independent Variable	B	t	R	R^2	ΔR^2
Step 1			.538	.289	.289
PE	.538	3.433**			
Step 2			.658	.433	.144
PE	.465	3.208**			
RAN	-.386	-2.663*			

Note. PE = Phonological Encoding, RAN = Rapid Automatized Naming. B = Standardized Beta, ΔR^2 = R Squared Change.*p < .05, **p < .01, ***p < .001.

Table 17 demonstrates the contribution of PE and RAN to word spelling at the third grade. Accordingly, PE alone accounted for 39 % of the total variance in spelling achievement ($F_{1, 44} = 28.513$, $p < .001$) at this grade level. When RAN was entered into the model, it accounted for 6 % of the remaining variance beyond the contribution of phonological knowledge ($F_{change} = 5.299$, $p < .05$). Overall, the model accounted for 46 % of the total variance in the spelling achievement of the third graders. This outcome demonstrated that both PE skills and RAN performance significantly contributed to word spelling in Turkish at the third grade.

As for Grade 4, as shown in Table 18, PE was again entered into the regression model in the first place. According to the results, PE skills significantly

accounted for 28 % of the total variance in spelling achievement of the fourth graders ($F_{1, 29} = 11.789$, $p < .01$). When RAN was entered into the model as the second variable, it accounted for 14 % of the remaining variance beyond the contribution of phonological knowledge ($F_{change} = 7.094$, $p < .05$). Therefore, the whole model accounted for 43 % of the total variance in the fourth graders' spelling performance. The results showed that both phonological encoding and rapid naming were significant predictors of word spelling achievement of the fourth graders. These findings indicate that in line with the third graders, the fourth graders also tended to use phoneme-grapheme conversion skills as their primary strategy when spelling and they additionally utilized automatization for retrieving word specific orthographic knowledge stored in the mental lexicon. When compared, though, it was seen that the amount of variance explained by PE skills was larger at Grade 3 (39 %) than at Grade 4 (28 %). On the other hand, RAN accounted for larger amounts of variance in word spelling at Grade 4 (14 %) in comparison to Grade 3 (6 %). Hence, parallel to what was found for reading achievement, as the grade level increased, phonological knowledge tended to become less influential and automatization started to gain more importance in predicting spelling achievement in Turkish. To this end, the related research hypothesis was confirmed.

Research Question 5: What kinds of spelling errors are prevalent in the handwritings of the students? Are the observed error characteristics subject to any variation depending on the grade level and task modality?

To answer this question, an error analysis was conducted, and each spelling error was counted and recorded under the corresponding error category (see Table 8 for the rubric) by the researcher. Then, after calculating the total number of error

occurrences, percentages were obtained out of frequencies in each error category. Pie charts were used to illustrate the distribution of the error types.

First, a comparison is made between the task modalities to see whether error characteristics in spelling change across copying and dictation tasks at word and text levels. Then, the most common error types are compared on the basis of grade levels. The findings are demonstrated by the following pie charts.

Error types in word level spelling

As demonstrated by Figure 2, the most common error types were diacritic omission, grapheme substitution and grapheme omission errors at word level spelling across modalities. There was an increase in the amount of grapheme substitution errors in the dictation task when compared to the copying task.

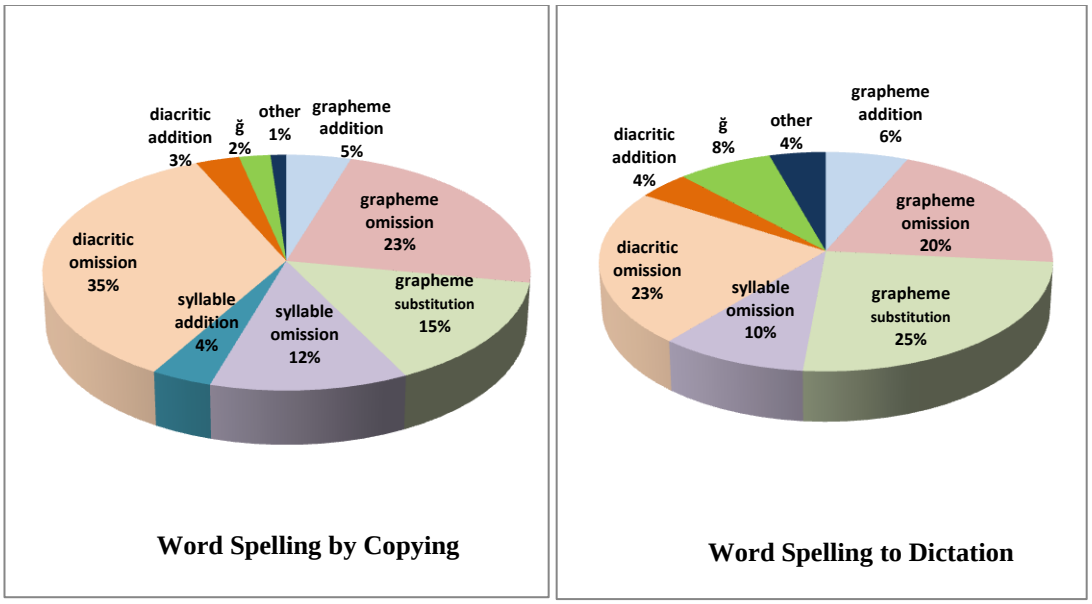

Fig. 2. Error distributions in word spelling across different modalities.

This outcome is not surprising since the dictation task entailed more cognitive load and use of working memory capacity (WMC) during spelling. Another finding was that although it had small percentages, errors related to *soft g* increased during the word dictation task. The reason for this result is that *soft g* is not pronounced in

standard Turkish, and the students had difficulty in mapping this sound onto its corresponding grapheme while listening.

