READING FLUENCY AND COMPREHENSION IN A TRANSPARENT ORTHOGRAPHY: EVIDENCE FROM TURKISH CHILDREN

HATİCE ÖZATA

BOĞAZİÇİ UNIVERSITY

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READING FLUENCY AND COMPREHENSION IN A TRANSPARENT ORTHOGRAPHY: EVIDENCE FROM TURKISH CHILDREN

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Hatice Özata

Boğaziçi University

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DECLARATION OF ORIGINALITY

I, Hatice Özata, certify that

- I am the sole author of this thesis and that I have fully acknowledged and documented in my thesis all sources of ideas and words, including digital resources, which have been produced or published by another person or institution;
- this thesis contains no material that has been submitted or accepted for a degree or diploma in any other educational institution;
- this is a true copy of the thesis approved by my advisor and thesis committee at Boğaziçi University, including final revisions required by them.

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Date July 2, 2018

ABSTRACT

Reading Fluency and Comprehension in a Transparent Orthography: Evidence From Turkish Children

This study was designed to explore the concurrent relationships of reading skills (i.e., word-level reading fluency and comprehension) with cognitive and linguistic variables (i.e., rapid-automatized naming [RAN], phonological awareness [PA], phonological memory [PM], morphological awareness [MA], orthographic knowledge [OK]), processing speed [PS], and vocabulary), along with parental education level. The interplay among these variables was also investigated. A total of 92 Turkish-speaking children in grades 2 and 4 were administered a battery of tests to measure their performance with respect to reading skills and linguistic and cognitive variables. A preliminary model of reading that illustrated the proposed direct and indirect (i.e., mediating) relationships among the variables was developed. The model was then tested using a classical path analysis which relied on a series of simultaneous multiple regression. The results revealed that alphanumeric RAN and OK remained the strongest and most persistent predictors of fluent word reading at both grade levels. Other variables, namely PA, PM, MA, OK, PS, vocabulary, and parents' education level, made no significant direct or unique contribution to word reading fluency. PA and PS indirectly influenced second graders' fluent word recognition through OK. However, only PS made an indirect contribution to word reading fluency via OK in grade 4. As for the reading comprehension skill, fluent word recognition, vocabulary, and parental education level were identified as independent precursors across grades. In addition, the mediating roles of vocabulary and fluent word recognition were emphasized in reading comprehension.

ÖZET

Saydam Ortografide Akıcı Okuma ve Okuduğunu Anlama:

Türk Çocuklarından Bulgular

Bu çalışma, okuma becerilerinin (sözcük okuma akıcılığı ve okuduğunu anlama) bilişsel ve dilbilimsel değişkenler (Hızlı otomatik isimlendirme [HOTİ], fonolojik farkındalık [FF], fonolojik bellek [FB], morfolojik farkındalık [MF], ortografi bilgisi [OB]), işleme hızı [İH] ve sözcük dağarcığı) ve anne-baba eğitim seviyesi ile olan eşzamanlı ilişkisini araştırmak için dizayn edilmiştir. 2. ve 4. sınıflardan toplam 92 Türkçe konuşan çocuğa söz konusu okuma becerileri ile bilişsel ve dilbilimsel değişkenlerdeki performanslarını ölçen testler uygulanmıştır. Değişkenler arasında öngörülen doğrudan ve dolaylı ilişkileri gösteren önceden tasarlanmış bir okuma modeli geliştirilmiştir. Bu model daha sonra eş zamanlı çoklu regresyona dayalı klasik yol analizi ile test edilmiştir. Analiz sonuçları, her iki sınıf seviyesinde de, harf/sayı temelli HOTİ ve OB'nin en güçlü ve en tutarlı yordayıcılar olduğunu ortaya koymuştur. Diğer değişkenler olan FF, FB, MF, OB, İH, sözcük dağarcığı ve anne-baba eğitim seviyesinin sözcük okuma akıcılığına önemli ölçüde doğrudan ve bağımsız katkısı bulunmamıştır. FF ve İH ikinci sınıfların akıcı sözcük okumasını OB aracılığıyla dolaylı yönden etkilemiştir. Fakat 4. Sınıfta, sadece İH, sözcük okuma akıcılığına OB aracılığıyla dolaylı katkıda bulunmuştur. Okuduğunu anlama becerisi ele alındığında, akıcı sözcük okuma, sözcük dağarcığı ve anne-baba eğitim seviyesinin sınıf düzeyleri arasında bağımsız yordayıcılar oldukları saptanmıştır. Ayrıca, sözcük dağarcığı ve akıcı sözcük okumanın okuduğunu anlamadaki dolaylı rolü vurgulanmıştır.

CURRICULUM VITAE

NAME: Hatice Özata

DEGREES AWARDED

PhD in English Language Education, 2018, Boğaziçi University

MA in English Language Education, 2013, Boğaziçi University

BA in English Language Teaching, 2004, Boğaziçi University

AREAS OF SPECIAL INTEREST

Literacy acquisition in L1 and L2, bilingualism, language transfer, cognitive and linguistic processes in language learning, reading disability

PROFESSIONAL EXPERIENCE

Research Assistant, Department of English Language Education, Giresun University, 2017-present

Instructor, School of Foreign Languages/ Department of Basic English, Yıldız Technical University, 2005-2017

Exchange student and research assistant, Georgia State University, USA, 2010-2011

Reading Coordinator, Department of Basic English, Yıldız Technical University, 2007-2010

English Teacher, Adapazarı Atatürk Super High School, Sakarya, 2004-2005

AWARDS AND HONORS

Boğaziçi University High Honor Degree-2004

GRANTS

Council of Higher Education M. A Scholarship for Research abroad, 2010-2011

Boğaziçi University Scholarship, 1999-2004

PUBLICATIONS

Book Chapter

Özata, H., Babür, B., & Haznedar, B. (2016). Phonological awareness in reading acquisition. In B. Haznedar and F. N. Ketrez (Eds.). *The acquisition of Turkish in childhood* (243-271). Amsterdam: Benjamins Publishing Company.

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DEDICATION

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CHAPTER 1

INTRODUCTION

1.1 Background of the study

In broad terms, reading refers to a process of matching distinctive visual symbols to units of sound so as to gain access to meaning (Ziegler & Goswami, 2005). This spectacularly complex process involves the integration of many disparate sophisticated sets of perceptual, cognitive and linguistic abilities ranging from low-level visual perception to recognition of word forms, phonological processing, eye-movement control, and all of the higher-level linguistic processes required to recover the meaning of the written words (Norris, 2013).

Reading is usually expressed as "a key foundational skill not only for school but for life" (Bradley, 2016, p. 107). This pivotal activity allows the skilled reader to achieve myriad of exercises from simply following lines of print smoothly and scanning for specific information to understanding the content, making a quick summary of what is read, drawing conclusions and inferences and ultimately writing down thoughts and feelings about the written material. On the other hand, when individuals experiences difficulties in reading, they are also challenged with problems in almost every facet of social and academic life. Adolescents and children with reading difficulties, for instance, are confronted by broad academic failure, serious school problems (e.g., absenteeism, school dropouts) and poor peer relations and are also found vulnerable to behavioral and emotional difficulties as well as life-course-persistent conduct problems (e.g., exhibiting disruptive and violent behavior and having problems about following rules) (Bennett, Brown, Boyle, Racine &

Offord, 2003; Daniel et al., 2006). Accordingly, a robust body of research has investigated the process of reading acquisition that requires an array of subskills and the factors contributing to success or failure of these skills.

Basically, the act of reading necessitates the identification and comprehension of strings of words in a fluid manner. At this point, several studies have highlighted the substantial importance of fluent and accurate word recognition vis-a-vis reading comprehension. Skilled word recognition, according to Kirby, Georgiou, Martinussen and Parrila (2010) is “extremely important, perhaps essential, for the higher level or more advanced aspects of reading, especially reading comprehension” (p. 342). In a similar vein, Parrila, Kirby and McQuarrie (2004) emphasized that recognizing words with increasing complexity and decreasing familiarity is one of the most challenging academic ability that many children struggle to learn in the first years of formal schooling. Durgunoğlu and Öney (1997) regarded the ability to identify or decode words quickly and effortlessly as an integral component of young children’s fluent reading. Further, according to Shankweiler (1989), beginning readers and sometimes even more experienced readers may be troubled with comprehension because of difficulties in deciphering the individual words of the text. Perfetti (2007) expressed that comprehension relies upon successful word reading. Skill differences in comprehension may stem from skill differences in word reading. Accordingly, Stanovich (1993) pointed out the significance of word reading as such:

> Reading for meaning is greatly hindered when children are having too much trouble with word recognition. When word recognition processes demand too much cognitive capacity, fewer cognitive resources are left to allocate to higher-level process of text integration and comprehension. Trying to read without the cognitive resources to allocate to understanding the meaning of the text is not a rewarding experience. (p. 281)

In parallel with Stanovich (1993), Norton and Wolf (2012) stated that the development of automaticity at all the lower levels of reading (e.g., decoding) frees readers to direct cognitive resources to the deepest levels of thought and comprehension. In other words, accurate and fluent processing of all sublexical units, words, connected text as well as all the perceptual, linguistic, and cognitive processes involved in each level of reading activity provides readers with sufficient time and resources allocated to comprehension and deeper thought, a manner which is labeled as *fluent comprehension* by Wolf and Katzir-Cohen (2001). Similarly, The National Reading Panel (NRP, 2000) explained why problems with reading accuracy, speed and expression interferes with comprehension as such:

> The reader must recognize the printed words (decoding) and construct meaning from the recognized words (comprehension). Both decoding and comprehension require cognitive resources. At any given moment, the amount of cognitive resources available for these two tasks is restricted by the limits of memory. If the word recognition task is difficult, all available cognitive resources may be consumed by the decoding task, leaving little or nothing for use in interpretation. Consequently, for the nonfluent reader, difficulty with word recognition slows down the process and takes up valuable resources that are necessary for comprehension. Reading becomes a slow, labor-intensive process that only fitfully results in understanding. (p. 8)

It appears that fluent and accurate word recognition is one of the most essential prerequisites to understanding what is read (Perfetti, 1986; Shankweiler,1989); therefore, identifying the constructs that underlie success in word reading has paramount importance.

In addition to the ability to read single words efficiently, many studies have focused on factors that significantly predict success in reading comprehension. After all, understanding what is printed on page is the very ultimate goal of reading (Stanovich, 2000). Additionally, although word reading and reading comprehension are closely intertwined, different additional factors might underlie performance in reading comprehension. According to Oakhill and Cain (2006), in addition to deriving and integrating the meanings of the individual words, sentences and paragraphs, many different skills may contribute to efficiency in text comprehension. For instance, the skilled reader is required to identify the key ideas or themes of the text, make an inference to fill in missing details and take corrective action, such as rereading, once comprehension breakdowns take place. In brief, it is essential to examine the factors that play roles in the development of good text comprehension.

Oakhill and Cain (2006) identified three broad areas at the word level, sentence level and text level and pointed out that any deficiency in these areas may lead to reading comprehension difficulties. At the word level, the researchers referred to word reading fluency and accuracy, emphasizing that comprehension problems might arise due to slow or inaccurate word reading which causes limited processing capacity necessary for comprehension processes. Vocabulary knowledge is another word-level skill that affects reading comprehension. According to Oakhill and Cain (2006), vocabulary knowledge is one of the best precursors of reading comprehension and poor vocabulary restricts the understanding of the text. At the sentence level, knowledge about syntactic forms is significant for working out the meanings of sentences in a text. Finally, at the text level, difficulty in comprehension might arise because of the problems at the discourse level of processing text (e.g., inference making, metacognition and comprehension monitoring and understanding text).

To date, research literature on reading acquisition has consistently emphasized that reading is a complex and multifaceted ability that necessitates the integration of several different cognitive, linguistic and perceptual processes. Understanding which cognitive, linguistic, perceptual and/or socio-economic factors play crucial roles in the development of reading ability, whether these factors are the same or different in reading at the word and text levels, and how the relations between these factors and reading subskills alter depending on the age of the reader can offer insights into why children present individual differences in their reading performance. Thus far, studies have identified rapid naming, phonological awareness, phonological short-term memory, morphological awareness, orthographic knowledge, processing speed, vocabulary, and socio-economic status as potential predictors influencing reading development in elementary school years. Herein, these variables will be introduced briefly. A comprehensive discussion on each of these variables will be presented in the next literature review chapter.

To start with, there is a growing body of data from a wide array of languages demonstrating that variation in rapid-automatized naming (RAN) is one of the most important causal determinants of individual differences in reading ability, especially in word reading fluency (Albuquerque, 2012; Albuquerque, 2017; Babayiğit & Stainthorp, 2010, 2011; Babür, 2003; Bishop, 2003; Bowers & Newby-Clark, 2002; Bowers, Steffy & Tate, 1988; Cutting & Denckla, 2001; de Jong & van der Leij; 1999; Furnes & Samuelsson, 2011; Georgiou, Parrila & Liao, 2008b; Kirby, Georgiou, Martinussen & Parrila, 2010; Norton & Wolf, 2012; Papadopoulos, Spanoudis & Georgiou, 2016; Plaza & Cohen, 2003; Wolf & Bowers, 1999). These studies repeatedly reported that rapid serial naming of familiar visual symbols such as letters and numbers predicted a considerable amount of variance in reading.

Furthermore, a convincing body of evidence from studies with different languages has indicated that success in word reading is largely dependent upon the child's phonological awareness (PA) (Adams 1990; Anthony & Francis, 2005; Bradley & Bryant, 1983; Christensen, 1997; Gillon, 2007; Güldenoğlu, Kargın & Ergül, 2016; Hoien, Lundberg, Stanovich & Bjaalid, 1995; Hulme, Hatcher, Nation, Brown, Adams & Stuart, 2002; McBride-Chang & Kail, 2002; Schatschneider, Fletcher, Francis, Carlson & Foorman, 2004; Torgesen, Wagner & Rashotte, 1994). Researchers have come to a strong consensus that the ability to deal explicitly and segmentally with sound units is one of the best predictors of reading progress in the earliest stages. Basically, the causal relationship between PA and reading acquisition is attributed to PA's role as a foundational ability that underlies the learning of spelling-sound correspondences in the initial stages of reading acquisition (Adams, 1990; Stanovich, 1993; Ziegler & Goswami, 2005). Having a pivotal role in early reading development, PA has also been explored in depth with respect to its developmental pattern. The relevant studies in this area have revealed that there is a general predictable order of PA development from larger units to smaller units, i.e., from syllables and onset/rimes to phonemes (Anthony & Francis, 2005; Anthony, Lonigan, Driscoll, Phillips, & Burgess 2003; Fox & Routh, 1975; Ho & Bryant, 1997; Treiman & Zukowsky, 1991).

In addition to rapid naming and awareness of phonology, previous research has also explored the role and predictive value of phonological short-term memory (PM) on children's reading abilities. However, studies presented conflicting and varying results on the role of PM in the development of reading skills. Although some studies (e.g. Babayiğit & Stainthorp, 2007; Gathercole & Baddeley, 1990; Gathercole & Baddeley, 1993; Hansen & Bowey, 1994; Nithart et al., 2011; Passenger, Stuart, & Terrell, 2000) detected PM as a critical correlate of reading, others reported insignificant connections between PM and reading skills, particularly examined along with other cognitive and linguistic components of reading (e.g. Dufva, Niemi & Voeten, 2001; Georgiou, Das & Hayward, 2008a; Høien-Tengesdal & Tønnessen, 2011; Parrila et al., 2004). In spite of its contradictory role in predicting reading abilities, some studies found a close link between PM and PA (e.g., Alloway, Gathercole, Willis & Adams, 2004; Näslund & Schneider, 1991; Wagner & Torgesen, 1987) while others reported a declining influence of PM on vocabulary knowledge by the age of 8 (e.g., Gathercole, Willis, Emslie, & Baddeley, 1992).

Morphological awareness (MA), i.e., one's understanding of how words can be divided into smaller units of meaning such as roots, prefixes and suffixes, is another metalinguistic awareness skill that has been investigated as an indicator of reading achievement. Although MA has been less frequently examined than RAN and PA, studies in a variety of languages have identified MA as a significant unique predictor of both word reading and reading comprehension in the elementary school years (e.g., Asadi, Khateb, Ibrahim & Taha, 2017; Carlisle, 1995, 2000; Deacon & Kirby, 2004; Gafoor & Remia, 2013; Green, 2009; Ho et al., 2012; McBride-Chang et al., 2005; Levesque, Kieffer & Deacon, 2017; Shu, McBride-Chang, Wu & Liu, 2006). That is, researchers in this line of research have reported that knowledge of morphology makes a direct contribution to word reading and reading comprehension even after the effects of other reading-related predictors such as PA, PM, RAN, vocabulary, intelligence, and prior reading ability have been taken into account. Clearly, as Apel (2014) suggested, MA is a crucial linguistic awareness that merits "as much attention for the role it plays in reading and spelling development as does phonemic awareness" (p.198). Because MA reflects the ability to identify and manipulate morphemes (the smallest linguistic units with semantic information), it encompasses the knowledge and awareness of different facets of linguistic sensitivity at syntactic, semantic and phonological levels. As such, research evidence has suggested a longitudinal influence of MA in reading that goes beyond the influence of PA which is confined to the early stages of reading acquisition especially in transparent languages.

Furthermore, researchers have also investigated children's orthographic knowledge (OK) in relation to reading. Studies have demonstrated that children's familiarity with the general spelling rules of a language and their ability to detect permissible letter combinations from those that are not make a significant independent contribution to success in word reading and reading comprehension (Barker, Torgesen & Wagner, 1992; Cunningham & Stanovich, 1991; Cutting & Denckla, 2001; Deacon, 2012; Stanovich & West, 1989). OK has also been found interrelated to other reading-related skills such as RAN and PS (e.g., Cutting & Denckla, 2001; Georgiou, Parrila, Kirby & Stephenson, 2008d; Loveall Channell, Phillips & Conners, 2013).

Processing speed (PS), a person's general speed of completing cognitive tasks within an allocated period of time, has also been acknowledged as another variable that predicts reading achievement (Bowey, McGuigan & Ruschena, 2005; Kail & Hall, 1994; Christopher et al., 2012). Although there is an on-going debate over how RAN is associated with PS and literature entails conflicting results about this relationship (Catts, Gillispie, Leonard, Kail & Miller, 2002; Chiappe, Stringer, Siegel & Stanovich, 2002; Cutting & Denckla, 2001; Kail & Hall, 1994; Scarborough & Domgaard, 1998), research on PS has shown that PS makes a significant independent contribution to reading performance.

Additionally, various investigations have revealed the powerful influence vocabulary has on word-level reading and reading comprehension (Chall, Jacobs & Baldwin, 1990; de Jong & van der Leij, 2002; Garlock, Walley & Metsala, 2001; Hart & Rinsley, 1995; Joshi, 2003; Ricketts, Nation & Bishop, 2007; Verhoeven, 2000; Verhoeven & van Leeuwe, 2008). Overall, these studies have reported that children with poor vocabulary knowledge tend to lag behind those children with rich vocabulary in reading skills, particularly in reading comprehension. More specifically, Durgunoğlu (2017) defined vocabulary as one of the key factors to consider in reading comprehension in transparent orthographies because decoding does not appear as a bottleneck in such orthographies.

In addition to cognitive and linguistic variables, environmental factors such as children's parental socio-economic status (SES) might play a decisive role in their reading achievement. Numerous studies have reported that SES exerts profound impacts on children's performances in word reading, reading comprehension as well as in other predictors of reading skills such as vocabulary, letter knowledge, phonological sensitivity and memory (e.g., Aikens & Barbarin, 2008; Bowey, 1995; Jehangir, Glas & van den Berg, 2015; Whitehurst & Lonigan, 1998).

Furthermore, in a comprehensive study that included English and other European languages (i.e., Greek, Italian, Spanish, German, Norwegian, Icelandic, Portuguese, Dutch, Swedish, French, Danish and English) with varying degrees of orthographic consistency, Seymour, Aro and Erskine (2003) identified linguistic differences in syllabic complexity and orthographic depth as factors responsible for the delayed acquisition of children's basic reading skills such as word reading fluency and accuracy in the opaque languages, particularly in Danish and English. That is, the rate of development in accuracy and fluency in foundation level reading in deep orthographies (e.g., English) was slower in comparison with shallow orthographies. Parallel to this, Wimmer (2006) stated that in consistent orthographies children gain high levels of accuracy after a few months of reading instruction. Thus, the main focus of further development is rapid attainment of fluent and fast reading rather than accurate reading. Accordingly, this current study is essentially concerned with the dynamics underlying word reading fluency and reading comprehension in Turkish which is characterized by shallow orthography and one to one grapheme-phoneme correspondences.

1.2 Purpose of the study

The primary purpose of this study is to explore the concurrent relationships between reading skills (i.e., word-level reading fluency as indexed by real and nonword reading fluency, and reading comprehension) and cognitive, linguistic and socio-economic variables (i.e., phonological awareness (PA), phonological short-term memory (PM), rapid-automatized naming (RAN), morphological awareness (MA), orthographic knowledge (OK), processing speed (PS), vocabulary and parental education level) in normally developing readers in Grades 2 and 4. Of specific interest is the extent to which RAN, PA, PM, MA, OK, PS, vocabulary, and parental education level together and/or independently explain variability in children's word reading as well as their reading comprehension performances and how these variables are associated with each other (e.g., whether the influence of RAN is mediated by any of the other predictors of reading, or whether it makes a direct contribution to word reading and reading comprehension). The study also intends to explore the relative role of word-level fluency on reading comprehension. Pearson product-moment correlation was applied to determine the significant correlations between the variables. In addition, a series of multiple regression analyses were conducted to explore how much unique variance each independent variable explain in word reading and reading comprehension. Finally, path analysis using multiple regression analysis results was conducted in order to investigate the direct and/or indirect contribution that the multiple independent variables make to word-level reading and reading comprehension in Turkish. This statistical method was selected as it allows researchers to determine whether or not a multivariate set of nonexperimental data fits well with a particular hypothesized causal model (Wuensch, 2016). More specifically, this thesis study has the following objectives:

1. To expand our understanding of reading development in Turkish, which has a transparent orthography.
2. To examine the amount of unique variance that RAN, PA, PM, MA, OK, PS, vocabulary knowledge and parental education level account for in word reading fluency and reading comprehension in a sample of typical readers in Grades 2 and 4.
3. To examine how these independent variables (i.e., directly or indirectly) affect dependent variables.

1.3 Significance of the study

This study investigates the cognitive, linguistic and socio-economic variables in reading acquisition of Turkish, a relatively less studied transparent language in comparison to English-like opaque languages. In specific terms, the primary aim of this study is to examine the relative contribution of RAN, PA, PM, MA, OK, PS, vocabulary knowledge and parental education level to word reading and reading comprehension of Turkish primary school children (in Grade 2 and 4). Although these variables have been a topic of interest in numerous studies, they have not been explored at once in one study. Accordingly, this doctoral study represents an attempt to contribute to the growing body of reading literature by further measuring the relative importance of a wide range of multiple variables in reading progression of

Turkish children who have learned to read via a phonics-based approach. Given its transparent orthography and rich morphology, further investigation of multiple variables in one study may present a more comprehensive and inclusive picture of reading development in Turkish. Considering the emergency of developing reading skills early in childhood and the importance of reading in the child's social as well as academic life, the results of this doctoral thesis study has the potential to provide policy-makers, educators, assessors and parents with a better understanding of various factors underlying children's reading development in Turkish.

Additionally, given the scarcity of research in Turkish reading acquisition, it is not clear what specific roles phonological, morphological and orthographic skills play in a consistent writing system with rich inflectional and derivational morphology. Despite some significant and current studies which explored the relative contributions of some of these variables in Turkish reading development (e.g., Babayiğit & Stainthorp, 2007, 2010, 2011; Bektaş, 2017; Öney & Durgunoğlu, 1997; Sönmez, 2015), the relative roles of general PS, vocabulary and SES factors in predicting reading skills are still unclear in the Turkish language. The current study extends the results of the previous studies by including a wide array of cognitive, linguistic, and social variables in a proposed path model of reading and testing the predictive power of this model in a cross-sectional study design. Coming up with a more comprehensive model of reading in Turkish, the results of the current study will have significant pedagogical implications for literacy education in Turkey. The study will create a window of opportunity to raise awareness among parents, primary school teachers and practitioners in the field of literacy acquisition. Developing a full understanding of the complex procedures underlying reading acquisition is vital for

(i) identifying efficient teaching methods, (ii) helping children with specific reading difficulties, and (iii) fighting against academic failure and school and drop out rates.

1.4 Definition of key terms

Grapheme: The smallest unit of written language.

Morpheme: The smallest meaningful unit.

Morphological Awareness: One's conscious awareness of the morphemic structure of words and his/her ability to reflect on and manipulate that structure (Carlisle, 1995).

Nonword reading (Pseudoword reading/ Word Attack): The ability to access and integrate multiple phonological codes. Pseudowords have no lexical address but share the phonology of the target written language (Wagner & Torgesen, 1987).

Orthographic Knowledge: The information that is stored in memory that tells how to represent spoken language in written form (Apel, 2011).

Path Analysis: A form of multiple regression statistical analysis conducted to evaluate causal models by examining the relationships between a dependent variable and two or more independent variables. Using this method one can determine the nature of the directions between variables (i.e., direct versus indirect) and estimate both the magnitude and significance of causal connections between variables.

Phoneme: The smallest unit of sound that affects the meaning of a word.

Phonemic awareness: The ability to detect individual phonemes within a word (Goswami, 1999).

Phonological Awareness: The ability to recognize, identify, and manipulate any phonological unit of a spoken word (Gillon, 2007).

Phonological Memory: “Recoding written symbols into a sound-based representational system that enables them to be maintained efficiently in working memory during ongoing processing” (Wagner & Torgesen, 1987, p. 193).

Processing Speed: The pace at which one takes in information such as visual, auditory and perceptual, makes sense of it and begins to respond.

Rapid Automatized Naming (RAN): Also known as naming speed or rapid serial naming, RAN refers to how quickly an individual can retrieve and pronounce the names of a set of familiar stimuli such as letters, numbers, colors and objects.

Reading Comprehension: The process of making meaning from a given text (Wooley, 2011).

Socio-economic Status: An individual position within a hierarchical social structure. Socioeconomic status depends on a combination of several variables, including occupation, education, income, wealth, and place of residence. In this study, SES was assessed on the basis of parents’ level of education.

Vocabulary Knowledge: Knowledge of word meanings. A measure of expressive vocabulary in which children are required to verbally define words was used in this study.

Word reading (Decoding/word identification/single word reading/ word recognition): The ability to accurately and fluently identify words in print.

1.5 Summary

Numerous studies have shown that RAN, PA, PM, MA, OK, PS, vocabulary knowledge and SES factors such as parents’ education level create individual differences in the progression of reading skills. It is also vital to explore to what extent these variables make contributions to Turkish reading acquisition and the nature of the relationships (direct vs indirect) between these variables and reading skills. Such a study will enable us to better make sense of the process of reading development and empower us by offering insights necessary for making changes in literacy instruction programs in Turkey. This, in turn, will help our children learn *how to read* with more ease and move to the stage in which they use *reading as a means of learning*.

A causal model of reading that displays direct and indirect relationships between independent and dependent variables has been proposed. The significance and directions of the relationships were tested by means of simultaneous multiple regression in path analyses.

The remaining chapters are organized as follows: Chapter 2 provides a review of literature on previous studies and summarizes the results of these studies. Chapter 3 provides some information on the characteristics of Turkish language phonology, morphology, and orthography. It also describes Turkish literacy context, referring to Sound Based Sentence Instruction Method. Chapter 4 presents a full description of the study design including research questions, hypotheses, participants, setting, instruments, procedure and statistical data analysis methods. In Chapter 5, the key results of the study are reported. Chapter 6 includes a discussion, interpreting the results with respect to research hypotheses and previously published knowledge about reading. It also summarizes the main findings of the study, explains the implications of the findings and presents the limitations in the research design and makes suggestions for future research.

CHAPTER 2

REVIEW OF LITERATURE

This chapter begins with a concise discussion on the definition of reading ability and its two fundamental components, i.e., word recognition and reading comprehension. Following this, the connection between fluent word recognition and reading comprehension is discussed. Then, brief overviews of important scientific approaches and models which explain the development of reading ability and which focus word reading fluency and reading comprehension association are given. This is followed by a review of research with regard to the key precursors of reading skills (i.e., fluent word recognition and reading comprehension), namely RAN, PA, PM, MA, OK, PS, vocabulary knowledge and SES factors, particularly, parental education level. Regarding these variables, each section below covers one particular predictor, comprising its definition and the most common tasks used for measuring that specific predictor as well as a comprehensive literature review that presents the results of the previous studies across different languages with reference to the target predictor.

2.1 Reading and its basic components

Reading is one of the critical academic abilities that every child is expected to gain successfully when they start formal schooling at primary level. It is an important core skill that influences a child's success academically and socially throughout his/her life. As such, *how children master the reading skill* has remained as a central problem that researchers endeavor to solve in the field of literacy.

Broadly defined, reading refers to the process of matching distinctive visual symbols to sound units to gain access to meaning (Ziegler & Goswami, 2006). Alternatively, Hammill (2004) defines it as "a process by which individuals understand and interpret graphic symbols" (p.466). In the simple view of reading, Gough and Tunmer (1986) identified reading as "the *product* of decoding and comprehension, or $R = D \times C$" (p.7). Here, decoding is mostly equated with word recognition and refers to the ability to read isolated words quickly, accurately, and silently. In this view, comprehension refers to the linguistic comprehension and defined as the process by which given lexical (i.e., word) information, sentences and discourses are interpreted. According to this view, if the value of one of these components is zero (i.e., if one cannot decode any words or achieve comprehension in a particular language), then the reading activity will also be zero. Apparently, although reading has often been viewed as a very complex intellectual ability that requires individuals to coordinate and use various sub-skills and knowledge simultaneously (Adams, 1990; Fuchs, Fuchs, Hosp & Jenkins, 2001; Hoover & Gough, 1990; Hoover & Tunmer, 1993), definitions of reading generally posit two principal components: word recognition and/or comprehension, which are the focus of the following sections.

2.1.1 Word recognition[1]

Word recognition can basically be defined as the ability of a reader to recognize printed words accurately, fluently and effortlessly. Perfetti (2007) delineated word recognition as "the rapid retrieval of a word's phonology and meaning" (p.358).

[1] In the present study, word recognition and word identification refer to individual word reading and are used interchangeably.

Word recognition has been acknowledged as the foundational process of reading (Stanovich, 1996). Adams (1990) noted that unless the processes involved in word recognition operate sufficiently, nothing else in the system of reading can work properly. Likewise, Stanovich (1996) also focused on the centrality of word recognition and wrote that as a by-product of any successful approach to developing reading ability, any deficiency in the word recognition skill is always a reasonable predictor of difficulties in the development of reading comprehension ability. Further, Stanovich (1996) added that one should not expect any benefits of instructional innovations in reading comprehension without the presence of at least adequate word recognition ability. Accordingly, many researchers studying reading acquisition in beginning readers have focused substantial attention on fluent and accurate word recognition, a crucial aspect of young children's reading success. As Ehri (2002) highlighted,

> One of the great mysteries to challenge researchers is how people learn to read and comprehend text rapidly and with ease….A large part of the explanation lies in how they learn to read individual words. Skilled readers are able to look at thousands of words and immediately recognize their meanings without any effort. (p. 7)

Over the last two decades, the development of quick and effortless identification of words has become a topic of interest especially in transparent languages (i.e., languages with one to one phoneme-grapheme correspondences) as word reading accuracy often reaches at ceiling after only a few months of formal reading instruction in phonologically more transparent orthographies (Babayiğit & Stainthorp, 2007; Landerl & Wimmer, 2008; Öney & Goldman, 1984). Word recognition speed is also identified a relevant and highly stable indicator of reading skills as well as the only indicator that discriminates reading skill levels in consistent orthographies (Bast & Reitsma, 1998; Durgunoğlu, 2017; Landerl & Wimmer, 2008). As for the Turkish language, due to its the systematic orthography and advanced PA of words and syllables, accurate word identification develops rapidly in young readers (Durgunoğlu, 2017). In fact, the accuracy level reaches 100% by the end of first grade (Durgunoğlu & Öney, 1999; Öney & Durgunoğlu, 1997). Thus, fluent word recognition has been acknowledged as a better index of word reading proficiencies of Turkish readers than accuracy (Durgunoğlu, 2017).

Overall, studies in transparent languages have revealed that speed of word recognition is an important correlate and independent predictor of reading comprehension in early school years (e.g. de Jong & van der Leij, 2002; Protopapas, Sideridis, Mouzaki & Simos, 2007). The research studies have further reported that fluent word recognition ability is strongly related to variables such as RAN, PA, PM, MA, OK, PS, Vocabulary, and SES. Various studies have generally confirmed that the process of rapid word identification is facilitated by proficiency in these subskills.

When defining word recognition, it is also important to give a definition of *fluency* because the development of fluent and automatic word recognition is regarded as one of the principal educational goals for elementary school-age children. Various definitions have been presented for fluency. In general terms, fluency in reading incorporates the capability to read quickly, accurately, and, when oral reading is considered, with proper expression (NRP, 2000). Meyer and Felton (1999) defined fluency as "the ability to read connected text rapidly, smoothly, effortlessly, and automatically with little conscious attention to the mechanics of reading, such as decoding" (p.284). Here, the concept of automaticity refers to one's ability to recognize words (both pronunciations and meanings) instantly without directing any attention to figuring out the word. The process of word reading becomes more automatic and cognitively less capacity demanding as readers develop word recognition skills with more experience and practice (Stanovich, 1996). When automaticity in word recognition is achieved, attentional resources become available for reading comprehension (Schwanenflugel et al., 2004). In another definition, Harris and Hodges (1995) identified fluency as “freedom from word identification problems that might hinder comprehension” (p. 85). Here, fluency acts as a connector between word recognition and reading comprehension. Referring to fluency as a bridge between word identification and reading comprehension, Pikulski and Chard (2005) emphasized the role of fluency in these reading components. The authors explained that readers cannot pay attention to both word identification and comprehension simultaneously as the construction of meaning necessitates multiple subskills such as making inferences and responding critically which always require careful attention. Because nonfluent readers shift attention between the processes of word identification and comprehension, reading becomes a laborious and punishing process for such readers. According to Pikulski and Chard (2005), once attention is drained by identifying words, little or no capacity is left for the attention demanding process of comprehending. Thus, as a critical component of fluency, automaticity of word decoding is vital for high levels of reading success.

Likewise, according to Ehri and McCormick (1998), the ability to read words by sight automatically is vital for text reading as it permits word reading processes to function unobtrusively and provides readers with giving their attention on the meaning of print instead. It appears that when the process of word recognition is fluent and performed with little thought and effort, a child can spare his/her attention to understanding what is on the page. However, not all children can achieve fluent and automatic word reading. Children’s dysfluency at the word level impedes their reading performance in several ways. First, in comparison with their peers, they read less text in the allocated time and thus will process less text to remember, comprehend, or appreciate. Second, they consume more cognitive energy than peers struggling for identifying individual words. Last but not least, slow readers may have a poorer capacity to retain extended segments of text in their memories and to integrate those segments with other parts of the text (Mastropieri, Leinart & Scruggs, 1999).

In short, word recognition is an important part of the total reading process. Studies in transparent orthographies have paid attention to fluent word recognition and identified it as a significant precursor of reading comprehension. The problems in word fluency appears to influence high levels of reading achievement by leaving fewer cognitive sources directed for processing meaning and making sense of the text as a whole. As such, understanding the facilitating processes that underlie the fluent visual recognition of isolated words is of prime importance. Considering the critical role of fluent word recognition for reading development, this study attempts to explore the factors that have an impact on word reading fluency in Turkish, a language with a transparent orthography. Further, examining the relationship between fluent word recognition and reading comprehension in Turkish is another concern of this study. Therefore, word reading fluency is both a dependent and an independent variable in the present study. The following section presents the definition of reading comprehension.

2.1.2 Reading comprehension

In addition to word recognition, the ability to comprehend what is read has also been identified mutually important to the process of reading (NRP, 2000). Indeed, the real purpose of reading, according to Oakhill and Cain (2006), is "deriving meaning from the text" (p. 379). Reading comprehension is viewed critically significant for both academic learning and life-long learning (NRP, 2000). As Stevens, Slavin and Farnish (1991) put forward,

> From the middle elementary years through the rest of their lives as students, children spend much of their time reading and learning information presented in text. The activity of reading to learn requires students to comprehend and recall the main ideas or themes presented in expository text. (p. 8)

In broad terms, comprehension refers to the construction of the meaning of printed text (Pikulski & Chard, 2005). According to Kendeou, McMaster and Christ (2016), reading comprehension is multidimensional and one of the most complex human activities. Even understanding a simple sentence, for instance, necessitates visual processing of target words; identifying their phonological, orthographic, and semantic representations as well as linking these words by applying syntactic rules to make sense of the underlying meaning of the sentence (Perfetti & Stafura, 2014). Understanding the core of each sentence is necessary but not adequate. Graesser (2015) noted that to achieve text comprehension at deeper levels, one should relate the meanings of sentences, construct inferences, utilize relevant background knowledge, identify the text structures, and take the authors' aims and motives into consideration. In short, as Oakhill and Cain (2006) suggested, understanding a written text requires the integration of many component skills at the word (fluent and accurate word reading, and vocabulary knowledge) sentence (knowledge about syntactic forms), and text levels (discourse structures) along with efficient working memory capacity and background knowledge.

Likewise, Kendeou et al. (2016) pointed out that at different levels of the reading comprehension process, the reader makes use of various *sources of* *knowledge*. In the Reading System Framework, Perfetti and Stafura (2014) proposed three such sources: 1) linguistic knowledge (about phonology, syntax, and morphology), 2) orthographic knowledge (about the orthographic system), and 3) general knowledge (about text forms, e.g., text genres and the world). The general knowledge, according to Kendeou et al. (2016), also includes academic knowledge taught at school and vocabulary. Researchers in the area of reading have underlined the critical role of these knowledge sources at different levels of reading, including word recognition (Bektaş, 2017), inference making (Oakhill & Cain, 2006), overall text comprehension (Alexander & Murphy, 1998).

To sum up, given the complexity of reading comprehension, it is quite difficult to come up with a complete definition of it that includes all the sub-processes and knowledge required for understanding a written text. Meanwhile, considering the critical role of comprehension in the total reading process as well as its importance in academic achievement and life-long success, it is highly urgent to identify some basic dynamics that affects reading comprehension in Turkish. This thesis study attempted to measure the child's silent reading comprehension performance as well as the underlying factors that are assumed to influence reading comprehension. The Turkish comprehension test employed in the current study includes several texts which increase in length and difficulty as the child moves on. The child is expected to answer comprehension questions for each given text. Overall, the reading texts mainly require the integration of syntactic and semantic properties of printed words and sentences into a representation of the whole passage and understanding the gist of the reading text, reading for specific information along with inference making, vocabulary and world knowledge. Evaluating children's performance in comprehension, this study was aimed at examining the associations between the children’s comprehension ability and their fluent word reading ability, vocabulary knowledge, alphanumeric RAN, MA, PS, and SES background. The next section revisits fluent word recognition and reading comprehension connection in depth by summarizing the results of some research studies in different languages.

2.1.3 The relationship between fluent word recognition and reading comprehension

According to Samuels (1976), a fluent reader is the one who can decode words automatically without the services of attention and so is able to give all his/her attention to processing meaning while performing decoding at the same time. Parallel to this definition, Nathan and Stanovich (1991) pointed that readers proceed to higher level reading skills after they achieve word recognition, (i.e., the ability to contact visually presented words with their stored memory codes and meanings). They also added that when processes of word recognition performed with little capacity and fluently, most of the reader's cognitive capacity can be used for comprehending the text, criticizing it, elaborating on it, and reflecting upon it. Conversely, dysfluent word recognition processes claim excessive cognitive capacity, leaving less capacity for comprehension.

Perfetti and Hart (2001) also noted that many problems in comprehension stem from ineffective lower level processes that are necessary for the identification of words. Accordingly, studies in various languages with different sample groups have emphasized the critical role of fluent word recognition and seen it as a cornerstone for the development of successful comprehension (Bell & Perfetti, 1994; de Jong & van der Leij, 2002; Fernandes, Querido, Verhaeghen, Marques, Araujo, 2017; Fuchs et al., 2001; Klauda & Guthrie, 2008; Nathan & Stanovich, 1991; Perfetti, 2007; Protopapas et al., 2007; Schwanenflugel et al., 2004; Therrien, 2004;

Wise et al., 2010). In an earlier experimental study, working with English-speaking third graders, Perfetti and Hogaboam (1976) found that skilled comprehenders were more rapid at oral word decoding (both at real and pseudoword reading) compared to less skilled comprehenders. In this early work Perfetti and Hogaboam (1976) suggested that differences in higher order reading skills such as comprehension might emerge because of differences in word reading skills. The researchers pointed that when readers have less well-developed, less automatic decoding skills, they spare limited capacity for higher order processes of comprehension. That is, provided that decoding is an automated process, it does not put heavy demands on the reader's higher comprehension processes.