Among the grapheme substitution errors, the most problematic pairs were *m-n* (32 %) and *e-i* (21%) in the copying task. Similarly, it turned out in the dictation task that *e-i* (19 %) and *m-n* (11 %) were the most difficult pairs for the students. In addition, there were several cases in which *y* was substituted for *ğ* in the dictation task (10 %). Common examples of grapheme substitution errors appeared in forms such as *dedeciy(ğ)im (grandpa), kaplun(m)bağa (turtle),* and *öğreni(e)ceğinizi (that you will learn)* in both tasks. Lastly, diacritic omission errors appeared to be more common in the copying task. This is an interesting finding; however, it is possibly related to the fact that attentional mechanisms were more actively involved in the dictation task, and the students may have paid more attention to this less salient aspect of spelling as they listened to the researcher.

In the word copying task, the most problematic word was *kullanılabilmektedir (it can be used)* both for the third graders (59 %) and the fourth graders (58 %) as a long, multimorphemic word with a letter doublet. Students mostly omitted one of the *l*s when spelling this word. In the word dictation task, the most difficult word to spell was *öğreneceğinizi (that you will learn)* for the third graders (52 %) and *kavuşabileceklerini (that they will meet)* for the fourth graders (45 %). The participants had difficulty in spelling these words probably because they were long and multimorphemic words including several diacritics, and there exists a conflict between their conventional spellings and everyday pronunciations *(öğreneceğinizi vs. *öğreniceğinizi; kavuşabileceklerini vs. *kavuşabiliceklerini*). Furthermore, the word *öğreneceğinizi* includes two *soft g*s.

The comparison of grade levels in word copying task revealed that there was a parallelism in the patterns of the most common error types at both grade levels (see Figure 3). A notable finding was that diacritic omission errors constituted a larger proportion of the total number of errors at Grade 4 in comparison to Grade 3. This might be due to the fact that the fourth graders probably found the task uninteresting and paid less attention to the use of diacritic marks as they copied the target words. Among grapheme substitution errors, the most problematic pair was *m* and *n* both for the third graders (32 %) and the fourth graders (31 %).

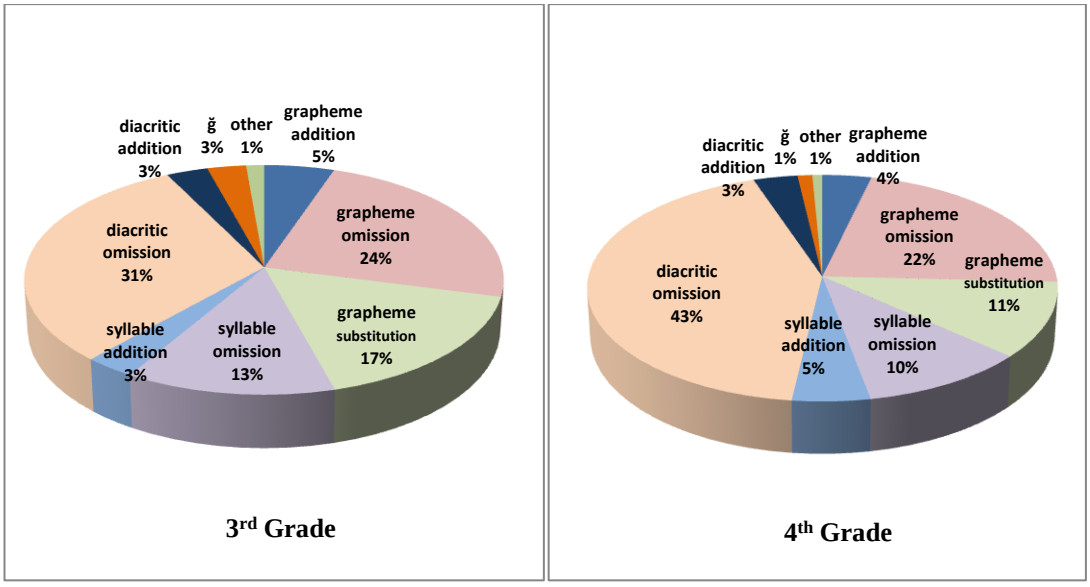

Fig. 3. Error distributions across grade levels (word spelling by copying).

In the word dictation task, the distributions of the error types were again similar across grade levels (see Figure 4). As in the copying task, the most common errors were diacritic omissions, grapheme omissions and grapheme substitutions. A similar finding was that diacritic omissions made up a larger proportion of the total number of errors in the handwritings of the fourth graders. Among the grapheme substitution errors, the most problematic pair was *e* and *i* for both grade levels (16 % at Grade 3, 26 % at Grade 4). The reason for this tendency might be the conflict between the conventional spelling and the variations in word pronunciation in spoken Turkish as

in the example of *öğreneceğinizi* misspelled as *öğreniceğinizi*. Although the researcher did not convert *e* into *i* in her pronunciation, the students tended to apply this conversion based on their own phonological representations.