In line with these findings, working longitudinally with Dutch children from first through third grade, de Jong and van der Leij (2002) identified word reading speed as a significant predictor of reading comprehension. The researchers reported that the relationship of word decoding speed to reading comprehension remained stable and significant from first to third grade (.70 and .61, respectively). Accordingly, de Jong and van der Leij (2002) concluded that the progression of different reading components (i.e., fluent word reading and reading comprehension) is partially based on different determinants. That is, whereas word reading fluency was mainly influenced by RAN, additional influences of word reading speed, vocabulary, and listening comprehension on reading comprehension were observed from first grade through third grade.

Klauda and Guthrie (2008) conducted a study with a sample of fifth graders and examined the longitudinal relationship of word recognition fluency, syntactic unit (sentence) fluency and whole passage fluency to reading comprehension in English. Hierarchical regression analyses indicated that word reading fluency explained 10% of variance in reading comprehension after controlling cognitive variables of background knowledge and inferencing. Further hierarchical regression analyses in the study reported that word reading speed alone accounted for 43% of the variance in reading comprehension when the other types of fluency (i.e., syntactic and passage) were taken into consideration. The researchers concluded that fast recognition of isolated words was a significant predictor which facilitated growth in comprehension 12 weeks later.

In a more recent study, Kim, Petscher, Schatschneider, and Foorman (2010) examined how children's performance in nonsense word fluency and oral reading fluency (i.e., a child's ability to fluently and accurately read aloud a grade-level connected text within 1 minute) is related to their later reading comprehension achievement. The sample included children from Grade 1, 2, and 3 and were followed over a period of three years. Overall, the study reported that children's oral reading fluency explained the largest amount of variation in children's proximal (i.e., first-grade) and distal (i.e., third-grade) reading comprehension achievement.

In another study, Wise et al. (2010) examined how different measures of oral reading fluency (i.e., nonsense-word oral reading fluency [TOWRE Phonemic Decoding Efficiency], real-word oral reading fluency [TOWRE Sight Word Efficiency]), and oral reading fluency of connected text) relate differentially to reading comprehension performance of second-grade students. Both correlational and path analyses indicated that real word reading fluency was the major determinant of reading comprehension for second graders. It held a stronger relationship to reading comprehension than nonsense word reading fluency and oral reading fluency of connected text. Based on this finding, the researchers proposed that real word reading fluency can be an efficient measure for identifying potential reading comprehension difficulties.

In a more recent study, Fernandes et al. (2017) investigated direct and indirect effects of fluency at word and text levels on reading comprehension in European Portuguese. Participants were children from Grade 1 to Grade 6. The researchers reported direct influences of real word reading fluency and of text-level reading fluency on reading comprehension from Grade 1 to Grade 6. The study also revealed an indirect effect of pseudoword reading fluency on reading comprehension which was mediated by word reading fluency and/or text reading fluency measures.

To sum up, fluent word reading inextricably tied to reading comprehension. Nonfluent word reading, on the other hand, has been considered a bottleneck for the development of effective comprehension. A considerable amount of cognitive resources is needed to allocate for understanding, interpreting, and responding critically to written texts. When cognitive resources are initially expanded for word identification processes, these higher order reading skills of comprehension will certainly suffer.

The following section presents the most cited approaches and developmental models of reading that focus on word recognition and comprehension. Meanwhile, it gives the theoretical grounds for a relationship between word reading and comprehension. Although this thesis study was not primarily concerned with testing the validity of these approaches and models in Turkish, they provide helpful hints for reasoning some of the results detected in the current study. The models of the reading process are particularly enlightening to portray the link between fluent word recognition and comprehension in Turkish. As Stanovich (1996) pointed out, the recent global models of the reading process virtually embody some type of hierarchical structure in which the meanings triggered by the successful word recognition are the building blocks for subsequent comprehension processes.

2.2 Stage and phase models of reading on word recognition

Different models have attempted to account for the stages or phases that children go through while they are learning how to read words. Overall, these models to word reading put forward that the child proceed from reading words as unanalyzed chunks to approaching it more analytically by using grapheme-to-phoneme mappings and orthographic knowledge (Oakhill & Cain, 2006). Herein, the most popular two models, namely Frith's (1985) *stage theory of reading* and Ehri's (1999) *phase theory* are presented.

Frith (1985) suggested that the child proceed through three basic stages: *logographic*, *alphabetic* and *orthographic*. In the *logographic* stage, the child initially recognizes familiar words by relying on salient graphic features and visual characteristics. At this stage, the child might also make use of contextual clues to guess an unfamiliar word. In the next stage called *alphabetic stage*, different from the previous stage, the child starts to gain alphabetic knowledge, learns the rules of grapheme-phoneme correspondences, and applies them to read unknown words. Finally, in the *orthographic stage*, the child recognizes words by utilizing larger orthographic units instead of graphemes. At this final stage, the child's word recognition becomes more automatized as the child already becomes familiar with the conventions and rules of orthography in his/her language by experiencing with recurring spelling patterns across words and applies this accumulated knowledge to articulate words.

Different from Frith (1985), Ehri (1999) viewed the progression that the child goes through in word reading as *overlapping phases* rather than discrete stages in which each stage is a prerequisite for the following stages. Ehri (1999) used the term, *phrases,* to reflect the type of the predominant alphabetic knowledge in the connections that are formed in sight word learning, and proposed a theory that includes four phrases: *pre-alphabetic, partial alphabetic, full alphabetic*, and *consolidated alphabetic*. The pre-alphabetic phase takes place in the earliest period of sight word learning. Similar to Frith's logographic stage, children in *pre-alphabetic phase* make use of selected visual features when reading a familiar word because they are non-readers, lack letter-sound connections and have little knowledge about the alphabetic system. For instance, they might remember the words, *look*, by the two eyeballs in the middle, or *dog* by the tail at the end (Ehri, 2005). Unlike pre-alphabetic phase, children in *partial alphabetic phase* make use of partial alphabetic connections to read words in addition to visual cues as they learn the names or sounds of alphabet letters. However, they form connections between only the most salient letters of the words, i.e., first and final letter sounds. Children are confined to making partial connections as they are unable to segment the words into all of its phonemes. They have not developed full knowledge of the alphabetic system yet; thus, they cannot decode unfamiliar words (Ehri, 2005). In the third phase of the theory, children become *full alphabetic phase* readers as they can learn sight words by forming complete connections between letters in spellings and phonemes in pronunciations. They acquire the major grapheme-phoneme correspondences (Ehri, 2005). An important characteristics of this phase is that word reading becomes much more accurate. Readers in this phase can read unfamiliar words, invent spellings that represent all the phonemes and recall correct spellings of words better than partial phase readers. Lastly, in *consolidated phase*, in line with Frith's orthographic stage, children utilize larger units such as rimes, syllables, morphemes, and whole words as they already become familiar with recurring letter patterns in different words. Accordingly, they retain increasingly more sight words and letter patterns in memory. Knowing letter chucks is especially important for remembering how to read multisyllabic words, unfamiliar words, and pseudowords rapidly. For example, when the child knows the relevant chunks in long words such as *interesting*, he/she has to make fewer connections to retain the word in memory because the number of the connections is reduced from 10 grapheme-phonemes to four syllabic chunks (Ehri, 2005). For another example, the reader in the consolidated stage stores a multiletter unit *–ent* as a chunk after repeatedly reading the words *went, sent,* and *bent*. When the consolidated alphabetic reader encounters the word *dent* for the first time, he/she needs to connect just the two units, *d* and *–ent.* This, in turn, helps the development of efficient fluency in word recognition.

In addition to these stage or phase theories that give an account of word recognition from a developmental perspective, there are also theories that conceptualize rapid and accurate word recognition as a significant precondition, or an important determinant for successful reading comprehension. Four such models, LaBerge and Samuels' (1974) *Automaticity Model of Reading*, Gough and Tunmer's (1986) *Simple View of Reading,* Joshi and Aaron's (2000) *Component Model of Reading,* and Perfetti's *Verbal Efficiency Theory* (1985) and his *Lexical Quality Hypothesis* with Hart (2002) are briefly discussed below.

2.3 Theories on word recognition as a key to comprehension

In *Automaticity Theory*, LaBerge and Samuels (1974) explained that the completion of a complex skill requires the coordination of many component processes within a limited time period. When each component requires attention, successful execution of the complex skill is difficult as there is not enough attentional capacity left for that complex skill. The reason for this is evident: The cognitive processing capacity of the human being is confined to a particular task within allocated time and he/she has only limited cognitive resources to devote to that particular task. Therefore, when the components at lower levels are performed automatically, attentional load allocated for the complex skill remains within tolerable limits, giving rise to successful performance. According to LaBerge and Samuels, automaticity is the main explanatory construct in reading. In essence, the authors articulated the view that skilled reading comes out when the reader directs attentional capacity from lower level word identification processing to resource-demanding comprehension functions. Beginning readers, on the other hand, first concentrate on word reading. On condition that they achieve automatic, instant word recognition, they can gradually shift attention and cognitive resources to understand what they read. Here, repeated practice generates automatic word recognition and releases attention for comprehension. Thanks to repeated reading, readers become more acquainted with words, phrases, and their meanings and can spare more attention for comprehension (Perfetti, 2007; Samuels & Flor, 1997).

In addition to LaBerge and Samuels' (1974) automaticity model of reading, Gough and Tunmer (1986) proposed the Simple View of Reading to shed further light on the role of decoding in reading. From a perspective of Gough and Tunmer (1986)'s simple model of reading, how well one comprehends a reading text is the product of word recognition and oral language/linguistic comprehension skills. The Simple View formula (i.e. *R= D x C*) put forward that to the extent that one can recognize words expertly and have strong language comprehension skills, he/she can achieve reading. If a child is able to read the words within a passage, but is not able to understand them, successful reading will not take place. Likewise, if a child is deprived of the word recognition ability, then he/she is destined to fail in reading regardless of his/her performance in language comprehension ability. Word recognition and linguistic comprehension abilities are equally important in this reading model. In the model, the definition of skilled decoding (D) goes beyond "sounding out" and includes rapid and accurate reading of familiar and unfamiliar words in both lists and connected text (Gough & Tunmer, 1986). Linguistic comprehension (C) is also defined as the ability to derive meaning from spoken words depending on the sentences and discourses they appear in (Gough & Tunmer, 1986). The simple view argued that the combination of these two variables makes a better prediction on reading comprehension (R).

Inspired by the Simple view of Reading, Joshi and Aaron (2000) suggested the *Component Model of Reading.* According to this model, reading is a cognitive process that is composed of several independent components. Decoding is treated as a basic requirement for word recognition. In the Component Model, sight-word reading is considered a speeded up decoding process (i.e. Decoding + Speed= Sight-Word Reading) because sight-word reading is built upon decoding skills. According to Joshi and Aaron, rapid and automatic recognition of written words characterizes skilled readers; thus, the speed at which written words are processed should be measured as a factor in reading. Based on a study with English-speaking third graders, the researchers examined whether the addition of processing speed as a variable would enhance the predictive ability of the classic Simple View of Reading proposed by Gough and Tunmer. Joshi and Aaron used letter naming as an index of processing speed. The researchers found that while decoding and listening comprehension explained 48% of the variance for reading comprehension, speed of naming the letters added another 10%. Joshi and Aaron (2000) concluded that adding speed of processing to the simple view formula significantly improves prediction of reading comprehension. Accordingly, the researchers proposed a revised model of reading, namely the Component model, which is expressed by the formula, $R = D \times C + S$. For Joshi and Aaron, this new model gave satisfactory results for third graders. They also anticipated that the predictive capacity of the model will increase at grade 4 and beyond where speed emerges as an important factor. At this point, it will be interesting to see if speed of letter naming is a factor for the reading comprehension skill of Turkish second and fourth graders.

Parallel to previously mentioned models, Perfetti's Verbal Efficiency Theory (1985) places word reading at the heart of reading comprehension and claims that word identification (i.e. rapid retrieval of a word's phonology and meaning) is a limiting factor in reading comprehension. The theory links word-level reading with comprehension via the assumption that comprehension integrates higher level processes that necessitate cognitive resources (working memory). These processes are more resistant to automatization as they depend more on memory (e.g. integrating propositions across clauses, inference processes, syntactic repairs, and linking text models with previously known world knowledge). Instead, word identification and its sublexical processes are better candidates for low-resource or automatic processing. Automatic, resource-cheap word-level processes, which is labelled as verbal efficiency by Perfetti (1985), could preserve processing resources for higher level comprehension and thus support it. Hence, children with this word-level efficiency tend to be successful at reading comprehension whereas children with inefficient word-level processes probably experience problems in comprehension. Being automatic, efficient word reading lends processing resources to be dedicated to comprehension. At this point, *efficiency* is defined as rapid, low-resource retrieval of a word identity (Perfetti, 2007). Efficiency in underlying processes requires knowledge about word forms (grammatical class, spellings, and pronunciations) and meanings, and effective practice (reading experience) of these knowledge components. Originally, VET emphasized the speed and automaticity of word recognition processes. Such a theory, according to Perfetti and Halt (2002), was correct but incomplete. In a more recent view, Perfetti and Halt (2002) questioned words and the reader's word identification processes that lead to individual differences in comprehension. In the *Lexical Quality Hypothesis (LQH)*, they approached word recognition processes more comprehensively and argued that the reader's lexical quality (LQ) for a given word influences efficient word reading and jeopardizes comprehension. LQ refers to the reader's knowledge of a given word that represents the word's form and meaning constituents as well as knowledge of word use that integrates meaning with pragmatic features. Perfetti (2007) identified five features of lexical representation that distinguish high and low lexical quality: Orthography, phonology, morpho-syntax, meaning, and constituent binding (the degree to which the first four features are bound together). The last feature, bindings, are connections that provide coherence among the orthographic, phonological, and semantic representations. The identification of the word is the retrieval of these features which are expected to work synchronously at retrieval, giving the impression of a unitary word. These defining features (i.e. orthography, phonology, morpho-syntax, meaning and constituent binding) of high quality provide the reader with grasping rapidly and reliably what exactly the printed word is. That is, high-quality representations minimize confusion about word meaning and word form. Low-quality word representations, on the other hand, cause word-related problems in comprehension. In general, LQH argued that local processes of integrating word meanings within and across sentence boundaries are influenced by the LQ of words that are recognized as part of the comprehension process (Perfetti, 2007; Perfetti & Halt 2002).

To sum up, the four theoretical frameworks, namely LaBerge and Samuels' (1974) Automaticity Theory, Gough and Tunmer's (1986) Simple View of Reading, Joshi and Aaron's (2000) Componential Model, and Perfetti's (1985) Verbal Efficiency Theory view efficient word identification skill as a foundational factor that causes discrepancies between skilled comprehenders and less-skilled comprehenders. Of course, this does not imply that comprehension is totally dependent upon efficient word reading. However, many problems in comprehension might arise due to inefficient word recognition skills.

After giving the theoretical foundations for the vital role of fluent word recognition, it is also important to present a wide-angle view that encompasses many cognitive and linguistic components of reading comprehension. Perfetti and Stafura (2014) proposed such a broad framework and named it the *Reading Systems Framework.* This framework is important for this thesis study for two reasons. First, it depicts the link between word reading and reading comprehension from a broad-scope perspective. Second, it specifically gives substantial attention to the central role of vocabulary knowledge in text comprehension, which is also a concern of the present study.

2.4 The reading systems framework: A general view of reading comprehension

According to Perfetti and Stafura (2014), reading has too many components to be pictured in a single theory. This complexity of reading has led to different theories that focus on a manageable part of reading (e.g. theories of word reading, theories of learning to read, theories of dyslexia, and theories of comprehension at sentence and text levels). Analyzing a set of intertwined problems of reading theory (i.e. how readers comprehend and how skill differences come out), Perfetti and Stafura (2014) reintroduced a broad-scope framework of reading comprehension, the Reading Systems Framework, which represents a wide-ranging set of knowledge sources, and processes that act on these knowledge sources. This framework is important as it demonstrates specific systems and subsystems and the interactions among them. The framework (see Figure 1) is targeted to reflect reading more fully by adding word-level processes to the higher processes of comprehension. Overall, this Reading Systems Framework makes the following assertions about reading:

1. Three types of knowledge sources are utilized in reading: linguistic knowledge, orthographic knowledge, and general knowledge (knowledge about the world, including knowledge of text forms, e.g., text genres)
2. The processes of reading—decoding, word identification, meaning retrieval, constituent building (sentence parsing), inferencing, and comprehension monitoring—use these knowledge sources in both constrained ways (e.g. decoding uses orthographic and phonological knowledge but not general knowledge) and in interactive ways (e.g. inferences use general knowledge and propositional meaning extracted from sentences).

3. These processes take place within a cognitive system that has pathways between perceptual and long-term memory systems and limited processing resources (p. 25).

According to Perfetti and Stafura (2014), such a general framework can form a basis and guide novel theories and specific hypotheses about reading expertise and reading problems. For example, the framework can be used to generate hypotheses about the sources of comprehension problems. One can focus on measurable weaknesses in one or more of the components (knowledge and processes) included in the framework. For instance, failure in lower level processes such as decoding defines basic reading disability or dyslexia. More specific hypotheses focus on lower level components in visual or phonological subsystems and indicate phonological processing problems as sources of reading disability.

Although the framework acts as a scaffold for theory development and hypothesis testing for different interactions between reading subsystems, Perfetti and Stafura (2007) paid specifically more attention to lexical component and its interaction with text comprehension. Theoretically, Perfetti and Stafura (2007) argued that within the Reading Systems Framework, knowledge of written words and meanings has a centrality in reading and thus is a *pressure point* for reading comprehension, i.e., " a prime candidate for a cause of reading comprehension difficulty" (p. 26). The researchers claimed that the interaction between the word identification system and the comprehension system is mediated by lexical knowledge (both form and meaning). Perfetti and Stafura (2014) gave two complementary hypotheses to explain the links between lexical processes and comprehension processes. First, text comprehension depends upon understanding individual words within the text and integrating their meaning into a mental model of the text (fluent word-to-text integration). At this point, word comprehension is regarded as the output of the word identification system and the input to the comprehension systems (sentence, text, and situation). The second hypothesis is that learning words necessitates grasping information about both word forms (phonological specificity and orthographic precision) and meanings. According to Perfetti and Stafura, readers continuously tune and update their current understanding of the text by integrating the currently read word into a mental structure. It is in these word-to-text integration processes that individual differences in reading comprehension arise. Thus, emphasizing the centrality of vocabulary knowledge in a theory of comprehension, Perfetti and Stafura suggested a closer examination of how subtle differences in word knowledge affect reading comprehension skill.

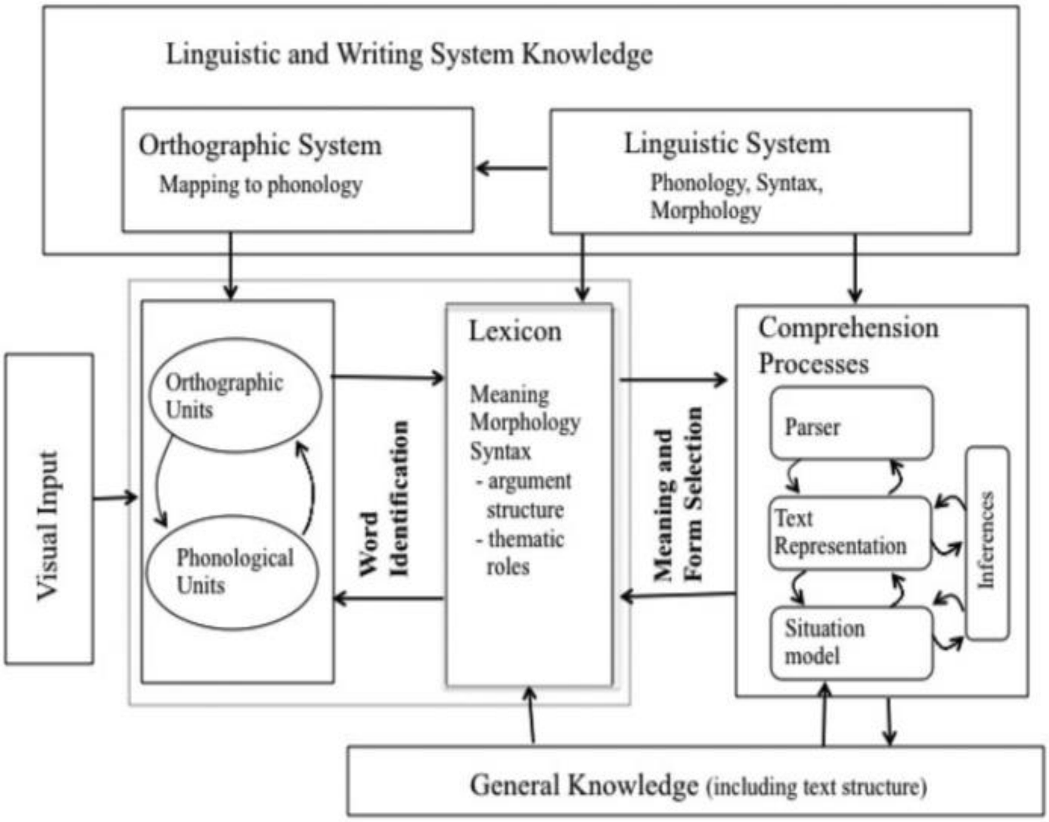

Figure 1. The reading systems framework. The components of reading within language-cognitive architecture from visual processing through higher level comprehension. The key elements are knowledge sources, basic cognitive and language processes, and interactions among them. The framework allows the development of specific models (e.g., word identification models, models of inferences) and allows hypotheses about both the development of reading expertise and reading weaknesses. A particular point of focus is the lexicon, which is a central connection point between the word identification system and the comprehension system. (Perfetti & Stafura, 2014, p. 24)

Taken together, the existing theories and the reading frameworks presented above have helped us deepen our understanding about the development of reading skills, i.e., fluent word reading and reading comprehension, and how these two skills are theoretically connected to each other. At this point, reviewing the studies that have investigated the underlying cognitive and linguistic dynamics of word reading fluency and comprehension will provide us with a broader picture of reading acquisition.

2.5 Predictors of reading

An extensive number of studies in the field of literacy development have focused on fluent word reading and reading comprehension and the underlying cognitive and linguistic variables that contribute to and/or facilitate these two reading skills. In respect of the variables that strongly correlate with and predict fluent word recognition and reading comprehension the most commonly discussed areas are rapid-automatized naming (RAN), phonological awareness (PA), phonological memory (PM), morphological awareness (MA), orthographic knowledge (OK), processing speed (PS), vocabulary knowledge, and socio-economic status (SES).

Understanding the essence of these factors and the interrelations among them may cast further lights on to what extent they are influential in the development of the core reading skills, i.e., fluent word reading and comprehension in Turkish. Accordingly, each following subsection first gives a theoretical definition of each construct and provides examples of the most prominent tasks used for its measurement. Following this, a comprehensive research literature is presented with reference to the role of each construct in fluent word reading and comprehension.

2.5.1 Rapid-automatized naming (RAN)

Current research has shown that numerous factors influence efficient reading. RAN or, the skill to correctly respond to a set of visual stimuli verbally and quickly, has been identified as one of the most important variables in the prediction of reading ability. In order to gain a better understanding of the basis for RAN and the rationale behind it, it is essential to examine how it has been developed, conceptualized and used in various studies over the years.

2.5.1.1 On the definition of RAN

Rapid automatized naming (RAN), also labeled as rapid serial naming and naming speed, is usually defined as the ability to retrieve and fluently name a series of highly familiar visual symbols such as objects, colors, letters or digits. The history of RAN started with a study published by Geschwind and Fusillo in 1966. In the study, a patient's inability to name colors was considered as a sing of visual-verbal disconnection, leaving the patient with incompetence in reading. Geschwind and Fusillo (1966) suggested that the deficit in color naming experienced by their patient might arise due to loss of visual-auditory connections in the brain.

Such neurological findings in adults also motivated many researchers such as Denckla and Rudel to investigate and enlighten unexpected results in children from the perspective of neurology. That is, the finding that an adult-acquired lesion could result in visual-verbal disconnection that bring about severe reading problems became the starting point of a new stance to explore children who were unexpectedly unable to read in first grade (Deckla & Cutting, 1999). These children were examined to see if they had also difficulties in naming colors. Instead of the dramatic inability to name colors that was observed in adults with pure alexia, the children's responses to color naming tasks were characterized by long latencies. Denckla (1972) explained such hesitancy as *lack of automaticity*.

In subsequent research, Denkla and Rudel created four RAN tasks, namely the Objects RAN, the Colors RAN, the Numbers RAN and the Letters RAN to measure the speed of naming familiar items. According to Deckla and Cutting (1999), these RAN tasks are both concurrent and longitudinal discriminators, discriminating between adequate and poor readers.

Denckla and Rudel’s early studies in 1972, 1974 and 1976 created a new area of inquiry in reading acquisition where several subsequent studies both expanded and replicated Denckla and Rudel's findings that RAN tasks differentiated children with reading difficulties from typical readers of the same age and RAN was a crucial predictor of reading success (e.g., Blachman 1984; Christo & Davis, 2008; Manis, Doi & Bhadha, 2000; Stanovich 1981; Stanovich, Nathan & Zolman, 1988; Wagner, Torgesen & Rashotte 1994; Verhagen, Aarnoutse & Leeuwe, 2008; Wolf & Bowers, 1999; Wolf, Bowers & Biddle, 2000). The studies also generated methodological debates about the format of RAN (i.e., *discrete format* versus *continuous format*). In the *continuous* or *serial naming format* also used by Denckla and Rudel, a series of 50 familiar items are printed on a page and the participant's score is the total time to name all items serially. *Isolated* or *discrete naming format*, however, requires the participant to name common items that are presented one at a time on a computer screen quickly and accurately (Wagner et al., 1997). The participant’s score is calculated by averaging the latencies in the 50 test items. According to advocates of a discrete-trial format, it eliminates the extraneous sources of variance such as scanning, sequencing, and motoric strategies that exist in continuous trial formats. On the other hand, proponents of continuous formats have claimed that it is these so-called extraneous sources of variance, namely rapid scanning, sequencing, and so on that reflect cognitive requirements essential for textual reading (Wolf, 1991). That is, proponents argue that by decreasing task complexity to the naming of individual stimuli only, the discrete trial format may exclude exactly the components that continuous naming speed and reading share, because “both require serial processing” (Georgiou, Parrila, Cui & Papadopoulos, 2013, p. 222). Additionally, the continuous format may produce more demands on executive functioning than the discrete format, making continuous formats better predictors of reading than discrete formats (Deckla & Cutting, 1999). Previous studies found serial naming performance of participants to be more highly correlated with reading than was isolated naming performance (e.g., de Jong, 2011; Stanovich, 1981; Stanovich et al., 1988; Wolf & Bowers, 1999). More specifically, serial naming task for alphanumeric rapid naming test items was detected as a better predictor of both serial and discrete word reading performances of beginning and more experienced readers in consistent and inconsistent orthographies (e.g., Dutch: de Jong, 2011; Greek: Protopapas, Altani & Georgiou, 2013; English; Bowey et al., 2005).

In addition to the discussions that go around the format of RAN, there appeared heated debates about the nature of RAN and its relation to PA. The controversy arisen in the field is essentially concerned with whether rapid naming should be recognized as a subskill under the umbrella of phonological processing or whether it is a separate process. Wagner et al. (1997) placed RAN within the phonological processing domain, alongside PA and PM and defined phonological naming as "the rapid retrieval of phonological codes from permanent memory, typically names of items such as yield pictures of common objects, colors, digits, or letters" (p.469). In this view, naming speed is claimed to have predictive value in early reading mainly through its ability to measure the speed of access to phonologically based codes (Torgesen et al., 1997). Support for the inclusion of rapid naming in phonological processing also comes from other researchers such as Schatschneider, Carlson, Francis, Foorman, and Fletcher (2002). The researchers detected a positive high correlation between visual naming speed and PA. They found low PA and low naming scores to go hand in hand in children with poor reading skills and asserted that phonological processing common in these two constructs may produce severe deficits in early reading. Schatschneider and colleagues further commented that the naming speed deficit in children with both PA and rapid naming deficits may stem from deficits in phonological processing rather than some independent, nonphonological processes. As an alternative to these arguments, some other researchers argued that RAN is not a secondary constituent subsumed under phonological processing (e.g., Bowers & Newby-Clark, 2002; Bowers & Wolf, 1993; Cornwall, 1992; Manis et al., 2000; Plaza & Cohen, 2005; Wolf & Bowers, 1999; Wolf et al., 2000; Wolf et al., 2002). Rather, it is a unique independent predictor of reading, especially of reading fluency, beyond PA and PM (e.g., de Jong & van der Leij, 1999; Parrila et al, 2004). To understand the complexity of the reading skill and its multiple processes and move beyond a unidimensional conceptualization of reading disabilities, Wolf and Bowers conducted a series of studies with children who had reading difficulties (e.g., Bowers & Wolf, 1993; Wolf & Bowers, 1999) and found that the two sets of processes, i.e., PA and RAN contributed to reading ability separately. Based on the findings of these studies, Wolf and Bowers (1999) proposed *the Double Deficit Hypothesis* (DDH), which identifies three types of impaired readers (i.e., those with phonological deficits, those with naming-speed deficits, and those with both deficits). The DDH principally proposes that RAN and PA measures can function as independent systems that explain equally significant variance in reading ability. Pursuing this, results from many studies have supported the DDH as a valid framework for the investigation of distinct subtypes of children with reading problems. Unlike Schatschneider et al. (2004), the 2008 study done by Katzir, Kim, Wolf, Morris and Lovett (2008), for example, revealed that 90% of the children with a single phonological deficit (n = 40) had a standard score of 90 or above on a rapid letter naming task (M = 92.85, SD = 12.05) and children with a single naming speed deficit (n = 28) presented average phonological skills, supporting the view that rapid naming is independent of PA. Parallel to this, Wolf et al. (2000) wrote that visual naming speed is underlined by multiple processes which demand for an array of cognitive requirements, such as attentional, perceptual, conceptual memory, lexical and articulatory sub processes. In this view, phonological processing is only one subcomponent of the RAN tasks. Moreover, Norton and Wolf (2012) view RAN as "a microcosm or mini-circuit of the later-developing reading circuitry" (p. 430) with its apparently simple task of naming a series of familiar items as rapidly as possible. Based on more recent data from previous studies, the researchers pinpointed three reasons why RAN should not be considered a subset of phonology. First, there is not a strong correlation between RAN and phonological processing. A comprehensive meta-analysis including correlational literature on measures of PA and RAN found a low correlation between these two constructs with an overall correlation coefficient of $r = .38$. The factor analysis of the meta-analytic data also indicated that PA and RAN load on different factors, proposing some independence among the measures (Swanson, Trainin & Necoechea, 2003). Second, Norton and Wolf (2012) stated that based on the evidence from regression and structural equation models, RAN and PA explain unique variance in reading skill. Third, the authors pointed out different biological bases for RAN and PA abilities. In a study done with early-school-age twin pairs, Petrill, Deater-Deckard, Thompson, DeThorne and Schatschneider (2006), for example, found a core set of genes common to PA, RAN and reading outcomes. However, the researchers also found some evidence for separate genetic influences on PA and RAN. They reported independent effects of RAN and phonology on word identification and phonological decoding.

In sum, previous research indicated that the speed with which individuals name letters and digits is a more robust predictor of reading performance, while the speed to identify objects and colors is less predictive. In addition to this argument, whether RAN is distinct from other measures of phonological skill has received a considerable amount of attention in the research literature. Studies have mostly given inconsistent and contradictory evidence for the place of RAN concerning phonological processing skills. It seems that further research studies in different languages will boost our understanding of the relationship between rapid naming and PA and shed further light on whether these two variables are dissociated and have unique contributions to different aspects of reading skill development. The next subsection will focus on the nature and content of RAN tasks that are commonly administered in studies.

2.5.1.2 RAN tasks

According to Norton and Wolf (2012), fulfilling a RAN measure necessitates a synchronization and integration across a wide range of processes that overlap with reading (e.g., eye saccades, working memory, the connecting of orthographic and phonological representations). In other words, the authors underline that RAN tasks operate as “a microcosm of the reading system, providing an index of one’s abilities to integrate multiple neural processes” (Norton & Wolf, 2012, p. 448). Essentially, Wolf and Bowers (1999) identified seven related processes that rapid naming tasks require:

(a) attentional processes to the stimulus (e.g. letters);

(b) bihemispheric, visual processes responsible for initial feature detection, visual discrimination, and pattern identification; (c) integration of visual features and pattern information with stored orthographic representations; (d) integration of visual and orthographic information with stored phonological representations; (e) access and retrieval of phonological labels; (f) activation and integration of semantic and conceptual information with all other input; and (g) motoric activation leading to articulation. (p.418)

Further, RAN tasks rely on *automaticity* within and among individual constituents during speeded naming. Automaticity, according to Stanovich (1990), is used to refer to some processes becoming fast, obligatory and autonomous and requiring only limited use of cognitive resources. Norton and Wolf (2012) stated that the ability to automate both the individual linguistic and perceptual components and the connections among them in visually presented serial tasks explains why RAN is a consistent predictor of later reading regardless of writing system. Gray (2004) also highlighted the centrality of automaticity for the acquisition of more complex skills such as reading and for the growth of higher order thinking and learning. Accordingly, Torgesen, Rashotte, & Alexander (2001) pointed that individuals having difficulties in automatic word recognition may struggle to efficiently understand what they are reading. Even mild difficulties in word identification might distract a reader's attention from the underlying meaning, diminish the speed of reading and generate the necessity to reread the texts to grasp the intended meaning (Hook & Jones, 2004). At single word level, as previously mentioned, automaticity refers to fast, accurate and effortless identification of a word. Parallel to this definition, the speed and accuracy with which single words are recognized is regarded as the best predictor of comprehension (Hook & Jones, 2004). Wolf and Bowers (1999) also relate naming speed to reading comprehension although this effect is an indirect consequence of naming speed on word identification. According to Wolf and Bowers (1999), slow naming speed results in lower word recognition, which in turn impairs reading comprehension.

Different types of standardized RAN tasks are administered in studies to explore the connection between RAN, reading, and other cognitive variables. The published RAN-RAS Tests originally improved in English by Denckla and Rudel include the four classic subtests: objects, colors, numbers and letters in addition to two rapid alternating stimulus (RAS) in which alphanumeric (letters and numbers) and non-alphanumeric (colors and objects) items are alternated. The RAS subtest was created by Wolf in 1980s and is structurally analogous to the RAN, with two or three types of items repeated interchangeably throughout the card, demanding a shift in attention and processing between sets of different stimuli. Each of the RAN-RAS subtests has 50 items designed in 5 rows. 10 items are placed in each row. The five different token items for each subtest are pseudorandomized and the same test item does not appear consecutively on the same line (Norton & Wolf, 2012). Research shows that different RAN-RAS subtests may generate different cognitive demands and thus lead to diverse consequences in relation to reading acquisition. Specifically, Närhi et al. (2005) pointed out that RAN tasks are multi-componential and vary in their requirements of higher order strategic functions. That is, although partly measuring the same processes, RAN tasks can be differentiated based on the nature of the stimuli presented in the tasks.

Before school age, most 5-year-old children have already become acquainted with the common objects and colors presented on rapid naming tests, yet many are still struggling with learning the numbers and alphabet. Consequently, 5- and 6-year-olds often name the non-alphanumeric stimuli faster than alphanumeric stimuli. After school entry, however, the alphanumeric stimuli become much more automatic and named more rapidly thanks to more practice and exposure to letters and numbers. That is, with the start of formal schooling, alphanumeric stimuli are named faster; therefore, alphanumeric RAN has been found to become more strongly associated with reading ability (Compton, 2003; de Jong, 2011; Wolf, Bally, & Morris, 1986). In particular, based on their meta-analysis Araújo and colleagues (2015) identified that the performance measured on letter- and digit-naming tasks was more strongly correlated to reading competence compared to the RAN tasks requiring naming of colors or objects. Therefore, according to the authors, alphanumeric RAN tasks may spot underlying processing abilities that are essential for word reading more efficiently and thus should be preferred over nonalphanumeric ones in studies concerning with reading development. Emphasizing differential skill requirements regarding the rapid naming of alpha- and non-alphanumeric stimuli, Närhi and colleagues (2014) also mentioned the most consistent relation between lower level reading skills (i.e. word decoding) and speed of naming alphanumeric stimuli. Non-alphanumeric rapid naming tasks, on the other hand, are suggested to be a correlate of reading comprehension (Wolf et al., 1986). Accordingly, in this thesis study, only alphanumeric RAN tasks were used due to their strong association with reading for children in Grades 2 and 4. This should be borne in mind when comparing the results with other studies using different types of RAN tasks.

To sum up, underlined by multiple processes, RAN tasks are valuable tools across age groups and languages/orthographies because of their predictive power on reading ability that can also be measured before children acquire how to read. Thus, these tasks can reliably be utilized as early indicators of risk associated with reading difficulties (Norton & Wolf, 2012). However, it seems that the nature of the relations between RAN tasks and reading might vary depending on the age of the children assessed, on the stimuli used in RAN tasks, and on the reading measure used as well as the orthographic depth of the target language.

The next section summarizes the results of the previous studies on rapid naming in relation to reading skills. Of particular interest, studies that focus on word reading and comprehension are given.

2.5.1.3 The relationship of RAN to reading skills

The DDH in 1990s promoted further research and discussions on the role of rapid naming in reading acquisition and reading disabilities. RAN in relation to different reading skills has eluded many researchers and it has been extensively studied in various languages since then. The majority of these studies have indicated that 60% to 75% of the individuals with reading or learning disabilities display RAN-related deficits (Katzir et al. 2008, Norton & Wolf, 2012; Wolf et al., 2002) and RAN is one of the best predictors of reading fluency across languages that vary in orthographic consistency (Georgiou et al., 2008b).

One fundamental reason why RAN reliably predicts reading skill is that RAN is “an apparent analogue of the reading process” (Stringer, Toplak & Stanovich, 2004, p.892). RAN and reading share many cognitive and linguistic subprocesses (Araújo, Reis, Petersson & Faísca, 2015; Manis, Seidenberg & Doi, 1999; Wolf, 1991). Georgiou and colleagues (2013) presented two main reasons for the strong RAN-reading connection: First, both tasks entail serial processing. Second, RAN demands active production of specific names that requires access to well-specified phonological representations. Parallel to this argument, a robust body of research have consistently indicated that RAN is a significant correlate and precursor of word-level reading and reading comprehension (Araújo et al. 2015).

To start with, in a study concurrently conducted with normally developing readers from first to thirds grades, Cutting and Denckla (2001) examined to what extent RAN explained variability in word reading independent of other variables such as PS, PA knowledge of orthography, articulation and memory span. The path analyses results reported that RAN had direct effects on word reading (Path coefficient of -0.36, $p<.05$). The researchers noted that the contribution of RAN to word reading was not explained by the mediating effects of PA, OK, or memory span.

Manis and colleagues (Manis et al., 1999; Manis et al., 2000) validated the connections between performance on naming tasks (particularly the naming of letters and numbers) and reading ability. Participant children were selected from two public elementary schools in the U.S and were tested for their reading skills (word identification, nonword reading, exception word reading, and reading comprehension), vocabulary knowledge, phonological skills (sound deletion task) and rapid naming (serial naming of letters and numbers). The children were recruited in Grade 1 and followed through Grade 2. The results replicated previous findings that RAN accounted for a sizable amount of unique variance in all of the component reading measures (including word identification, exception word reading, nonword reading, and reading comprehension) even after vocabulary and phonemic awareness partialled out.

Bishop's (2003) longitudinal study with kindergarteners also showed that the reading model that incorporates letter identification, RAN, PA and PM is the best predictor of early reading achievement (i.e. passage comprehension, oral fluency, sight-word recognition, and phonemic decoding efficiency). The participants in the study were followed over a two-year period during the kindergarten and first-grade years. The multiple regression analysis results showed that the combination of all four theoretical constructs, i.e., letter identification, RAN, PA, and PM yielded the strongest correlation for early reading achievement. The researcher emphasized the use of multiple standardized reading outcome measures that provides useful hints on the prediction of children's reading performance.