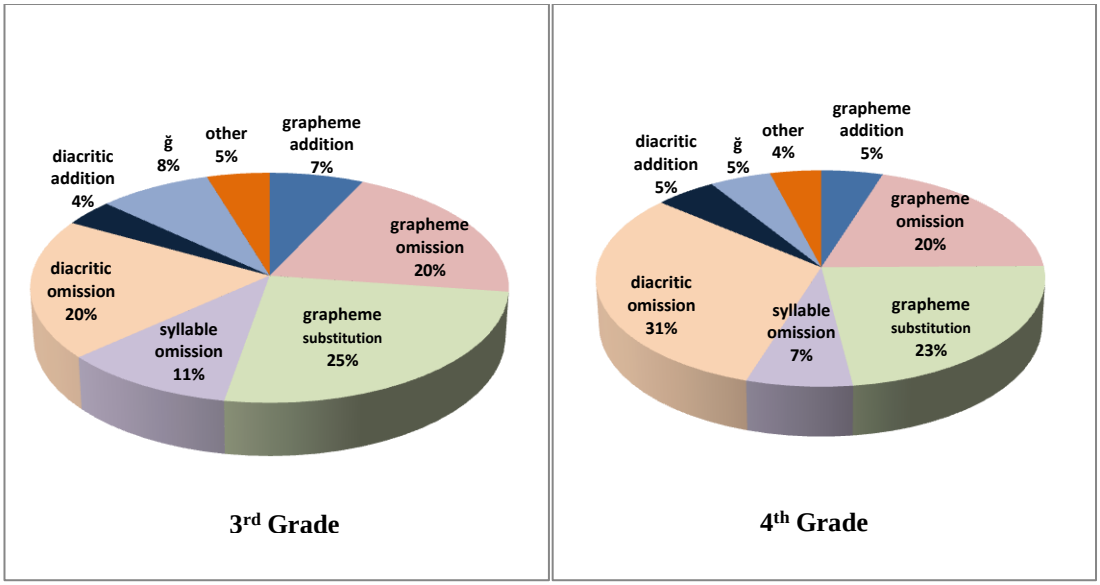

Fig. 4. Error distributions across grade levels (word spelling to dictation).

Overall, although similar error patterns were found in the word copying and the word dictation tasks; there were some variations in the error distributions. The word dictation task yielded more grapheme substitution errors in comparison to the word copying task. In addition, *soft g* errors were more common in the dictation task since its phoneme-to-grapheme mapping was problematic for the students during listening. Another interesting finding was that the students seemed to ignore using diacritics more often during the copying task when compared to the dictation task. This situation might be associated with attentional processes and motivational factors. As the dictation task was more challenging, the children were probably more alert and they might have taken the test more seriously. Therefore, it can be stated that task modality may influence spelling performance (Bosman & Van Orden, 1997) and the variation in the spelling errors. As for the comparisons across grade levels, diacritic omissions were more prevalent in the errors of the fourth graders. One possible

explanation for this finding is that the fourth graders did not find the tasks challenging, and they performed more negligently, without monitoring their cursive and going back to the letters to complete the missing diacritics. In other categories, it was found that the distributions of error types were similar at both grade levels.

Error types in text level spelling

In text level spelling, a large proportion of the spelling errors were grapheme substitutions both in copying and dictation tests. When compared to the spelling errors found in the copying task, the proportion of grapheme substitution errors was larger in the dictation task (see Figure 5). The most problematic pair was *a-o* both in copying (60 %) and dictation (77 %) tasks. Many of the students had difficulty in spelling the word *maydanoz (parsley),* and misspelled it as *maydonoz*. The reason underlying this error was probably the common mispronunciation of the word in spoken Turkish. Another finding was that some word addition and word omission errors emerged in the dictation task. There was no other significant variation in the error patterns across modalities.

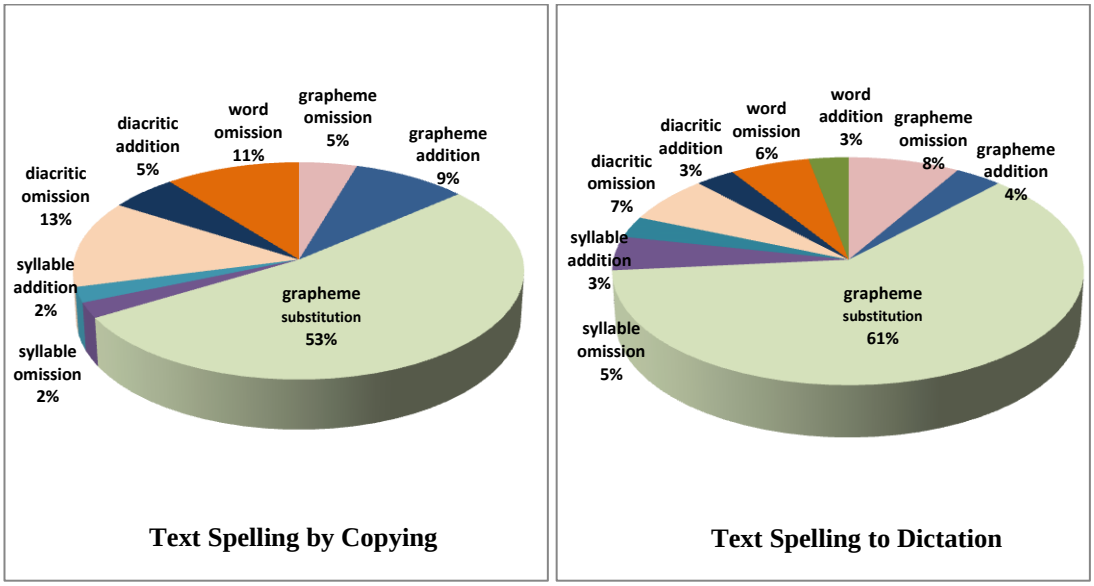

Fig. 5. Error distributions in text spelling across different modalities.

When the error patterns in the copying task were examined across grade levels, it was seen that the proportion of grapheme substitution errors was parallel at Grade 3 and Grade 4 (see Figure 6). For both levels, *a* and *o* appeared to be the most problematic pair, (79 % for the third graders, 72 % for the fourth graders) which yielded many substitution errors.