Similarly, Kirby, Parrila and Preiffer (2003) tested the predictive power of kindergarten naming speed (measured by color and picture naming) and PA (measured by sound isolation, phoneme elision, blending onset and rime) in English on subsequent reading development to Grade 5. It was found that both RAN and PA measured in kindergarten made independent and significant contributions to the prediction of reading skills, namely real word reading, nonword reading, and passage comprehension which was applied only in Grades 1-5. However, the amount of variance explained by PA and RAN changed throughout the years. That is, whereas PA was initially identified as a more powerful predictor in kindergarten and Grade 1, the researchers observed a decline in the early strength of PA as a predictor thereafter. Conversely, RAN increased its predictive power in the later grades although its influence on the reading measures was weaker in the early grades. RAN was also found to have a significant but weaker effect on nonword reading than on real word reading and reading comprehension. According to Kirby and colleagues, the diminished effect for PA might be interpreted in two ways: First, the relative positions of children on the PA dimension during and after kindergarten may have changed, making the kindergarten PA scores a poorer index of later PA. Alternatively, the changes in the nature of the children's reading in the later grades may cause a shift from reliance on phonetic to more orthographic skills during reading. That is, PA skills become crucial at the beginning of formal reading instruction, particularly in a relatively opaque orthography such as English. As children move into Grade 3, however, orthographic skills become more critical for reading success. At this point, the researchers interpreted that the predictive power of naming speed increases in later grades because RAN is needed for orthographic processing. That is, later reading development depends more on automatized processing of letters singly or in larger groups (Ehri, 1997), which, in turn, increases the role of RAN in later grades. Additionally, Kirby et al. (2003) pointed reading fluency for the close RAN-comprehension connection, with RAN being a precursor of fluency and fluency being mandatory for successful comprehension. A certain level of reading speed is necessary for sufficient comprehension (Wolf & Katzir-Cohen, 2001). Alternatively, such a link between RAN and comprehension might reflect an indirect consequence of RAN's impact on word identification. That is, slow rapid naming results in lower word recognition, which, in turn, impairs reading comprehension as suggested by Wolf and Bowers (1999).

In another study, Plaza and Cohen (2003) investigated how well RAN, PA, and syntactic awareness explain reading (fluent word recognition, pseudo word reading and reading comprehension) and spelling abilities in French, another language with inconsistent orthography. The multiple regression analyses showed that RAN, PA, and syntactic awareness predicted significant variance in reading and spelling at the end of Grade 1. In particular, RAN accounted for a significant amount of variance (8%) in children's written language ability (a composite score of reading and spelling abilities) once PA, memory, and syntactic awareness were entered into the regression model.

Thus far, the predictive strength of RAN was given in English and in French, which are orthographically inconsistent. These studies commonly revealed that RAN was an independent predictor of word reading skills as well as reading comprehension, particularly in later grades. It is also important to see if RAN is a significant contributor of word reading fluency and comprehension in other languages with different orthographic consistency. However, it should be noted that studies in more consistent orthographies mostly concentrated on RAN in relation to word reading fluency rather than comprehension.

Albuquerque (2017) emphasized the role of rapid naming on fluency in word, pseudoword and text reading in European Portuguese, which is labeled intermediate in terms of letter-phoneme correspondence. Both correlation and regression analyses indicated that RAN is significantly linked to all reading fluency measures. After controlling PA, RAN Digits accounted for 25% and 17% of the variance in real word reading fluency for third and fourth grades, respectively. Similarly, RAN Digit explained 21% and 18% of the variability in pseudoword reading fluency for third and fourth grades, respectively. The effect of rapid digit naming was found especially greater on text reading fluency for third and fourth grade children (35% and 24% respectively).

Papadopoulos et al. (2016) investigated the role of RAN in first and second grade Greek children's reading fluency. Both concurrent (Grade 1) and longitudinal (from Grade 1 to Grade 2) analyses displayed that RAN exerted direct effects on oral reading fluency (i.e., real word reading fluency and pseudoword reading fluency). In-depth analyses also reported indirect influence of RAN to fluent word reading. That is, the results showed that PA was found to strongly mediate the RAN-reading relationship in the concurrent analyses (in Grade 1), whilst OK was a stronger mediator in the longitudinal analyses (from Grade 1 to Grade 2).

In another recent study with Grade 4 Greek-speaking children, Georgiou, Parrila and Papadopoulos (2016) investigated the role of RAN in word reading efficiency (real word reading fluency), phonemic decoding efficiency (pseudoword reading fluency), and text reading fluency. The researchers found a strong correlation between RAN Digits and fluent real word reading (r=-57). The correlation between RAN Digits and fluent pseudoword reading was also high (r=-59). There was also a powerful correlation between RAN Digits and text reading fluency. Additionally, the in-depth path analyses indicated that the path model that included direct influence of RAN fitted the data very well, explaining 78.5 % of the variance in reading fluency (a composite score of the three fluency measures). Georgiou and colleagues concluded that RAN is a unique predictor of reading fluency although its effects were partly mediated by orthographic processing.

RAN and reading relation has also been studied in Turkish, another language with high grapheme-phoneme correspondences. Although the number of these studies is very few in comparison with other languages such as English, the results are noteworthy. The 2008 study conducted by Abolafya examined whether RAN (numbers and letters) is related to different reading components (word/ non-word reading, reading comprehension, oral reading speed, letter knowledge) for second graders (N= 118) with different reading levels (poor and good readers) in Turkish. Correlational analyses revealed that there was a significant correlation between naming speed tasks (numbers, letters) and word reading tasks for poor readers. RAN tasks (numbers, letters) were associated significantly and negatively with oral reading fluency for poor readers, as well. Furthermore, the results showed that RAN letters were significantly correlated with reading comprehension and letter knowledge in poor readers. These results are compatible with the ones found in

Scarborough (1998). On the other hand, regarding good readers, no significant correlations were detected between RAN tasks (numbers, letters) and reading comprehension. Significant correlations were only found between sight-word reading and RAN numbers and between non-word reading and RAN letters for this group. The study also indicated that children with higher reading ability were quicker than poor readers to name the letters and numbers. In addition, the results of the study highlighted that good readers who acquired automaticity had significantly higher reading comprehension scores than poor readers who consumed their cognitive resources to decode words and thus reserved less mental resources available for comprehension process. This, in turn, leads to lower reading comprehension scores for poor readers compared to good readers. The researcher also concluded that differentiating poor and good readers, RAN tasks could be administered as one of the valid and reliable screening measures of reading ability in Turkish.

Another Turkish language study was conducted by Babayiğit and Stainthorp (2010). They investigated the relative contribution of RAN, grammatical awareness, and PA in word-level fluency (i.e., fluent word reading, fluent nonword reading, and fluent agglutinated word reading) and text-level fluency in Turkish. The children were tested in the spring term of Grade 1 and then about 11 months later at Grade 2. The study replicated previous findings and underlined the central role of RAN in reading speed in a consistent orthography. That is, the results showed that although PA, grammatical awareness, and shot-term memory were correlated with the spelling measures, only RAN was identified as the most powerful and consistent longitudinal correlate of reading speed in Turkish regardless of the word type (single-morpheme words or multi-morpheme words) or the mode of presentation of the words (in isolation or context). Likewise, Babayiğit and Stainthorp (2011) conducted another longitudinal study with a total of 103 Turkish-speaking children. The children from Grade 2 and 4 were followed for one year, to Grade 3 and 5. The study was aimed at examining the relative role of RAN, PA, vocabulary, listening comprehension, and working memory on word reading fluency, reading comprehension, and spelling abilities. In line with the researchers' predictions and previous research evidence from other transparent orthographies reviewed here, rapid naming was detected as the most powerful predictor of word reading fluency whereas PA was identified as the strongest predictor of spelling skills. The study did not report any influence of RAN on higher levels of reading (i.e., reading comprehension).

Congruent with Babayiğit and Stainthorp (2011), Sönmez's study (2015) with Turkish Grade 3 and 4 children reported that RAN was a stronger precursor of word reading skills whereas the effect of phonological knowledge tended to diminish after Grade 3. That is, RAN explained 22% of the variance in word reading performance of third graders although PA accounted for an additional 9% of the variance after controlling RAN. As for fourth graders, whereas the predictive power of RAN increased to 29%, PA failed to make any significant contribution to reading skills. The same study identified PA as a significant precursor of spelling in Turkish.

A more recent study by Bektaş (2017) explored the role of RAN in real and nonword reading fluency with second and fourth grade Turkish speaking children. The study revealed that RAN was a more powerful predictor of fluent word reading compared to other variables (i.e., PM, PA and MA). That is, the results of several set of hierarchical regression analyses with the total sample reported that RAN accounted for 34% of the total variance in word reading fluency after controlling for PM. Of particular interest, RAN was detected as the strongest predictor of word reading fluency for both second and fourth graders, explaining 10% and 24% of the variance respectively. Concerning nonword reading fluency performance for the total sample, once again, RAN was identified as the strongest precursor which accounted for additional 21 % of the variance after controlling the effect of PM. More specifically, RAN explained 24% of the variance at fourth-grade nonword reading fluency although it did not have any significant unique prediction power for second-grade nonword fluency.

In another study done with Turkish-English speaking successive bilinguals and English-speaking monolinguals, Özata (2013) investigated the role of PA, PM and RAN in word reading performance. The results revealed that children's speed of rapid letter and number naming in the L1 and L2 was the most significant predictor of word-level reading fluency. Based on multiple regression analyses, RAN explained the largest proportion of the variance in Turkish (70%) and English (63% for bilinguals; 70% for monolinguals) word reading fluency.

The involvement of RAN in word-reading fluency has also been evidenced in Arabic, a language with complex graphic symbols and particular orthographic and morpho-syntactic systems. In a recent comprehensive study with a large sample of children (N= 1305) between first and sixth grades, Asadi et al. (2017) examined the influence of multiple linguistic and cognitive variables in word reading accuracy and fluency. Here, the results pertaining RAN will be shared. This study will be revisited again and the results related to other variables (PA, PM, MA, and OK) will be given in the following subsections below. Consistent with the results from both deep and transparent orthographies, Asadi and colleagues (2017) reported that RAN made a significant contribution to word-reading fluency in all grades although it had no impact on word decoding accuracy. The path analyses results showed that RAN's contribution to fluency was highly significant in almost all grades, ranging from .16

to .34 β weights. The standardized coefficient reached its maximum level in the fourth grade (β= .34). The absence of involvement of RAN in accuracy through all grades reinforces the argument that RAN is a better index of reading fluency rather than reading accuracy.

The significant effect of RAN on children's reading acquisition has been proven in cross-linguistic studies, which include different language pairs with varying degree of orthographic consistency. In general, RAN has been shown to be a strong correlate of current and future reading ability, especially reading fluency across ages and orthographies (Kirby et al., 2010). RAN taps a key dimension of reading ability with a persistent effect over the course of development, contributing fluency in both opaque and transparent languages (Araújo et al., 2015).

In a study conducted with English-speaking Canadian children, Greek-speaking Cypriot children and Chinese-speaking Taiwanese children, Georgiou et al. (2008b) revealed that across languages RAN was significantly correlated with all reading measures (i.e. word reading fluency and word reading accuracy) except reading accuracy in English. More specifically, it was found that across languages, there were higher correlations between RAN Digits and reading measures than the correlations between RAN Colors and reading measures. Equally importantly, across languages, the correlations between RAN and reading fluency were higher than the correlations between RAN and reading accuracy. These findings are in line with the previous research studies.

In another cross-linguistic study, Georgiou, Parrila and Papadopoulos (2008c) sought to examine the concurrent and longitudinal influence of RAN, PA, PM and orthographic processing on word-reading accuracy and fluency (at both word and text levels) of English-speaking children and Greek-speaking children. The children were followed from Grade 1 to Grade 2. Regarding reading fluency as a dependent variable, RAN Digits and orthographic processing was found to be a significant contributor in both languages. However, RAN tends to play a more significant role in reading speed in Greek than in English. With respect to reading accuracy, the findings revealed that PA is a crucial predictor of reading accuracy in both English and Greek; however, the effect of PA on reading accuracy was stronger in English than in Greek. Based on this finding, the researchers proposed that reading development in consistent orthographies yields less burden on PA than in inconsistent orthographies. Such a finding is important to make sense of the diminishing role of PA in consistent orthographies.

Furnes and Samuelsson (2011) also dealt with the longitudinal relationship between RAN and PA at kindergarten and Grade 1 and early reading and spelling development in Grade 1 and Grade 2 across transparent and opaque orthographies (i.e., Norwegian/Swedish vs. English). US/Australian children and Scandinavian children were followed longitudinally between kindergarten and Grade 2. The children were tested for their abilities in PA, RAN, fluent word recognition in both real and pseudowords, and spelling. The analyses indicated that RAN measured in kindergarten accounted for a small but significant amount of variance in fluent word recognition and phonological decoding (i.e., pseudoword reading) in Grade 1 in both the US/Australian and the Scandinavian groups (3% to 7%). The predictive power of Grade 1 RAN over fluent word recognition and phonological decoding remained in Grade 2 in English (2% to 3%). In Norwegian/Swedish, Grade 1 RAN predicted only Grade 2 phonological decoding (3%). Based on these findings, the researchers claimed that RAN is a long-term predictor of reading fluency and contributes to reading ability in a similar way across different orthographies.

In a more recent comprehensive study, Moll et al. (2014) questioned whether the cognitive underpinnings of reading and spelling are universal or language/orthography specific. The study included five different alphabetic orthographies with varying degrees of grapheme-phoneme consistency (i.e., English, French, German, Hungarian, and Finnish). The predictive strength of RAN, PA, and PM over literacy development (reading accuracy, reading fluency and spelling) of 1062 typically developing elementary school children beyond Grade 2 in Europe was observed concurrently. Interestingly, rather than differences, the researchers came up with prevailing commonalities of cognitive underpinnings that explain literacy development between the orthographies included in the study. RAN and phonological processing skills (PA and PM) were found to be two distinct factors, both accounting for significant amounts of unique variance in literacy attainment in all five orthographies. In addition, overall, both in consistent and less consistent alphabetic orthographies RAN was detected as the best predictor of reading speed (both word and nonword reading speed) while phonological processing (PA and PM) explained higher amounts of unique variance in reading accuracy and spelling. However, notably, the overall predictive value of three variables (PA, PM and RAN) on literacy measures was higher in English (25-39%) compared to more consistent orthographies (9-26%).

Vaessen et al. (2010) addressed transparency effect of a writing system on word-level reading fluency in a cross-sectional study with children in Grades 1 through 4 with Hungarian, Dutch, and Portuguese as their native languages. Overall, the authors proposed that the same cognitive components, namely RAN, PA, and letter-speech sound processing underlie the development of fluent reading skills in both opaque and transparent orthographies. In other words, according to Vaessen et al. (2010), cognitive development of fluent word reading in alphabetic scripts follows a similar developmental pattern in orthographies that differ in their consistency of letter-speech sound mappings. In all three orthographies included in the study the contribution of RAN, PA, and letter-speech sound processing to the cognitive development of word reading fluency was not influenced by orthographic consistency of the target languages, suggesting a strong relationship between these variables and reading in both opaque and transparent orthographies regardless of orthographic depth. Instead, reading expertise as well as word type and frequency modulated the strength of the relative contributions of RAN, PA, and letter-speech sound processing. The authors, however, noted that PA and letter-speech sound processing contributed to reading fluency for a longer period of time in opaque orthographies, which suggests the influence of orthographic consistency on the rate at which the reading system develops. The authors further explained that because letter–speech sound correspondences are ambiguous in opaque orthographies, children learning such languages probably have to develop more elaborate and complex decoding strategies, which may cause phonological skills to remain important for a longer period of time.

Taken together, RAN appears to be a strong concurrent and longitudinal predictor of reading ability, especially reading fluency, in several consistent and inconsistent orthographies. However, compared to RAN, the impact of PA on orthographically consistent languages seems to be time limited and fades away when children become skillful at decoding in a transparent orthography. Additionally, research suggests that the predictive value of RAN might differ depending on participants' reading skill (poor versus skilled readers), reading expertise and the type of measures (e.g., reading fluency versus reading accuracy) administered in research studies.

2.5.1.4 The relationship of RAN to other predictors of reading

Some studies that focused on RAN-reading association also examined how RAN is related to other predictors of reading such as PA, PM, OK and PS. Understanding such an interconnection will provide us with further information on whether the effect of RAN is mediated by any of the other word reading predictors, or whether it directly contributes to word reading. Contrasting with this assumption, subsequent research studies detected unique and independent contribution of RAN to reading ability beyond the effects of other phonological processing skills, namely PA and PM (e.g., de Jong & van der Leij, 1999; Parrila et al., 2004).

Alternatively, Bowers and colleagues (Bowers, Golden, Kennedy & Young, 1994; Bowers & Wolf, 1993; Sunseth & Bowers, 2002) highlighted the connection between rapid naming and OK development to explain RAN-reading connection. They speculated that slow letter or digit naming speed may be a sign of disruption of the automatic processes which support induction of orthographic patterns, which, in turn, facilitates quick word recognition. That is, an impaired timing mechanism (i.e., slow naming of visual stimuli such as letters) may negatively affect the sensitivity to commonly occurring orthographic patterns and inhibit the quick build-up of orthographic codes for common patterns. In this view, inadequate orthographic processing due to slow naming is proposed to impede efficient word reading. To support this view, researchers identified RAN as a unique predictor of OK (e.g., Manis et al., 2000). On the other hand, some other studies found evidence for the disconnection between RAN and OK as well as the unique contribution of RAN even after controlling for the effects of OK (e.g., Li, Shu, McBride-Chang, Liu, & Peng, 2012; Rothe, Schulte-Körne, Ise, 2014).

In contrast to these two perspectives, in some research studies, RAN is associated to reading as a function of domain-general factors such as PS (e.g., Kail & Hall, 1994). RAN-PS relation in explaining reading ability will be thoroughly discussed in the PS section below. Briefly, PS is assumed to have a pivotal role in the efficient execution of cognitive processes underlying both RAN and reading.

Taking all these hypotheses into consideration, the previously mentioned study, Denckla and Cutting (2001), inspected RAN in relation to PA, memory span, OK, PS and articulation in normally developing readers from first to third grades. Specifically, the researchers were interested in to what extent RAN, PS, PA knowledge of orthography, and memory span together and/or independently explain variability in word reading for early elementary readers, and how these variables were related to each other. The researchers conducted a very meticulous path analysis and found that all six variables in the model together accounted for 66% of the variance in word reading. As for the results pertaining RAN in relation to other variables, the study reported mixed results. RAN was found to have no significant direct effect on PA measured by phoneme deletion task (path coefficient of –0.12), which confirms that RAN and PA are relatively independent of one other. Similarly, RAN did not have a significant direct effect on memory span which was assessed via a task of digit span, either (path coefficient of 0.15). This indicated that RAN and PM were different processes. In addition, RAN was found to contribute to word reading independently from OK. Although RAN and OK were found significantly related (r= -.28), this relationship, according to the researchers, appeared because of the effects of PS on RAN. That is, when the effects of PS was controlled, RAN did not contribute to OK. Thus, Cutting and Denckla identified PS as a common linking factor between RAN and OK. Only PS was found to contribute directly to RAN performance. Based on these findings, the researchers concluded that PA, OK and RAN are vital and independent components of successful reading for normally developing beginning elementary readers. Concerning PS, the researchers commented that as a variable having direct influence on RAN, memory span and PA, PS is a necessary but not sufficient constituent of effective reading. Even its mediating role between RAN and OK was not adequate to account for all the variance associated with RAN and word reading.

Georgiou et al. (2016) found that RAN's effects on reading fluency were partly mediated by the effects of orthographic processing which was operationalized with speeded measures. Accordingly, the researchers commented that RAN contributed to the development of OK, which is crucial for reading fluently. Further, as in Cutting and Denckla (2001), the researchers noted that RAN-OK relation was moderated by PS. The researchers claimed that different cognitive processes may mediate the relationship between RAN and reading fluency at different points of reading development. According to the Georgiou et al. (2016), phonological processing may mediate RAN's effect on reading fluency in early grades because beginning readers are more dependent on phonological recoding for accurate and fluent word reading and thus efficient retrieval of the sounds from long-term memory is essential. However, a shift may take place in later grades and orthographic processing may become the significant mediator of RAN-reading relationship as advanced readers depend more on whole word recognition to read fluently. On the other hand, Georgiou et al. (2016) also emphasized that orthographic processing is not the only or the main reason that can explain why RAN is linked to reading fluency because there remained a large proportion of RAN's predictive power (79.4%) in reading fluency even after controlling for speed of processing, phonological processing, and orthographic processing. According to Georgiou and colleagues (2016), rapid sequential processing and articulation time included in RAN tasks can clarify this unexplained variance in RAN-reading fluency relation. Consistent with Cutting and Denckla (2001), Georgiou et al. (2016) highlighted the unique and independent contribution of RAN to word reading fluency despite its shared variance with other variables.