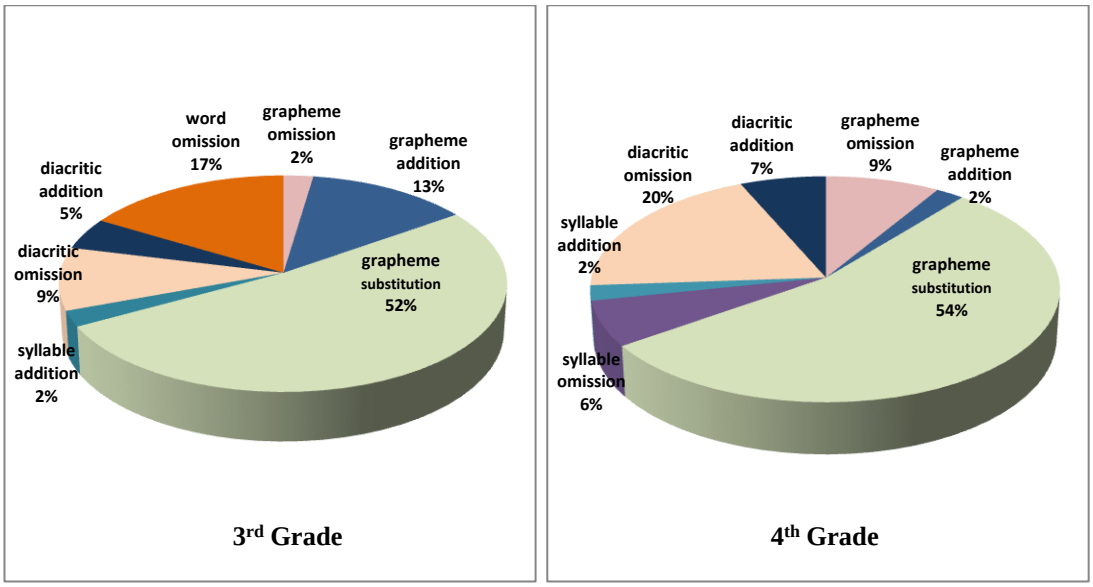

Fig. 6. Error distributions across grade levels (text spelling by copying).

Most of the students at both grade levels made errors when spelling the word *maydonoz* (70 % at the Grade 3, 61 % at Grade 4). Another finding was that unlike the fourth graders, word omission and grapheme addition errors were prevalent in the handwritings of the third graders. As in word level spelling, the fourth graders made proportionally larger amounts of diacritic omission errors in the text copying task. In addition, it was observed that 47 % of the third graders and 39 % of the fourth graders made various punctuation errors (use of capital letters, comma, and full stop) while copying the text.

In text dictation, grapheme substitution errors were again the most prevalent error type across grade levels (see Figure 7). As in the text copying task, the most

problematic pair among the grapheme substitution errors was *a* and *o* for both grade levels (55 % at Grade 3, 68 % at Grade 4).

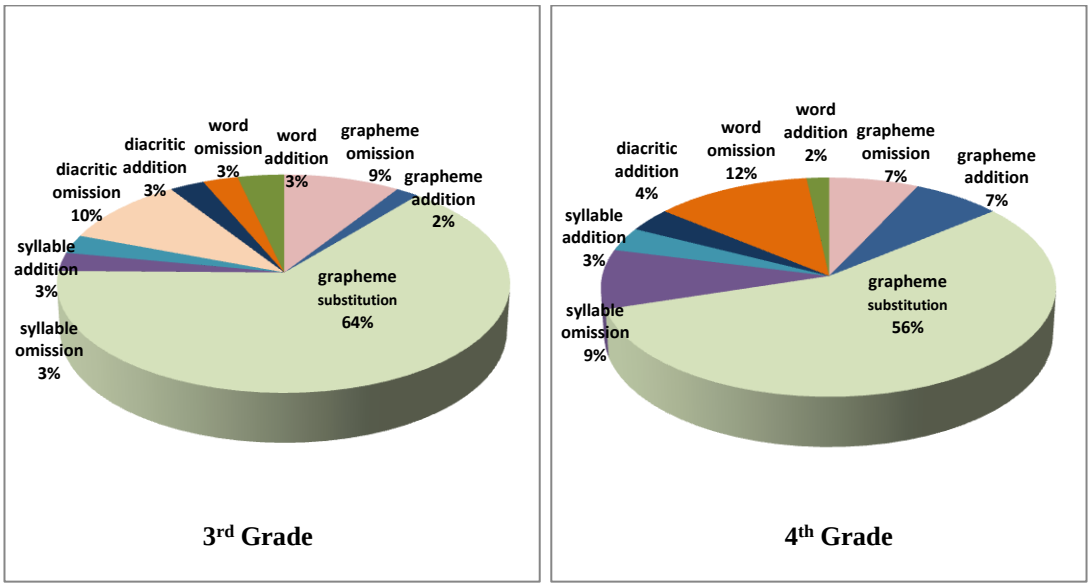

Fig. 7. Error distributions across grade levels (text spelling to dictation).

Interestingly, the fourth graders did not make any diacritic omission errors this time. On the other hand, they made slightly larger proportions of word omission, syllable omission and grapheme addition errors. Another finding was that 70 % of the third graders and 65 % of the fourth graders made a variety of punctuation errors in this task. When compared to text copying, a larger number of students had difficulty in using proper punctuation marks in the text dictation task. Again, the most problematic word was *maydanoz* for both grade levels (78 % at Grade 3, 74 % at Grade 4).

In general, the most common error types were found to be grapheme substitution, diacritic omission and grapheme omission errors in word and text level spelling tasks regardless of the grade level and task modality. In addition, most of the students had difficulty in using punctuation marks properly in the text level spelling tasks. This finding confirmed the fifth research hypothesis of the present study. As for the comparisons of the error patterns across grade levels and task modality, it was

found that both groups of students mostly made similar types of spelling errors in similar proportions. On the other hand, although there were no striking differences in the spelling errors across modalities, there emerged some variations, especially in the proportions of grapheme substitution errors, problems in *soft g* and diacritic omission errors. Thus, it could be stated that the related research hypothesis was also confirmed.

In this chapter, the results of the qualitative and quantitative analyses have been presented. The following chapter will provide a discussion of the results and implications for pedagogical purposes. In addition, it will acknowledge the methodological limitations; make suggestions for further research, and present the conclusions of the current study.

CHAPTER 6

DISCUSSION AND CONCLUSION

This chapter presents the discussion of the results obtained from the data analysis. Based on the findings, it also provides some implications for spelling instruction at Turkish schools. In the last section, the limitations of the present study are acknowledged, and some suggestions are made for further research in the field of literacy acquisition.

6.1 Discussion

6.1.1 PE, RAN, word reading and word spelling skills across grade levels

Normally developing children are reported to master phonological skills at very early stages of literacy acquisition in Turkish (Durgunoğlu & Öney, 1999). Therefore, it was hypothesized in the current study that both the third graders and the fourth graders had already acquired high levels of PA skills, and there would not be any significant difference between their test scores in phonological encoding. As predicted, the results of the Independent Samples t-Test suggested that the fourth graders did not perform significantly better than the third graders in the test of phonological encoding.

The analyses regarding the grade level differences in RAN, word reading and word spelling revealed that although both groups were considered to be skilled readers and spellers, the fourth graders' scores in these three tests were significantly higher than those of the third graders. This finding might indicate that automatization shows a progression across grade levels, and its involvement in literacy tasks enhances reading and spelling achievement at higher grades.

6.1.2 The interplay between PE, RAN, word reading and word spelling

According to Frith (1985), although reading and spelling skills are strongly associated with each other, they entail different developmental processes. While reading skills move from phonological stage to orthographic stage earlier, spelling remains as a phonologically oriented skill for a longer period of time. The correlational analyses of the current study provided supporting evidence for Frith's developmental model in the transparent orthography of Turkish.

The results demonstrated that PE correlated more strongly with spelling than with reading at both grade levels. On the other hand, RAN had stronger correlations with reading than with spelling both at Grade 3 and Grade 4. This means that while the mechanisms underlying spelling skills are phonologically driven, reading achievement is indexed by orthographic strategies as revealed by rapid naming performance. More specifically, it seems that phonological knowledge, which is very important for the acquisition of both reading and spelling skills at the very early stages, maintains its strong connections with spelling skills at Grade 3 and Grade 4 whereas it starts to be less crucial for reading skills. It was found that due to the highly transparent orthography of Turkish, phonological knowledge and phoneme-grapheme conversion skills were at the center of spelling performance for elementary school students.

When the correlations were examined with a focus on grade-level differences, it was seen that PE started to have weaker connections with reading and spelling as the grade level increased. On the other hand, RAN tended to demonstrate stronger correlations with reading and spelling at Grade 4 when compared to Grade 3. In other words, RAN established more central connections with the literacy skills of the students with more experience in reading and spelling, who were considered to have

higher levels of automatization. As for the relationships between RAN and PE, it was found that they had rather low correlations at both grade levels. This result probably indicates that rapid naming and phonological knowledge measures might be indexing two separate constructs as proposed by the double-deficit hypothesis (Wolf & Bowers, 1999).

6.1.3 Contributions of PE and RAN to word reading and word spelling

When compared to reading, spelling entails more sensitive phonological processes (Perfetti, 1997). As hypothesized, the results of the regression analyses of the present study showed that when compared to RAN, phonological skills accounted for a larger amount of variance in the spelling performance of the participants. In line with Perfetti's (1997) argument, spelling skills appeared to be more phonologically oriented than reading skills. On the other hand, RAN was a better predictor of reading performance than PE skills. This result supports the findings that RAN is a strong precursor of reading achievement across languages (Norton & Wolf, 2012). Besides, this finding provides supporting evidence for Babayiğit and Stainthorp's (2010) study, which revealed that while RAN predicts reading achievement, PA contributes to spelling performance in Turkish.

An important finding of the current study was that RAN made a significant contribution to spelling achievement beyond PE skills at both grade levels. In addition to the central role of phonological skills, automatization got involved in the rapid retrieval of word specific orthographic knowledge that was required to spell frequent words in Turkish. This finding contradicts with Babayiğit and Stainthorp's results which suggested that RAN did not explain any variance in spelling skills in the transparent orthography of Turkish. In their study, they followed a group of first graders into the second grade and investigated whether RAN predicted later reading

and spelling performance of Turkish speaking children. However, the current study had a cross-sectional design, and included students from Grade 3 and Grade 4, who were considered to be proficient spellers with higher levels of automatization in performing literacy tasks. The items used in the word dictation test were all familiar words which frequently appeared in the students' course books. Hence, in line with the arguments of Dos Santos and Befi-Lopes (2012), it is suggested that the high-frequency test items might have facilitated the use of automatization strategies during spelling even in the truly transparent orthography of Turkish. It is highly likely that the students made use of their word specific orthographic knowledge to a greater extent as they spelled the roots of familiar items, and they utilized phoneme-grapheme conversion strategies when spelling the suffixes attached to the long and multimorphemic words such as *söyleyebileceğiniz ([the thing] that you can say).* To this end, it is appropriate to suggest that Turkish speaking learners rely not only on phoneme-grapheme mappings of words, but also on word specific orthographic knowledge during spelling tasks.