As to the relation between RAN and memory span, the results are conflicting and inconclusive. On one hand, some studies (e.g., Spring & Perry, 1983; Wagner & Torgesen, 1987) have detected a correlational and/or causal link between RAN and memory. On the other hand, some other studies have found no evidence for such connection (e.g., Cornwall, 1992; Cutting & Denckla, 2001; Bowers, Steffi & Tate, 1988). Wagner, Torgesen, Laughon, Simmons and Rashotte (1993) emphasized that RAN and phonological memory are discrete but correlated processes. In contrast to such correlational studies in which RAN was hypothesized to contribute to memory span performances, in a comprehensive study on RAN, Babür (2003) detected a unique contribution of verbal STM to both alphanumeric RAN and nonalphanumeric RAN in the first grade (7% and 4%, respectively). The researcher also reported a moderate correlation between STM and alphanumeric and nonalphanumeric RAN in the first grade (.32 and .34. respectively). However, STM was not identified a significant predictor of either alphanumeric RAN or nonalphanumeric RAN in the second grade. This disconnection between RAN and memory, according to Babur, can be explained in two ways: First, the restricted range of scores on some of the variables might have reduced the strength of the associations between the variables.

Alternatively, second graders might have become so automatized in naming digit, letters and objects that STM did not exert any effects on these variables. The same study did not find any relation between RAN and PA in Grades 1 and 2.

Taken together, it appears that RAN is associated with other predictors of reading, particularly with PS and OK. RAN's relation with PA and PM is based upon correlational studies which do not essentially point to causality between these variables. Upon discussing the role of RAN in reading development and its relation with other reading-related skills, it is also essential to go over other dynamics affecting reading outcomes in order to come up with a more comprehensive model of reading. The next section will summarize the research literature on PA, another important variable that has been proved to be influential in reading development.

2.5.2 Phonological awareness (PA)

An extensive number of studies on reading acquisition in various languages have shown that PA, i.e., one's awareness of and access to the sound structure of oral language, is a vital construct that plays a causal and facilitating role in learning to read (e.g., Arabic: Asadi et al., 2017 ; Czech: Caravolas, Volin, & Hulme, 2005; Dutch: de Jong & van der Leij, 2002; English: Bradley & Bryant, 1983; Kirby, Parrila, & Pfeiffer, 2003; Torgesen et al., 1994; Finnish: Müller & Brady, 2001; French: Demont & Gombert, 1996; Turkish: Babayiğit & Stainthorp, 2007; Öney & Durunoğlu, 1997; Sönmez, 2015). The following subsection will present the definition of PA. Meanwhile, it includes a discussion on the developmental conceptualization of PA.

2.5.2.1 On the definition of PA

PA has still been of interest because of its well-established theoretical and empirical association with reading acquisition (Adams, 1990; Wagner et a., 1997). The ground-breaking work of Liberman and her colleagues in the 1970s (Liberman, 1973; Liberman, Shankweiler, Fisher & Carter, 1974) pioneered several studies that identify PA as an essential and robust precursor to the development of reading ability.

Simply defined, PA refers to one's ability to recognize, identify, and manipulate any phonological unit of a spoken word (Gillon, 2007; Oakhill & Kyle, 2000). According to Anthony and Francis (2005), a consensus on the definition of PA has emerged after four decades of research. That is, similar to the definitions given in research literature (e.g. Gillon, 2007; Oakhill & Kyle, 2000; Wagner et al., 1994), Anthony and Francis (2005) defined PA as a person's ability to recognize, discriminate and manipulate the sounds in his/her language, irrespective of the size of the target word unit. The authors also identified PA as a unified construct, i.e., a single cognitive ability during the preschool and early elementary school years that manifests itself behaviorally in a variety of skills throughout an individual's development. Essentially, PA includes skills related to phonological analysis, i.e., the ability to break whole words into constituent phonemes and phonological synthesis, namely the ability to blend isolated phonemes together to form whole words (Wagner et al., 1994, p. 75).

PA can be measured at three levels, namely the level of syllables, the level of onsets and rimes, and level of phonemes (Goswami, 1999). Syllabic awareness refers to a child' ability to identify constituent syllables in words (e.g. the word gasoline has three syllables). Onset-rime awareness means the ability to recognize that a single syllable consists of two units, the onset, which corresponds to any phonemes before the vowel (e.g. /b/ in bay) and the rime, which corresponds to the vowel sound and to any phonemes following that vowel (e.g. /iː/ in tea). Phonemic awareness is the ability to detect individual phonemes within a word. Phonemes are the smallest sounds that change the meanings of words (e.g. hop vs. top) (Goswami, 1999).

Upon discussing the definition and levels of PA, the question how PA develops through these levels will herein be addressed. Anthony and Francis (2005) pointed that PA usually develops more rapidly once literacy instruction begins. Children's experiences with written language dramatically affect PA development. As children become literate, their levels of PA increase as well. To illustrate this development, Durgunoğlu and Öney (1999) reported that children in upper grades perform better than children in lower grades on PA tasks. PA development is typified by a gradually more refined awareness of shorter and more abstract units of speech. Several studies in various alphabetic languages have shown that PA skills emerge in a predictable sequence in spite of structural differences in the phonology of the languages being learned (Anthony et al., 2003; Carroll, 2001; Cossu, Shankweiler, Liberman, Katz & Tola, 1988; Demont & Gombert, 1996; Denton, Hasbrouck, Weaver & Riccio, 2000; Fox & Routh, 1975; Ho & Bryant, 1997; Lonigan et al., 1998; Treiman & Zukowsky, 1991; Ziegler & Goswami, 2005). Broadly, the developmental progression of PA follows awareness of (a) syllables, (b) intrasyllabic units of onset (the initial consonant or consonant cluster in a syllable) and rime (the vowel and final consonant or consonant cluster), (c) individual phonemes within rimes (because children are more sensitive to the rhymes at the end of a word), and (d) individual phonemes within consonant clusters (Treiman, 1987; Wagner & Torgesen, 1987). Treiman (1987) supported this sequential development of PA with a study that included kindergarteners. The researcher found that most kindergarteners demonstrated syllable awareness as well as awareness of intrasyllabic segments although the majority of kindergarteners were unable to present phonemic awareness. At this point, in another early study, Alegria, Pignot, and Morais (1982) emphasized the critical role of formal literacy instruction in the sequential development of PA skills. The researchers claimed that different from phoneme awareness, syllable awareness is not greatly facilitated by a phonics-based program of reading instruction. The researchers did not identify any significant difference in syllable awareness performance of children who were taught to read based on a whole-word method and those who were taught to read via a phonic method. However, the latter group displayed a strikingly better performance in phonemic awareness than the former group.

Parallel to the results of these early studies, Ziegler and Goswami (2005) pointed out that normally progressing children generally master word-level skills before they master syllable-level skills, syllable-level skills before onset–rime skills, and onset–rime-level skills before phoneme-level skills. More specifically, syllable awareness is usually acquired by about age 3 to 4, followed by phonological awareness of onset–rime that is acquired by about age 4 to 5. Finally, phoneme awareness has been claimed to flourish once children are taught to read and write. In line with this view, Goswami (2006) emphasized that prereading children and illiterate adults generally perform poorly in tasks which demand manipulation or identification of single phonemes. Thus, according to Goswami, whereas syllabic awareness and onset-rime awareness seem to emerge as a natural consequence of language acquisition in normally developing children across languages, the emergence of phonemic awareness is an effortful outcome of reading acquisition.

Anthony and Francis (2005) also argued the existence of a general developmental sequence of PA from larger units to smaller units is universal across languages. The authors, however, stated that certain characteristics of spoken language (e.g., saliency and complexity of word structures, phoneme position, and articulatory factors) and of written language (i.e. orthographic features of transparent and opaque languages) along with genetics, intelligence, memory, and vocabulary might have an impact on the rate of normal PA development and on the proficiency that individuals normally attain at each PA level. A persuasive body of evidence (e.g., Caravolas & Bruck, 1993; Durgunoğlu & Öney, 1999; Ziegler & Goswami, 2005) supports that phonological and orthographic characteristics of languages influence PA progression. Durgunoğlu and Öney (1999), for example, found that some features of spoken languages such as the saliency of the syllable, familiarity of the nonword patterns, importance of onset or final phoneme deletion and importance of vowel harmony affect the development of PA. In the study conducted with Turkish and English-speaking kindergarteners and first-graders, Durgunoğlu and Öney (1999) displayed that compared to the English children, the Turkish children were more proficient in both dealing with the syllables and deleting final phonemes in words, reflecting the characteristics of the spoken language in Turkish. That is, Turkish is characterized by a more consistent syllable structure and fewer number of syllable types. The possible syllable types are as follows: V/ VC/ CV/ CVC/ VCC/ CCVC/ CVCC/ CCVCCC (Çapan, 1989). The Turkish language has also a strong vowel harmony, which requires its speaker to change the morphemes depending on the nature of the preceding vowel in a word. Thus, the Turkish children are assumed to hear individual phonemes in words faster. Additionally, in Turkish, inflections are attached to the ends of words, and as new morphemes are added, the syllable structure at the end of a word can reconstruct. According to Durgunoğlu and Öney (1999), such linguistic features in Turkish enable Turkish children to manipulate syllables more accurately earlier, demonstrate better performances in phoneme tapping and phoneme deletion tasks and achieve final phoneme deletions more effortlessly compared to their English counterparts. Goswami (2006) also mentioned that the rate of phonemic awareness growth in children might differ depending on the phonological structure of the language being acquired and its orthographic consistency. That is, children learning transparent orthographies such as Greek, Finnish, German, and Italian accomplish phonemic awareness fairly rapidly compared to children learning nontransparent orthographies such as English, Danish, and French. Linguistic differences in syllabic complexity and orthographic depth are responsible for the early or delayed acquisition of phoneme awareness in these languages.

In addition to the influence of phonological features and orthographic depth upon PA development, Anthony et al. (2003) emphasized the occurrence of overlapping stages instead of temporarily discrete stages in the acquisition of PA skills and suggested that in contrast to a strict stage theory of development, children continue to expand PA skills that they have already acquired while they are gaining new PA skills.

Taken together, it is evident that PA, one's degree of sensitivity to the sound structure of oral language, is strongly related to reading acquisition, and creates highly stable individual differences from late preschool on (Anthony and Francis, 2005). As previous studies suggested the general order of PA progression proceeds from larger units (e.g., ability to segment spoken words into syllables, and the ability to segment syllables into onsets and rimes) to smaller units (e.g., the ability to break onsets and rimes into phonemes) (e.g., Anthony & Francis, 2005). Noteworthy, this sequential order is universal across languages. However, the development of PA might yield certain patterns that reflect the characteristics of the language each child speak. Finally, children keep elaborating their previous PA skills as they are adding new PA skills to their repertoire.

Children's knowledge of PA can be evaluated with a range of different tasks. The next subsection will present some of these measurement tasks and some other factors related to task items influencing the results of studies.

2.5.2.2 PA tasks

The development of PA in children can be measured using a variety of different tasks such as rhyme recognition (Does *fish* rhyme with *dish*?), *sound-to-word matching* (Does *fish* begin with /*f*/?), *isolating single sounds from words* (What is the first sound in *fish*?), *blending* (What does /f-i-sh/ say?) and *phoneme deletion* or *elision* (Say *fish* without /*f*/) (Stahl & Murray, 1994). There are also tasks that measure syllable awareness such as *syllable segmentation* (e.g., How many syllables (or parts) are there in the word *coffee*?), *syllable deletion* (e.g., Say *finish*. Now say it again without saying *fin*?), and *syllable identity* (e.g., Which part of *complete* and *compare* sound the same?). Tasks that have been created and used to assess phonemic awareness are as follows: *Phoneme matching* (e.g., Which word begins with the same sound as *bat*: *horn*, *bed, cup*?), *phoneme isolation* (e.g., Tell me the sound you hear at the beginning of the word *food*?), *phoneme completion* (e.g., Here is a picture of a watch. Finish the word for me: *wa*___?), *Phoneme blending with words or nonwords* (e.g., What words do these sounds make: *m...oo…n*?), *phoneme segmentation with words or nonwords* (e.g., Say *it*. Now say *it* one sound at a time.), and *phoneme reversal* (e.g., Say *na* (as in *nap*). Now say *na* backwards" *-an)* (Gillon, 2007, p. 5-7). Such tasks designed to assess PA skills vary in difficulty. According to Adams (1990), PA tasks can be categorized into five levels of difficulty. At the basic level one can find having an ear for the sounds of words (e.g. the ability to remember familiar rhymes). The second level of difficulty involves the ability to recognize and classify patterns of rhyme and alliteration in words, which requires more focused attention to sound components (e.g., the ability displayed in oddity tasks). The third level requires children to be familiar both with the idea that syllables can be divided into phonemes and with the sounds of isolated phonemes (e.g., blending tasks, syllable-splitting tasks such as isolating initial phonemes). At the fourth level of difficulty, PA tasks require full segmentation of component phonemes (e.g., tapping tests). The most difficult tasks require children to add, delete, or move phonemes and to recreate the resultant word or pseudoword.

Several studies revealed that linguistic factors (e.g., total number of phonemes within a word, number of consonants in a cluster, position of the target sound, type of sound, and similarity in voicing) might have an impact on the difficulty levels of test items in PA tasks. Stahl and Murray (1994), for example, conducted a study with kindergarteners and first graders to test the influence of four levels of linguistic complexity (analyzing onsets and rimes, analyzing vowels and codas within rimes, analyzing phonemes composing cluster onsets and analyzing phonemes composing cluster codas) in commonly used PA tasks, namely blending, isolation, segmentation and deletion. Overall, phoneme isolation was identified as the easiest task, followed by blending, deletion, and segmentation. As for linguistic complexity, the researchers reported that linguistic complexity is a better way of defining the construct of PA and analyzing onsets and rimes was the easiest linguistic level, followed by analyzing vowels and codas, analyzing cluster codas and analyzing cluster onsets. In addition, the results of this study reported that clusters composed of liquids were easiest to segment, clusters with nasals were of middle difficulty, and clusters containing obstruents were most challenging to segment. The researchers concluded that speech sound manipulations such as the number of consonants within the consonant cluster influence items' difficulty level in PA task.

Likewise, McBride-Chang (1995) examined the influence of four different linguistic manipulations of consonant sounds on various PA tasks, using nonsense words with 3rd and 4th graders as participants. One of the crucial findings of this study is that PA constitutes at least three components, namely general cognitive ability, verbal memory and speech perception. Parallel to the finding that the speech perception is an essential component of PA, McBride-Chang (1995) hypothesized that speech manipulations (e.g. numbers of phonemes, types of phonemes, numbers of phonemes within a phoneme cluster and position of phonemes within a nonsense word) within individual PA tasks might affect item difficulties. Accordingly, *number of phonemes* within a nonsense word was observed to have the largest phoneme manipulation effect. That is, identifying five-phoneme nonsense words were the most demanding items for children. It is also important to note that similar to Stahl and Murray (1994) phoneme segmentation was detected as the most difficult of the three phonemic awareness tasks (i.e., phoneme deletion, position analysis of a particular phoneme within nonsense words and phoneme segmentation) because this task appears to put a heavy burden on memory in addition to a phoneme identification burden on the most difficult items. Further, *the type of a phoneme* (e.g., stop versus fricative consonants) had a significant effect on children's performance in position analysis task in which participants were asked to tell what sound came before or after another phoneme in the nonword (e.g., say *nelf*. Now what sound comes after the */l/* sound in the nonsense word *nelf*). Identifying the place of stop consonants within nonsense words was found to be more challenging compared to other phoneme types in position analysis task. Additionally, *the position of the phoneme* to be manipulated resulted in significant effects in both position analysis and phoneme deletion tasks. McBride-Chang (1995) detected that manipulation of a phoneme in the medial position was more difficult than was manipulation of a phoneme in the final or initial positions. The researcher mentioned different interpretations to explain medial position difficulty. According to one explanation, short-term memory constraints might cause challenges for phonemes in middle of a nonsense word. In other words, stimuli presented in the initial or final position are more easily recalled than those in the middle. For another explanation, due to coarticulation influences, a child might not distinguish the target speech sounds that occur in the middle of a stimulus word because preceding and following phonemes might interfere with their perceptions. Finally, it was observed that *number of consonants within a consonant cluster* influenced children's PA performances, especially in phoneme deletion tasks. That is, deletion of a phoneme from a consonant cluster of one was significantly easier in comparison with deletion of the same phoneme from clusters of two and three. Chafouleas, VanAuken and Dunham (2001) adopted the linguistic factors such as total number of phonemes in a word, type of initial sound (e.g., continuant vs. noncontinuant), and number of consonants in an initial cluster used by McBride (1995). However, different from McBride (1995), Chafouleas and colleagues examined the pattern of linguistic difficulty in younger children, i.e., kindergarteners and first graders, with test items including real words rather than nonwords. This study replicated the findings of previous research. That is, item difficulty in PA tasks varied depending on the linguistic manipulations. However, the researchers also pointed that different linguistic features might differently influence the difficulty level of each PA task. For instance, whereas the number of initial consonants seems to be influential in a deletion task, the total number of phonemes is significant in a segmentation task. In addition, Chafouleas and colleagues found the type of target sound (e.g., continuant vs. noncontinuant) and number of consonants in an initial cluster to be salient linguistic features affecting young children's PA task performances.

Although PA tasks differ in terms of the difficulty levels of test items due to speech sound manipulations, McBride-Chang (1995) identified three main properties that all PA assessment tools share: (i) The participant must first listen to one or more words or nonsense words presented orally; (ii) The participant is required to operate on that stimulus or set of stimuli; (iii) The participant is asked to verbally reply to the presented stimuli.

In sum, it seems that various types of PA measures have been adopted in different studies. The stimuli used in these experimental measures, however, may differ unsystematically. Thus, as McBride-Chang (1995) suggested, speech sound manipulations such as type of phoneme, position of phoneme, number of phonemes within a consonant cluster and number of phonemes in a stimulus should be taken into account to control item difficulty on PA tasks. Standardized PA tasks have been administered in this thesis study to discard problems that might arise due to linguistic factors.

Following the discussion on PA tasks, a brief literature on PA in relation to reading ability will be presented in the following part.

2.5.2.3 The relationship of PA to reading skills

There is now a wealth of evidence suggesting a strong relation between performances on PA and reading skills in orthographically different alphabetic and nonalphabetic languages studied to date (e.g., Bradley & Bryant, 1983; Christensen, 1997; Hansen & Bowey, 1994; Ho & Bryant, 1997; Hulme et al., 2002; McBride-Chang & Kail, 2002; Siok & Fletcher, 2001; So & Siegel, 1997; Torgesen et al., 1994). Noteworthy, this relationship is widely acknowledged as both causal and reciprocal. Examining longitudinal and experimental studies, Goswami (2006) recognized the direct causal link from PA to success in the acquisition of reading skills. There are also several reports of a causal reciprocal relationship between PA and reading achievement (Burgess & Lonigan, 1998; Hogan, Catts & Little, 2005; Perfetti, Beck, Bell, & Hughes, 1987; Stanovich, 1986). Hogan et al. (2005), for example, found a reciprocal relationship between PA and word reading, with kindergarten PA predicting word reading in 2nd grade and 2nd grade word reading predicting PA in 4th grade. Perfetti et al. (1987) also emphasized the mutual connection between phonemic awareness and learning to read. Based on a longitudinal study of first grade readers, the researchers suggested that although the rudimentary ability to manipulate isolated segments may be essential for significant progress in reading, reading itself provides the child with the ability to analyze words and to manipulate their speech segments. Perfetti et al. (1987), therefore, concluded that gains in reading lead to gains in phonemic awareness (more precisely in phoneme deletion), which, in turn, present additional gains in reading acquisition. In addition to the studies with school-age children, Burgess and Lonigan (1998) showed that reading and PA are reciprocally related prior to the onset of formal reading instruction. Conducting a one-year longitudinal study with 4- and 5-year-old children, the researchers investigated the role of letter-name and letter-sound knowledge in the growth of lower and higher levels of phonological sensitivity as well as the role of phonological sensitivity in the growth of letter-name and letter-sound knowledge in preschool children. In line with the results found with children during the early school years, Burgess and Lonigan (1998) demonstrated that rudimentary reading skills, namely letter knowledge made a significant unique contribution to the development of higher levels of phonological skills such as phonemic awareness. Additionally, PA abilities were found to facilitate growth in letter knowledge (a predecoding reading ability) of preschoolers.