When the results were examined with a focus on grade-level differences, it was found that as the grade level increased, the influence of PE tended to decrease and the role of RAN started to become more important in predicting spelling achievement. This outcome suggests that as the learners become more proficient, they utilize automatization to a greater extent when they spell words. This finding supports the argument made by Verhagen et al. (2010), who stated that the predominating influence of PA on spelling at very early stages of literacy tended to decrease as Dutch speaking children became more proficient learners. Although their participants were first and second graders, the patterns demonstrated by the third and

the fourth graders in the current study show parallelism to their finding that the role of RAN in predicting spelling increased at later stages of literacy development.

Regarding the role of RAN and PE skills in predicting reading achievement, it was found that RAN was the stronger predictor of reading skills at both grade levels. Beyond RAN, PE made a small but significant contribution to the reading skills of the whole sample. When analyzed separately, it was found that PE made a unique contribution to the reading skills of the third graders whereas it did not account for significant amounts of variance in the reading performance of the fourth graders. This result might be indicating that while the third graders are in an intermediate position between phonological and orthographic processes of reading, the fourth graders have attained higher levels of mastery in orthographic reading skills (sight word reading). Similar to the patterns found in the spelling data, the findings showed that as the grade level increased, the importance of PE tended to decrease and the role of RAN became more influential in predicting reading skills.

In summary, these findings suggest that whereas PA (measured as phonological encoding) is an index of spelling skills, RAN is a predictor of reading skills in Turkish. However, beyond PE, RAN makes unique contributions to the spelling skills of the third and the fourth graders as they spell frequent words. In reading, although PE makes additional contributions to the reading skills of the third graders beyond RAN, it does not account for statistically significant amounts of variance in the reading skills of the fourth graders. As the grade level increases, the influence of phonological knowledge tends to decrease, and RAN starts to play a more central role both in reading and spelling performance. This shows that automatization gets involved in the processes underlying literacy skills to a greater extent at higher grade levels.

6.1.4 Cognitive operations in reading and spelling in Turkish

The findings of the current study could be interpreted with reference to the dual route theory of word reading (Coltheart, 1978) and spelling (Tainturier & Rapp, 2001). As for reading, RAN was a better predictor of reading achievement than PE for both grade levels. This means that the participants primarily used the orthographic route for the recognition of the familiar test items. To be more specific, they generally recognized the items as sight words without resorting to phoneme-grapheme conversion strategies. However, PE was found to make a unique contribution to the reading skills of the third graders beyond rapid naming performance. This finding might indicate that the third graders switched between the orthographic route and the phonological route as they read target words. Even though they generally used sight word reading, they also utilized phoneme-grapheme conversion strategies during the test. On the other hand, although PE had moderate and significant correlations with the fourth graders' reading skills, it failed to account for statistically significant amounts of variance in reading achievement at this grade level. This condition might indicate that the fourth graders integrated automatization into their word recognition skills more efficiently, and adopted the orthographic route as their predominant strategy while reading the target items. This finding does not necessarily suggest that there was not any interplay between the orthographic route and the phonological route for the fourth graders. Instead, it is likely that the interference of the phonological processes was suppressed by the efficient use of orthographic strategies utilized to read the familiar words.

During spelling, the participants tended to follow the phonological route as their primary strategy. However, phoneme-grapheme conversion strategies were not necessarily the only way they used as they spelled the target words. Results of the

analyses revealed that as an additional strategy, skilled spellers (both the third graders and the fourth graders) could retrieve word specific orthographic representations through the lexical (orthographic) route rapidly and effortlessly, as indexed by their RAN performances. That is, the students made use of both lexical and sublexical strategies of spelling in the transparent orthography of Turkish.

Although RAN made unique contributions to spelling at both grade levels, the role of automatization appeared to be more influential in the spelling achievement of the fourth graders when compared to the third graders. This finding might imply that as the participants have more experience in literacy tasks, they transfer a larger amount of word specific orthographic information into their orthographic lexicons, and utilize the orthographic route to a greater extent while spelling words. This outcome supports Marsh et al.'s (1980) argument that spellers at higher grade levels make use of visual strategies to a greater extent when compared to spellers at lower grade levels. Although both the third graders and the fourth graders were assumed to be proficient readers and spellers in the current study, it turned out that the fourth graders were 'more proficient' than the third graders in terms of their RAN, word reading and word spelling performances. Therefore, it can be stated that this result is in line with the findings of Coenen et al. (1997), who suggested that more proficient learners employed orthographic strategies more often when compared to less proficient learners.

The finding about the importance of RAN in spelling achievement is in line with the suggestions of Seidenberg (1985), who claimed that the use of the orthographic route might have a remarkable role in word level spelling even in a truly transparent orthography when word familiarity is taken into consideration. In English, despite being regular (i.e. having consistent phoneme-grapheme

correspondences), high frequency words are considered to be transferred from the phonological route to the orthographic route (Reitsma, 1990). Thus, as in the case of exception words, they can be retrieved as whole units. In Turkish, nearly all words could be treated as regular items, and likewise, those which are highly familiar to the participants might have been transferred to the orthographic route of spelling. It is possible that especially in the case of long and multimorphemic words; familiar roots were retrieved as whole units, whereas the suffixes attached to them were processed by utilizing phonological encoding skills by the participants. This condition provides supporting evidence for the interaction of the two routes (Kreiner, 1992; Paap & Noel, 1991) during spelling production in the context of Turkish.

6.1.5 Spelling errors across task modalities and grade levels

The results of the error analysis suggested that the most common error types were found to be grapheme substitution, diacritic omission and grapheme omission, which constituted large proportions of the total number of errors. This finding shows parallelism to the previous research regarding the typical spelling errors found in the handwritings of Turkish speaking children (Bektaş, 2007; Demir, 2003; Erden et al., 2002; Kasapoğlu; 2010; Maraşlı, 2010). Among grapheme substitution errors, the problematic pairs were *m-n, y-ğ,* and *e-i* in word level spelling; and *a-o* in text level spelling. Additionally, in line with previous findings (Erden et al., 2002; Yıldız & Ateş, 2010), it was found that many students had difficulty in using punctuation marks properly.

There were some variations in the patterns of spelling errors across modalities (copying vs. dictation) at word and text level spelling. It was found that dictation tasks yielded larger proportions of grapheme substitution errors when compared to copying tasks since they were more challenging in cognitive terms. Another finding

was that diacritic omission errors were more common in copying tasks probably because the participants lost interest and did not pay attention to this less salient aspect of spelling during copying the target words.

Across grade levels, it was found that diacritic omission errors were more common in the spelling errors made by the fourth graders. This finding might indicate that the fourth graders were not as motivated as the third graders during the spelling tests, and they paid less attention to the proper use of diacritics. Regarding other types of spelling errors, the patterns were not strikingly different from each other at Grade 3 and Grade 4. It is predicted that cursive handwriting might have contributed to the emergence of diacritic omission errors in the present study. Since the students are taught to write in a continuous manner, they do not place diacritics of letters one at a time. Instead, once they finish writing words, they go back and complete missing diacritics as instructed by their teachers.

As proposed by Menz and Schroeder (2008), it was observed that many students made spelling errors when the spoken form of a word conflicted with its conventional spelling. There were errors such as simplification of consonant doublets *(kullanarak vs. *kulanarak)* and conversion of *e* into *i* as in the example of *öğreneceğinizi vs.*öğreniceğinizi*. These errors demonstrate the influence of phonological representations acquired through the spoken language on the emergence of spelling errors in Turkish. Although Turkish is defined as a language with a transparent orthography, such slight variations, if not explicitly taught during early years, might lead to spelling problems even during adulthood. Therefore, it would not be appropriate to acknowledge that such spelling errors are specific to the handwritings produced by elementary school students.

Another finding revealed by the error analysis was that there were various types of spelling errors related to the use of *soft g*. These errors appeared in the forms of syllable deletion (e.g. *kaplumba(ğa), dedeci(ği)m, aşa(ğı)da*) or grapheme substitution (e.g. *dedeciy(ğ)im*). Findings reflect the problematic condition of *soft g* for elementary school students, and support Ergenç's (1991) definition of *soft g* as a phenomenon which causes vowel shift and vowel lengthening in Turkish.

6.2 Conclusion

The findings of the present study demonstrated that phonological encoding was a significant precursor of spelling achievement whereas rapid naming played an important role in predicting reading performance in Turkish. This situation indicated that although the students reached the orthographic stage in reading, they were at the phonological stage in spelling.

In reading, it was found that the students at both grade levels primarily used sight word reading strategies as indexed by their RAN performances. While phonological knowledge contributed to the third graders' reading achievement, it did not make a significant contribution to the reading achievement of the fourth graders. This was probably because the third graders utilized phoneme-grapheme conversion as a compensatory strategy while the fourth graders had higher levels of mastery in sight word reading, which might have suppressed the potential effects of phonological operations involved in the reading processes.

As for spelling, the transparent orthography of Turkish probably contributed to the predominance of phonological processes in the participants' spelling performance. However, it was found that in addition to phoneme-grapheme conversion skills, automatization also played an important role in predicting spelling achievement at both grade levels. Within the scope of this study, automatization was

considered to be associated with orthographic processing, which is the retrieval of word spellings as whole units. As in the case of English, RAN contributed significantly to the spelling performance in Turkish. To this end, it was suggested that regardless of the orthographic depth, familiar words, or parts of familiar words could be retrieved as chunks by learners who attained a certain level of mastery in spelling skills.

Another finding of the present study was that the fourth graders integrated automatization into their reading and spelling performance to a greater extent when compared to the third graders. In addition, the role of phonological knowledge was found to be more influential for the third graders in performing literacy tasks. Furthermore, the low correlation between RAN and PE provided supporting evidence for the argument that rapid naming and phonological awareness represent two separate constructs as proposed by the double-deficit hypothesis.

Regarding the grade-level differences in RAN, PE, word reading and word spelling, it was found that since phonological skills are mastered very early in Turkish, PE skills did not significantly differentiate the fourth graders from the third graders. On the other hand, the fourth graders received significantly higher scores in RAN, word reading and word spelling tests than the third graders. Accordingly, it was suggested that there existed a developmental progression in these three skills across grade levels.

Lastly, the error analysis revealed that the third and the fourth graders mostly made diacritic omission, grapheme substitution, and grapheme omission errors in Turkish. In addition, many students had difficulty in using punctuation marks properly. Across modalities, dictation tasks yielded larger proportions of grapheme substitution errors in general whereas there were larger amounts of diacritic omission

errors in copying tasks. Across grade levels, no striking differences were found in the error patterns. That is, the third and the fourth graders made similar types of spelling errors in similar proportions. Another finding was that slight variations between spoken language and conventional spelling rules of Turkish led to the emergence of spelling errors in the students' handwritings.