In addition to this reciprocal relationship between PA and different reading skills, many studies have usually focused on the causal role of PA in reading. Accordingly, PA has been shown to be a strong concurrent and longitudinal predictor of reading ability in several alphabetic and nonalphabetic languages (e.g., English: Kirby et al., 2003; Schatschneider et al., 2004; Torgesen et al., 1994; Wagner et al., 1994; French: Demont & Gombert, 1996; Chinese: McBride-Chang & Kail, 2002; Tong & McBride-Chang, 2010). As for the role of PA in transparent orthographies, the results of the studies often yielded conflicting results. On one hand, some studies have recognized PA as a reliable predictor as in opaque and nonalphabetic languages (e.g., Finnish: Müller & Brady, 2001; Indonesian: Widjaja & Winskel, 2004; Norwegian: Hoien et al., 1995; Portuguese: Cavalheiro, dos Santos & Martinez, 2010; Turkish: Güldenoğlu et al., 2016). On the other hand, others have argued that PA owns a limited and less significant role in the development of reading skills in regular orthographies (Dutch: de Jong & van der Leij, 1999; Turkish: Babayiğit & Stainthorp, 2007; Bektaş, 2017; Öney & Durgunoğlu, 1997).

In a longitudinal study conducted with 403 English- speaking preschoolers, Bradley and Bryant (1983) demonstrated that onset/rime awareness was a significant precursor of subsequent reading and spelling development when assessed at the age of 8 and 9. Using the oddity task (e.g. *Which word does not rhyme: pin, win, sit?*) this study showed that there was a definite causal relationship between preschoolers' awareness of rhyme and alliteration and their eventual achievement in reading which was measured through word recognition tasks in the first and second grades.

In addition, in a very comprehensive longitudinal study with 216 English-speaking children, Wagner et al. (1997) examined the relations between phonological processing abilities (i.e., phonological awareness, phonological memory and phonological naming) and word level reading skills (real word and non-word reading) in English. The researchers followed the children from kindergarten to fourth grade and assessed their reading and phonological processing abilities annually. Of particular interest, Wagner et al. (1997) focused on the unique effect of PA on subsequent word-level reading abilities beyond that explained by the other two aspects of phonological processing. The results revealed that PA was a reliable and significant precursor of both real and nonword reading at each time period measured. Although phonological naming and vocabulary were also found to cause subsequent individual differences in word-level reading initially, these influences vanished as the grade level increased.

In a different study with English-speaking Canadian children attending Grades 3 and 4, Georgiou et al. (2008a) dealt with the effects of PA, RAN and working memory on word reading and passage comprehension. Based on the hierarchical regression analyses, similar to previous studies, Georgiou et al. (2008a) reported unique contributions of PA and RAN to word reading over and beyond the effects of age and working memory. In contrast to word reading, however, neither PA nor rapid naming explained unique variance in reading comprehension. The researchers concluded that PA and RAN are rather independent from each other using word reading as a dependent variable.

Concurrent studies have also reported similar findings about the role of PA on reading. Testing children on six occasions during the first grade and on three occasions during the second grade, Blaiklock (2004) found positive relationships between PA and word reading ability in New Zealand English. More specifically, significant concurrent correlations were detected between rhyme awareness and word reading as well as between phoneme awareness and word reading. However, the researcher pointed that many of the correlations between PA and word reading was reduced to nonsignificant levels once letter-sound knowledge was taken into account. Based on these findings, Blaiklock (2004) claimed that letter knowledge and PA might overlap in the variance they account for in reading achievement. That is, significant correlational results found between measures of PA and reading may stem from the common association of these variables with letter knowledge.

The predictive power of PA over reading skills have been evidenced in other opaque languages as well. Demont and Gombert (1996), for example, conducted a three-year longitudinal study with French children and tested to what extent PA and syntactic awareness account for reading skills (real word reading accuracy and speed, and reading comprehension) in French, another language with an opaque orthography. The researchers followed children from Grade 1 to 3. The results of this study showed that whereas children's PA predicted later recoding skills (i.e., fluent and accurate word reading), their syntactic awareness made a significant contribution to reading comprehension controlling for extraneous variables such as general and verbal abilities (i.e., intelligence and vocabulary).

In addition to the studies in opaque languages, studies in shallow orthographies found evidence for the strong PA and reading connection. Carrying out two research studies with a large sample size (n= 128 preschool children for Study 1; n= 1509 first graders for Study 2), Hoien et al. (1995) revealed that syllable, rhyme and phoneme awareness are essential elements of PA and are reliable indicators of success in early reading acquisition in Norwegian, a language with a fairly transparent orthography. Of these three components of PA, phonemic awareness was identified as the most potent predictor of word reading ability of the first graders, with phoneme identity measures having a unique status as predictors.

Support for PA as a determinant of success in reading also come from studies in Portuguese. Cardoso-Martins (1995), for instance, investigated the relationship between various levels of PA (i.e. awareness of rhymes, syllables, and phonemes) in literacy acquisition in Portuguese. One hundred five Brazilian children who were, on average, 6 years of age were tested before the beginning of formal instruction in reading, at the middle and at the end of the school year. Parallel to the findings of previous investigations, the results of the study displayed that PA made a significant contribution to the progression of word reading ability. In particular, children's performance on the phonemic awareness tasks (particularly, phoneme segmentation) significantly predicted their word reading capacity. In a more recent study, Cavalheiro et al. (2010) examined to what extent PA skills in Portuguese, namely syllabic and phonemic awareness, make an impact on reading speed and reading level of children who were between the ages of 5 and 8. Cavalheiro et al. (2010) observed that the higher the children's PA scores were, the greater speed-reading they presented. The researchers also detected a significant weak positive correlation between PA and reading level and speed. It was concluded that the presence of PA in Portuguese leads to better development and performance in reading.

In a longitudinal study, Widjaja and Winskel (2004) tested seventy-three Indonesian children in Grade 1 to investigate the role of PA in early reading acquisition in Indonesian, which is an orthographically transparent language. Children were measured on syllable detection, syllable deletion, onset detection, rhyme detection, phoneme deletion, letter identification, word reading and non-word reading. Of the PA skills measured in the study, the highest correlations appeared between between phoneme deletion and non-word reading ($r= .81$, $p<.001$). As in Portuguese, this study also noted not phonemic awareness was a significant unique predictor of both word reading and non-word reading in Indonesian.

The study conducted in Turkish by Güldenoğlu et al. (2016) found a similar pattern of results to those reported in Portuguese and Indonesian. The researchers examined the longitudinal effects of kindergarten PA skills on word reading and reading comprehension performances in first grade. The participants were 45 children with proficient PA skills and 40 children with poor PA skills. The findings pointed that although all participants displayed similar performances in terms of reading accuracy in both real and pseudoword reading tasks, participants with proficient PA skills were more successful at reading fluently and understanding passages than participants with poor phonological awareness skills. Güldenoğlu et al. (2016) commented that because participants with better PA were more experienced in word recognition, apply phonological analysis and synthesis skills and so recognize words faster, they were more advantageous in reading comprehension compared to those with poor PA skills.

Unlike Güldenoğlu et al. (2016), Babayiğit and Stainthorp (2007) did not detect any influence of kindergarten PA to reading fluency measured at the end of Grade 1 and 2. In the study, syllable tapping, syllable deletion, rhyme awareness, onset awareness, initial phoneme deletion and final phoneme deletion tasks were applied to assess children's PA abilities. The overall findings of the study showed that whereas PA measures, and in particular the sound oddity task, was the strongest and consistent predictor of spelling skills, it did not exert any significant contribution to early reading skills (i.e., real word and non-word reading fluency and reading speed). According to Babayiğit and Stainthorp (2007), such results can be attributed to some methodological limitations of the study as well as the extreme simplicity of Turkish orthography, which leaves no place for speech analysis skills to exert any meaningful effect upon reading accuracy by the end of Grade 1. That is, as long as a child can achieve to map the 29 alphabet letters onto their corresponding sounds, he or she can decode any word in Turkish. The transparency effect of orthography on PA and reading relations will further be thoroughly discussed below.

Although abundant body of evidence from both opaque and shallow writing systems suggest that PA is one of the major factors influencing word level reading, some other studies have shown that the nature of this affect might alter over time due to the characteristics of languages. In other words, the role of PA in relation to reading might change in time depending on the regularity of the correspondence between sounds and letters. At this point, Torgesen et al. (1997) highlighted that "characteristics of a language's orthography itself may powerfully impact the relative contributions of PA and RAN to the growth of word-reading ability" (p. 182). Parallel to this view, it should be noted that the aforementioned studies in transparent orthographies all explored the relative role of PA in early reading acquisition, among kindergarteners and first graders. Assessing PA in this period of schooling might enhance its role in reading. The type of the reading task (fluency versus accuracy) applied in the studies should also be born in mind as several studies have indicated that PA is a better index of word reading accuracy (e.g., Asadi et al., 2017; Wolf & Bowers, 1999). Consistent with this idea, Landerl and Wimmer (2008) observed that the link between PA and reading became weaker from Grade 1 to Grade 8 for children learning to read in German. The researchers wrote that the long-term development of fluent word recognition was influenced by rapid naming rather than PA. In a longitudinal study conducted with Dutch children, de Jong and van der Leij (2002) examined the influences of phonological abilities, rapid naming speed and linguistic comprehension (i.e., listening comprehension and vocabulary) on the development of word-decoding ability and reading comprehension. The researchers reported that although PA was strongly related to word decoding, it had no further impact on the development of word decoding after first grade. This result, according to the researchers, presents further evidence for the time-limited effects of phonological abilities on word-reading speed in Dutch children who were learning to read in an orthographically consistent language. Rapid naming was reported to be more important than PA in fluent word reading. However, different from de Jong and van der Leij (2002), in the previously reviewed study Wagner and colleagues (1997) reported longitudinal influence of PA on the development of real and nonword reading accuracy in English, which has an opaque orthography. Wagner et al. (1997) found that individual differences in PA significantly influence subsequent development of individual differences in word reading accuracy over a longer period of time. That is, according to the researchers, the influence of PA on accurate word reading in English is not developmentally constrained to beginning reading, extending instead through at least fourth grade.

Mann and Wimmer's (2002) study with German- and English-speaking children also yielded insights about how the complexity of the orthography to be learned affects the relationship between PA and reading. In the study, regarding phonemic awareness, American kindergartners were found to be advantageous but at the end of first grade, the German children showed more or less the same phoneme judgment performance as their American counterparts. Further, the German second graders were found to be more accurate decoders of pseudowords by the end of second grade. The authors explained higher reading performance of the German children compared to their English counterparts due to an increased emphasis on phonics and the greater transparency of the German alphabet. In addition, a weaker association between phoneme awareness and German decoding ability was observed in the study. That is, although the performance of German first and second graders on phoneme awareness tests was comparable to that of the American children, phoneme awareness was more strongly associated with decoding in American population. The more transparent German orthography, according to Mann and Wimmer, accounts for the decreased association between phoneme awareness and reading in German.

Wimmer's (1993) study with German-speaking dyslexic children at grade levels, 2, 3 and 4 provided further evidence for how a language's orthography is influential in PA and reading relation. It was found that the serious difficulties that the impaired children initially exhibited in phonemic segmentation and phonemically mediated word recognition disappeared after about two years of school. However, these children continued to experience pervasive speed impairment in reading. That is, in contrast to the English dyslexic children, for whom the difficulties related to word decoding persist, German dyslexic children overcome the difficulties inherent in phonemic segmentation and phonemically mediated word recognition relatively quicker. Wimmer explained this major difference by referring to the consistency of German writing system. The author commented that the consistency between graphemes and phonemes in German makes word decoding rather easy so that even children with initial decoding difficulties become competent in word decoding and phonemic segmentation after some delay, making use of contextual clues and guessing. However, German dyslexic children suffer from slow and laborious word decoding while their normally developing peers read rapidly and effortlessly.

In a series of studies conducted in Turkish, Babayiğit and Stainthorp (2007, 2010) also emphasized the time-limited effects of PA in a transparent orthography. They showed that PA did not make any significant contribution to later reading skills (real word and non-word reading fluency and reading speed) in Turkish. In parallel with these studies, in a cross-linguistic study, also reviewed in RAN section above, Furnes and Samuelsson (2011) showed that although kindergarten PA in English was significantly related to fluent word recognition and phonological decoding (pseudoword reading) in Grade 1, such influence was not detected on reading outcomes in Grade 1 and Grade 2 in Norwegian/Swedish. Furnes and Samuelsson (2011), instead, suggested that RAN was a stronger precursor of early reading development than PA and that PA was not a reliable predictor of reading skills beyond kindergarten in transparent orthographies.

A cross-language investigation of Ziegler et al. (2010) is also concerned with the orthographic depth and its impact on cognitive skills that are identified as universal predictors of reading. This study certainly deserves mentioning since it has brought a different interpretation to the role of orthography in PA-reading relation. The study included five languages (Finnish, Hungarian, Dutch, Portuguese, and French) with varying degree of orthographic consistency. Results from a large sample of Grade 2 children displayed that PA is an important variable affecting reading accuracy and speed performances in all orthographies. However, the weight of the contribution of PA to reading performance systematically differed with the degree of transparency of the orthography, being relatively strong in more opaque orthographies. RAN, on the other hand, had a much weaker influence that was confined to reading and decoding speed.

Following this, Vaessen et al. (2010) investigated the impact of orthographic consistency on four cognitive skills (PA, rapid naming, letter-speech sound processing and verbal working memory) underlying reading fluency in different European languages with varying degree of orthographic transparency. The sample of the study consisted of Hungarian, Dutch, and Portuguese primary school children from Grade 1 to Grade 4. Overall, the results indicated that the development of fluent reading skills in both opaque and transparent orthographies is governed by the same cognitive components. The researchers emphasized the importance of PA early in reading acquisition but detected a declining influence of PA with more reading experience and a strong influence of RAN on reading fluency in all three orthographies. However, PA and letter-speech sound processing were found to be influential in reading fluency for a longer period of time in opaque orthographies. Based on these findings, Vaessen et al. (2010) suggested that orthographic consistency affect the rate at which the reading system develops. Fluent reading develops at a slower rate in opaque orthographies in comparison with transparent orthographies. According to Vaessen and colleagues (2010), the ambiguity between letters and speech sounds in opaque orthographies probably lead children to develop more elaborate decoding strategies to form stable connections between orthographic patterns and phonological codes and thus phonological skills continue to stay significant for a longer period of time. The researchers commented that as children excel at decoding words accurately, a shift takes place and RAN becomes much more significant in reading acquisition. The orthographic depth of the language seems to modulate when this change from dependence upon phonology to fluency-based skills (e.g. rapid naming) happens. It appears that readers in more transparent languages tend to move away from phonological decoding strategies earlier in schooling and rely more on rapid naming during fluent reading. In short, awareness of phonological units such as phonemic awareness, in the words of Share (2008), “is likely to be equally important in consistent and inconsistent orthographies but at different phases in development” (p. 598).

To sum up, the growing empirical evidence from a variety of languages demonstrates that individual differences in PA make a significant contribution to explaining the variance in reading progression. However, it seems that how this metalinguistic ability affect the attainment of reading may vary depending on the degree of orthographic transparency of a language that has to be acquired. Orthographic depth seems to dictate the relative strength of the contributions of PA and RAN to reading development. As the relations between letters and sounds become more predictable in a language, PA skills may become less important in explaining subsequent reading success, more specifically, reading fluency while RAN ability becomes much more important.

Given the importance of PA in reading, it is also essential to examine the interconnections between PA and other predictors of word reading, which is the interest of the next subsection.

2.5.2.4 The relationship of PA to other predictors of reading

The relation of PA with RAN has been discussed in the previous RAN subsection. Whereas some researchers have placed these two constructs under phonological processing (e.g., Wagner et al. (1997), others have viewed them as separate and independent entities (e.g., Bowers & Newby-Clark, 2002; Bowers & Wolf, 1993; Cornwall, 1992; Wolf et al., 2000). Evidence for this argument also came from a more recent study of Asadi and his colleagues (2017) conducted in Arabic. In the study, the researchers showed that PA and RAN weakly correlated across all grades (between Grade 1 and Grade 6) (r= .24). The researchers also revealed that whereas PA predicted decoding (i.e., accuracy) significantly and consistently, RAN significantly contributed only to fluency in all grade levels. Asadi et al. (2017) used such results on the accuracy in decoding as an evidence for the disconnection of RAN from phonological processing abilities. PA's link with other predictors of reading such as PM, MA, OK and vocabulary will be addressed in the following subsections after these variables are thoroughly discussed.

Although the critical role of PA in reading outcomes has been convincingly proven in the research literature, other variables that lead to individual differences in reading acquisition should also be considered. One such variable is PM which will be discussed in detail in the next section.

2.5.3 Phonological memory (PM)

2.5.3.1 On the definition of PM

PM is defined as coding information in a sound-based representation system for temporary storage (Anthony & Francis, 2005; Baddeley, 1982). It is the ability to utilize phonological codes to retain information for short-term storage. PM develops at a slow rate due to the multiple components (i.e., short-term memory capacity, memory for serial order and long-term phonological knowledge) it includes (Wagner et al., 1994). In fact, phonological short-term memory capacity appears to grow rapidly through the early and middle childhood years. This progress is assumed to stem mainly from developmental expansion in the speed of rehearsing and of retrieving material from memory as well as from the emergence of subvocal rehearsal as a strategy beyond 7 years of age (Gathercole, 1998).

Prior to reviewing studies with reference to the relative role of PM, tasks that are applied to measure PM will be addressed in the following subsection.

2.5.3.2 PM tasks

In several studies, mostly, performance on nonword repetition and immediate serial recall tasks such as digit or word span have been administered as measures of PM. Such tasks entail the brief, verbatim retention of sequentially presented familiar verbal items (Torgesen et al., 1997) or require the repetition of nonsense verbal strings that are phonologically similar to real words (Stone & Brady, 1995). Additionally, these tasks, according to Nithart et al. (2011), include other associated constituents of PM such as (1) *short-term memory (STM) capacity*, (2) *long-term phonological knowledge* and (3) *memory for serial order*. STM is defined as the capacity to store material for short periods of time, and can be evaluated by manipulating the number of items to be remembered. Long-term phonological knowledge can be displayed via the *phonotactic frequency effect*, which refers to better recall rates for nonwords imitating existing phonological structures. The memory for serial order, namely the sequence in which items are presented, is usually measured by using serial-order recognition or reconstruction tasks (Nithart et al., 2011, p. 347-348). According to working memory model, these tasks measure phonological short-term memory because they require the representation, or coding, of information based on its phonological features in the storage (Baddeley, 1986).

Parallel to literature, nonword repetition and digit span tasks were administered to measure PM skills of children in this study. Giving the descriptions of the most commonly used PM tasks, a brief review on the role of PM in reading acquisition will be discussed in the next subsection.

2.5.3.3 The relationship of PM to reading skills

Wıth regard to reading, efficient phonological coding of information in working memory is thought to provide novice readers with sustaining an accurate representation of the phonemes that are related to target letters or parts of words while dedicating the maximum amount of cognitive resources to decoding and comprehension processes in progress (Wagner et al., 1997). Successful phonetic coding also permits readers to employ maximum resources to blend isolated phonemes together to make words (Wagner et al., 1994). PM may be particularly central in establishing simple letter-sound correspondence rules (Gathercole & Baddeley, 1990). According to Gathercole (1995a), when conversing graphemes into phonemes during word decoding, the sequence of phonemes has to be held in a short-term storage in order to be gathered and then matched to phonological lexical representations stored in long-term memory. These two processes depend heavily on PM.