6.3 Implications

The results of the current study suggest that reading and spelling skills go through different levels of cognitive and linguistic operations during literacy acquisition. While the students mostly rely on their phonological knowledge for spelling, they tend to utilize orthographic knowledge for reading. Thus, educators should handle spelling as a skill in its own right. As Ehri (1997) suggests, explicit teaching of spelling skills should be a central part of literacy instruction at schools. Teaching and assessment methods in spelling should be designed by taking into consideration that spelling skills form a separate construct with different underlying processes from the ones involved in reading.

Although spelling proved to be a phonologically oriented skill in the present study, it was found that automatized retrieval of letter chunks also played an important role in word level spelling in Turkish. Therefore, in addition to the teaching of phoneme-grapheme correspondence rules, reinforcing the use of analogies in classroom settings may contribute to students' efficiency in retrieving accurate word spellings during literacy tasks.

Despite the transparent orthography of Turkish, there might be slight inconsistencies between variational pronunciations of words and their conventional spellings. The findings of the present study revealed that several spelling errors emerged as the students transferred their phonological representations of words into

their spelling production. This finding implies that teachers should highlight the conflict between pronunciations and conventional spelling rules for certain words in Turkish. Explicit instruction on this issue will prevent such spelling errors from persisting into later stages of literacy.

High numbers of diacritic omission errors found in the handwritings might point to the problems regarding the use of the cursive style in literacy education. Although cursive is considered to have some cognitive benefits for students due to its continuous flow, the participants in this study tended to forget placing diacritics of letters once they finished spelling the words. Given that the Turkish alphabet includes several letters with diacritics, teaching of the cursive style might be disadvantageous for spelling accuracy in this respect. It seems that teachers should pay special attention to this issue and encourage their students to go back and monitor their handwritings for the completion of any missing diacritics.

Lastly, it was found that *soft g*, as an exceptional letter, is a source of confusion for students performing literacy tasks in Turkish. Probably, teachers need to focus on this letter more often during spelling instruction, and provide students with activities in which they find more opportunities to practice spelling words with *soft g*.

Overall, it is expected that these implications will contribute to the planning of instruction, design of spelling materials and creation of literacy assessment tools in Turkey. Further developments will make it possible for educational researchers to understand spelling processes better and respond to the needs of both normally developing children and those who are faced with special learning difficulties.

6.4 Limitations of the present study

Despite its important linguistic and pedagogical implications, the present study has several limitations. First, convenience sampling was used in order to access the participants. With a larger sample from randomly selected schools, the findings of the current study would be more credible in terms of generalizability. Second, traits such as verbal IQ, nonverbal IQ, reasoning ability and motor functioning were not measured prior to the administration of data collection instruments. These traits should have been measured to see whether the samples represent populations of normally developing third and fourth graders. In addition, entering such measures into the regression analyses as control variables would have made it possible to see the contributions of PE and RAN to reading and spelling performance more clearly. However, due to time limitations and procedural difficulties, the researcher had to rely on teacher reports regarding the children's general conditions. Another limitation was that the researcher could not access the information regarding the home language environment of the participants.

Lastly, the current study made use of data elicited from a cross-sectional research design. A longitudinal study would be beneficial to have a deeper understanding about the longer-term effects of PE and RAN in reading and spelling achievement in Turkish.

6.5 Recommendations for further research

The current study investigated the components of literacy at Grade 3 and Grade 4, which were considered to be skilled stages of literacy acquisition. Further studies including participants from beginning stages (i.e. first and second graders) are needed in order to make developmental comparisons in terms of spelling errors and the differences in underlying mechanisms of reading and spelling across grade levels.

In fact, the present study is a part of a joint project, the other part of which investigates the literacy skills of first and second graders in Turkish. Ideally, though, large-scale studies with greater numbers of participants from all grade levels (1 to 4) should be conducted to elicit more credible results. In addition, future studies should compare outcomes in literacy achievement with reference to different instructional methods (phoneme vs. syllable based approach), socioeconomic backgrounds (high vs. low) and handwriting styles (cursive vs. print).

This study aimed to shed light on reading and spelling processes in normally developing children. Further studies should investigate the components of literacy in Turkish speaking participants with reading difficulties for the development of more efficient ways of assessment, diagnosis, and intervention. Lastly, in order to have a clearer understanding regarding the role of RAN in spelling familiar versus unfamiliar words, prospective studies should include two separate spelling tests with items that are controlled for length, but differ in terms of their frequency counts.

APPENDIX A

SAMPLE ITEMS FROM LETTER-WORD IDENTIFICATION

1. Başarılı
2. Doğal
3. Farklı
4. Günümüz
5. Ulaşım
6. İnsanlar
7. Dürüst
8. Özellikle
9. Eğitim
10. Gideceğinden

APPENDIX B

SAMPLE ITEMS FROM SPELLING OF SOUNDS

1. Uk
2. Çe
3. Bü
4. Fır
5. Ken
6. Ors
7. Zurt
8. Aca
9. Eket
10. Olku

APPENDIX C

SAMPLE ITEMS FROM WORD SPELLING

1. Çok
2. En
3. Türk
4. Dedi
5. Görse
6. Bitti
7. Ağaç
8. Annesi
9. Renklerle
10. Uçurtma

APPENDIX D

SENTENCES FROM TEXT SPELLING

Dün gece yolda giderken zıplayan bir tavşan gördüm. Elinde bir demet maydanoz, bir sepet yumurta vardı. Hoplaya zıplaya evin yolunu tutmuştu.

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