In comparison with the number of studies that has been interested in the critical role of RAN and of PA, there have been fewer investigations that have explored the precise nature of the contribution of PM to reading acquisition. Additionally, as to the role of PM in reading achievement, studies displayed inconsistent and contradictory pattern of results. Whereas some studies (e.g. Gathercole & Baddeley, 1990; Gathercole & Baddeley, 1993; Hansen & Bowey, 1994; Nithart et al., 2011; Passenger et al., 2000; Wagner & Torgesen, 1987) report a causal connection between PM and reading acquisition, others fail to detect strong predictive influence of PM on reading skills, particularly when it was included as a controlling variable (e.g. Dufva et al., 2001; Georgiou, et al. 2008a; Høien-Tengesdal & Tønnessen, 2011; Parrila et al., 2004). According to Parrila et al. (2004), such variability in the results comes out possibly because of the different degrees of orthographic regularity of target languages (e.g., Dutch is much more regular than English), variation in the outcome measures (e.g., word reading speed versus word reading accuracy), other variables controlled for and types of phonological processing tasks (e.g., PA and RAN) involved in the studies.

Some researchers emphasized pivotal role of PM in early reading acquisition. According to Gathercole and Baddeley (1990), for instance, PM offers “a critical contribution to reading development at the point at which relationships between letter groups and sounds are being acquired” (p.358). This stage typically corresponds to 6 years of age. In a similar vein, Tunmer and Hoover (1993) suggested that the ability to retain phonological information in working memory temporarily might influence decoding skills particularly in three points. First, PM facilitates the long-term learning and application of grapheme-phoneme correspondence rules. Second, when reading unfamiliar words, beginning readers make use of blending operations which involve serial processing of isolated sounds. Here, PM helps beginning readers store isolated sounds in working memory to form a candidate word which is then compared with other word candidates from the mental lexicon. Performing blending operations during reading, according to Tunmer and Hoover (1993), put heavy demands on short-term memory. Accordingly, this might be the reason for positive correlations observed between blending ability and short-term memory tasks (Wagner et al., 1997). Finally, PM assists novice readers identify unfamiliar regular and irregular words by combining contextual information with grapheme-phoneme knowledge.

In parallel with these views, Mann (1984) reported that PM scores of English kindergarteners were associated with their reading achievement measured one year later. It was found that children who differed in their reading ability significantly differed in their talent to repeat a string of spoken words. That is, the kindergarteners who displayed poorer performance in a word recall task (i.e. repeating strings of rhyming words and strings of nonrhyming words) tended to become poor readers in the first grade. Those beginning readers recalled fewer words in the verbal memory test and were also slower at naming the letters in comparison with good or average readers in the first grade. Mann (1984) concluded that phonological processing can presage reading success and tests of phonological processing skills such as word recalling and letter naming are able to distinguish the future poor readers from the future good readers.

Working with thirty-four preschoolers, Nithart et al. (2011) investigated longitudinal influence of PM, PA, and phonological perceptual discrimination upon the development of reading in French. The study specifically addressed the functions of multiple subcomponents of PM such as short-term memory (STM) capacity, memory for serial order and long-term phonological knowledge in reading acquisition. The children were followed from the last year at kindergarten to the end of the first grade. The correlational analyses detected that PA and PM were closely interrelated in first grade but not in kindergarten level. Further, based on the hierarchical regression analyses, Nithart and colleagues pointed that these two phonological skills made independent contributions to success in the earliest stages of reading acquisition. In other words, whereas reading abilities such as decoding (reading a nonsensical text that is composed of nonwords) and word recognition (measured by a word-to-picture matching task) were explained mainly by PA performance at kindergarten schooling level, they were subsequently accounted for by PM abilities tested at the end of first grade, with specific contribution of the serial-order STM to the decoding ability, and of long-term phonological knowledge to word recognition. Based on these results, the researchers proposed that the roles of PA and PM begin to differentiate during the learning of reading although these two phonological skills keep on being highly correlated. That is, the study showed that at the early stage of the acquisition of reading skills, PA is an essential factor for the instruction of letter-sound correspondences rules. On the other hand, PM may subsequently be instrumental by maintaining the sequences of phonemes resulting from grapheme-to-phoneme conversion. That is, children need to hold a sequence of phonemes in the requisite order in STM and match an assembled sequence of phonemes with long-term phonological word representations.

The predictive power of PM in lower levels of schooling has also been reported in orthographically different languages. In a study conducted by Babayiğit and Stainthorp (2007), which was also mentioned in PA subsection above, the influence of preschool short-term PM and PA on reading and spelling skills at the end of Grade 1 and 2 was longitudinally investigated in the transparent orthography of Turkish. Children's short-term memory capacity was measured via digit span and word-span task in which a child was expected to repeat back one-syllable concrete words. Rather than PA, STM emerged as the most powerful and consistent longitudinal correlate of reading speed performance. As for this observed close relationship between PM and reading fluency, the researchers commented that phonological STM may make greater contribution to early literacy development in agglutinative languages such as Turkish as these languages are characterized by long words with a string of suffixes.

In contrast to the findings presented by Nithart et al. (2011) and Babayiğit and Stainthorp (2007), neither Näslund and Schneider (1991) nor Dufva et al. (2001) did detect a direct effect of PM on later reading development in the transparent orthographies of German and Finnish.

The study of Näslund and Schneider (1991) was aimed at exploring the longitudinal relationships among factors such as verbal ability, PM capacity and PA which were hypothesized to affect later word reading speed and reading comprehension in German. The children were assessed in kindergarten and again in Grade 2. The researcher did not observe any powerful longitudinal direct connection between PM and reading skills (i.e. reading speed and comprehension). In fact, PA was detected the only significant predictor of reading speed, which in turn noticeably affected reading comprehension in Grade 2. On the other hand, PM in preschool was only indirectly linked to word reading fluency through its strong connection to PA.

Likewise, Dufva and colleagues (2001) examined PM and PA in relation to the development of reading skills in a longitudinal study, by following 222 Finnish preschoolers through Grade 2. The researchers were mainly concerned with the contribution of PM to word recognition (measured by a lexical decision task, which is a computer-aided test requiring children to decide as quickly as possible whether the letter string on the computer screen is a real word or a pseudoword) and reading comprehension. PM was assessed through word span, sentence span and digit span forward tests. The children were tested for their PM, PA and reading abilities three times, namely, at the end of preschool, Grade 1 and Grade 2. In accordance with the results attained by several previous studies, the results showed that PA was the most significant predictor of word recognition. On the other hand, as in Näslund and Schneider (1991), the influence of PM on both word recognition and comprehension was identified as both indirect and moderate. That is, PM had no predictive effect on word recognition in the initial stage of reading progression. PM exerted only a weak effect on PA at preschool level. It is by means of this connection that PM had a weak indirect influence on Grade 1 word recognition. Although the effect of PM on Grade 2 word recognition was significant, this effect was weak. Additionally, PM did not directly influence reading comprehension, which was mainly predicted by listening comprehension. The indirect influence of PM on reading comprehension was also mediated by listening comprehension. The researchers concluded that taking PA and listening comprehension into account, there seems to be little place for PM as a precursor of word recognition and reading comprehension.

Similar results were reported by Parrila et al. (2004). The study examined the predictive relationships between articulation rate, verbal short-term memory (i.e. phonological short-term memory), naming speed and PA tasks administered in kindergarten and again in Grade 1 and word reading and passage comprehension variance in Grades 1, 2 and 3 in English. The result of the study showed that Verbal STM did not account for significant unique variance in reading after controlling the effect of other phonological processing variables. That is, Verbal STM had no independent contribution; however, it shares its predictive variance with other phonological processing skills. On the other hand, kindergarten RAN made a unique and lasting contribution to predicting reading. In a similar vein, both kindergarten and Grade 1 PA explained unique variance in all reading measures after the effect of other phonological processing variables was controlled. In fact, Grade 1 PA became the strongest predictor of reading across the three years.

In a comprehensive study by Høien-Tengesdal and Tønnessen (2011), the relationship between word decoding efficiency (a composite score of word recognition, nonword reading and irregular word reading tasks) and three different phonological skills, namely PA, verbal short-term memory (V-STM) and RAN were investigated in 1007 Scandinavian third- and fifth-grade children. In accordance with the results reported by the previously mentioned studies (e.g., Dufva et al., 2001; Näslund & Schneider, 1991; Parrila et al. 2004;), the results of hierarchical regression analyses in this study showed that PM did not account for a large significant unique variance in word decoding abilities of third and fifth graders. It contributed only 0.7% of the variance to word decoding among typical decoders. Instead, phonemic awareness was detected as the most powerful phonological skill explaining 15.1% of the variance in word decoding ability among typical readers. RAN explained approximately 5-7.0% of the variance in word decoding efficiency.

On the contrary, the results of Asadi and colleagues (2017), a previously reviewed study, made the picture for PM-reading connection more complicated. They reported significant effects of PM in word reading accuracy and fluency in Arabic. Although this involvement of PM was significant in all grades in decoding, it was observed in Grades 2, 3, 4, and 5 for word reading fluency. PM had no predictive value in Grades 1 and 6 in this study. Based on these findings, the researchers suggested that Arabic-speaking children rely on phonological decoding strategies as they deal with the smallest units of the words and must keep more information in working memory for the synthesis that slow down the reading rate and challenge memory (Perfetti, 1992; Wolf & Katzir-Cohen, 2001). The researcher also attributed the involvement of PM in reading to the overlap between the phonology and memory, which will be discussed profoundly in the next subsection.

Taken together, the findings of various studies have offered opposing results as to the role of PM as a predictor of word reading and reading comprehension. In spite of these contradictory results, however, PM appears to make an important contribution to the development of reading ability, at least in the early stages of reading acquisition not only in opaque languages but also in languages with transparent orthographies. This implies that impaired PM skills might be characteristic of readers with reading difficulty in later reading development (e.g. Høien-Tengesdal &Tønnessen; 2011; Snowling, 1981). On the other hand, it should also be underlined that PM seems to be an unreliable precursor of subsequent reading skills in both transparent and opaque languages, especially when PA and RAN were controlled for (e.g., Parrila et al., 2004). Taken all these mixed findings into consideration, this current study included PM together with PA and RAN. It would be interesting to present its possible direct and indirect (i.e., mediating) effects in later reading development in Turkish.

Given that PM might be sharing more of its predictive variance in reading with other aspects of phonological processing (i.e., PA and RAN), it is important to review the nature of PM's close connection with PA as well as with some other predictors of reading.

2.5.3.3 The relationship of PM to other predictors of reading

As previously stated in the RAN section, the results pertaining RAN-PM link is inconsistent and contradictory. Unlike this, the close relation of PM with PA has been cited in several studies (e.g., Wagner & Torgesen, 1987; Wagner et al., 1994). One potential reason for this close association might be the verbal memory load required in many tasks devised to measure PA. Hansen and Bowey (1994) noted that PA tasks might place strong demands on PM. That is, PA tasks require retention of material to complete the task successfully. For instance, PA tasks such as sound categorization and phoneme deletion demand one or more phonological representations to be stored while further analytic procedures such as comparison and deletion of segments are being performed (Alloway et al., 2004). For another example, in blending, a series of two or more phonemes has to be kept active in PM while blending them into a word (Dufva et al., 2001). Another alternative explanation for this interrelation between PA and PM is verbal phonological short-term memory tasks such as digit span and nonword repetition demand phonological processing in order to temporally store verbal material into a phonological code (Gathercole, Packiam-Alloway, Willis & Adams, 2006).

According to Näslund and Schneider (1991), PA and recoding skills rely on the efficiency of memory. Emphasizing the close relationship between PA and PM, the authors noted that

> Only as children gain in their ability to simultaneously retain and access verbal information while mentally representing speech as consisting of phonemic components, will they be able to use phonological recoding as an efficient strategy in organizing speech and text for better decoding and ciphering of text. (p.389)

In their previously reviewed study, Näslund and Schneider (1991) revealed that the capacity to efficiently store and retain verbal information remains to be significant for phonological processing, including the second year of reading instruction. That is, longitudinal analyses displayed that PM was a powerful predictor of children's PA performances in tasks such as recognizing phoneme changes and manipulation of phonemes in both kindergarten and second grade. The researchers concluded that beginning readers' performances in such PA tasks were influenced by the limitations on their memory capacity.

Another previously mentioned study, Cutting and Denckla (2001) also showed that the correlation between PA and PM was significant (r = .36) and was similar to the correlations that Wagner et al. (1994) found between their phonological analysis and synthesis tasks, and memory span task (the correlations ranged from .27 to .35). Congruent with Hansen and Bowey (1994) and Alloway et al. (2004), Cutting and Denckla (2001) explained that memory span may support phonological analysis and synthesis (both of which were required in the PA tasks used in this study) abilities because the number of speech sounds that one can hold in memory is a restrictive factor in the reader's ability to manipulate the sound structure within a word and then produce the new word without a certain phoneme. The overlapping variance between PM and PA has been discussed and found by others (e.g., Asadi et al., 2017; Brady 1986; Nithart et al., 2011; Wagner et al. 1997).

In addition to the close interrelation between PA and PM, it is also suggested that PM skills tapped by nonword repetition play a causal role in vocabulary acquisition during childhood (Gathercole & Baddeley, 1990). In other words, PM has been claimed to be critically important in establishing long-term memory representations of the phonological forms of new words (Gathercole & Baddeley, 1989; Gathercole et al., 1992). Gathercole and Baddeley (1989), for example, found that children's PM performances on a test of nonword repetition at both 4 and 5 ages were strongly associated with their vocabulary knowledge, even after the contribution of the more general cognitive factors of intelligence and chronological age had been taken into account. Such a high relationship between PM and vocabulary continued to exist when children's early reading skills were emerging. PM scores at age 4 were also a good precursor of vocabulary scores one year later. Further, children with high vocabulary scores were better at repeating nonwords than children with low vocabulary scores. Gathercole and Baddeley (1989) concluded that phonological short-term memory might directly contribute to the long-term learning of new words. That is, short-term phonological traces in working memory provide an important basis for the construction of more durable long-term representations of new words. When acquiring a new word, a child must repeat an unfamiliar phonological word uttered by a more experienced speaker of a language in order to form phonological representation of that new word. The longer the new word is kept in short-term storage, the greater its chance to be acquired. In the working memory model presented by Baddeley in 1986, the phonological loop is responsible for the encoding, maintenance and manipulation of speech-based information and is proposed to sustain a short-term phonological store in which phonological information is temporarily held. The material kept in the phonological store fades away in time although it can be refreshed via subvocal rehearsal (Gathercole et al., 1992). Phonological loop, i.e., the verbal short-term store, is particularly suitable for retaining sequential information (Baddeley, 2000). This phonological component of working memory has also a central role in learning the phonological forms of new words, especially between 4 and 6 years of age and boosts performance on measures of phonological short-term memory such as nonword repetition and digit span (Baddeley, 2000; Baddeley, 2003; Gathercole, 1995b; Gathercole & Baddeley, 1989; Gathercole, Tiffany, Briscoe, Thorn & The LSPAC team, 2005). Additionally, as children get older, the relationship between phonological loop and vocabulary becomes much more reciprocally facilitative, with high PM capacity constraining vocabulary learning and with current vocabulary knowledge promoting the repetition of unfamiliar nonwords (Baddeley, 2003). It should also be, however, emphasized that such a direct link between PM and vocabulary knowledge is not long-lasting after 5 years of age. Based on a longitudinal study in which English children were tested at ages 4, 5, 6, and 8, Gathercole et al. (1992) presented that the direct causal influence of PM on vocabulary acquisition observed between 4 and 5 years of age declined to a nonsignificant level by age 8. The researchers also noted that after 5 years of age, the direction of causality in the developmental relationship between PM and vocabulary knowledge seems to change. Between both 5 and 6 years and 6 and 8 years, the connection between vocabulary scores and later phonological memory skills becomes stronger than the converse links between the PM measures and later vocabulary knowledge. According to Garthercole and colleagues (1992) the decline in the prior influences of PM on vocabulary acquisition during the early school years may be overshadowed by other more potent current dynamics operating at the age of 8. For example, as children's vocabularies expand during the first years of the primary school, they might make use of analogies with existing vocabulary items as a strategy for learning phonological forms of new words, which eases the load of PM in the acquisition of a new item. Another possibility is that as the vocabulary development during middle and later childhood is characterized by more abstract words, rather than PM abilities, semantic and conceptual skills may set the parameters in the learning of new words. More importantly, reading activity during the early school years increasingly influences vocabulary growth. Garthercole et al. (1992) found a strong significant association between reading ability at age 6 and vocabulary knowledge at age 8 ($r = .68$, $p < .001$).

To sum up, a strong connection has been acknowledged between PA and PM. PM skills might impact performance upon PA tasks, and vice versa. Furthermore, children's PM capacity appears to be a critical prerequisite and determinant of children's later vocabulary knowledge, especially between the ages of 4 and 5. However, when children are exposed to print during the early school years, a shift takes place and reading becomes the major pacemaker in vocabulary knowledge. PM's link with other variables such as PS will be presented in the following subsections.

Stanovich, West and Cunningham (1991) wrote that despite the important role of phonological processing skills in explaining variance in the acquisition of word reading, there is another class of factors that could explain additional variance. Accordingly, another question of interest in this study is whether children's awareness of the morphological structures of words facilitates their word reading and reading comprehension. Morphological awareness is another construct that will be discussed in relation to reading acquisition in the following subsection.

2.5.4 Morphological awareness (MA)

2.5.4.1 On the definition of MA

MA has been cited as another variable that underpin reading acquisition in the early school years. Morphological knowledge, according to Green et al. (2003), involves "sensitivity to the internal, meaning-related structure of words, including knowledge of inflections (i.e., affixes to root words, such as *look* plus *ing* that reflect changes in tense or number) as well as knowledge of derivational forms (i.e., changes to a base word that transform the word from one grammatical category to another, such as *quick* to *quickly* or *write* to *written*)" (p. 752). Basically, MA refers to children's ''conscious awareness of the morphemic structure of words and their ability to reflect on and manipulate that structure'' (Carlisle, 1995, p. 194). Apel (2014) proposed that a comprehensive definition of MA should include the followings:

> (a) awareness of spoken and written forms of morphemes; (b) the meaning of affixes and the alterations in meaning and grammatical class they bring to base words/roots (e.g., *-ed* causes a verb to refer to the past as in *walked*; *-er* can change a verb to a noun, as in *teach* to *teacher*); (c) the manner in which written affixes connect to base words/roots, including changes to those base words/roots (e.g., some suffixes require a consonant to be doubled or dropped when attached to a base word/root in written form, such as in *hop* to *hopping* and *hope* to *hoped*); and (d) the relation between base words/roots and their inflected or derived forms (e.g., knowing that a variety of words are related because they share the same base word/root, such as *act*, *action*, *react*, and *activity*). (p. 200)

According to Carlisle (2003), in addition to the preeminence of PA in the early stages of reading acquisition, as children proceed to upper grades, other facets of linguistic awareness such as morphemic awareness become vital to the development of word reading and reading comprehension. Morphemes are the smallest meaningful units (including base words, prefixes and suffixes) and function as phonological, orthographic, and semantic/syntactic units. For instance, the word *imperfection* in English consists of three morphemes: *im* as the prefix giving the meaning of "not, the opposite of", *perfect* as the root and -*ion* as the suffix, giving the meaning of "the action or state of" in nouns. Each of these items contributes different aspects of meaning to the word (Deacon, 2012). According to Carlisle (2003), morphemes ease not only word reading but also understanding of words and texts. In addition, morphemes are characterized as primary "building blocks" of words. Base words and affixes can be utilized in many different words or long words can be broken into smaller units, providing hints for pronunciation, spelling and meaning (Carlisle, 2003, p. 295). For example, in the case of the distinctive pronunciations of *uni* in *uninform* and *uniform* (*un+inform* and *uni+form*, respectively) the placement of morpheme boundaries provides an important clue for pronunciation (Deacon, 2012).

Carlisle (2003) mentioned that children's awareness of morphology is influenced by a number of linguistic factors such as *frequency, transparency* and *productivity*. The lexical storage of high frequency words that are morphologically complex differs from that of low frequency words. Frequency and productivity often go hand in hand; that is, the most productive forms are generally used commonly (e.g. the suffix –*er* agentive as in *teacher* in English). Transparency is related to different parts of word structure. It is about either the phonological representation of the base form in a complex word (*active-activist* versus *sing-signature*) or intact spelling of the base form within the complex word. There is also semantic transparency, referring to how the meanings of parts facilitate the understanding of the whole word. It is assumed that readers read and understand phonologically and semantically transparent words more easily than *opaque* or *shift* words that are deprived of transparency (Carlisle, 2003).

A brief definition of MA has provided insight about what MA is composed of. Next, the summary of research studies that included MA as a variable will be given.

2.5.4.2 The relationship of MA to reading skills

A number of studies have recognized that MA is significantly linked to word reading fluency and reading comprehension (e.g., Carlisle, 1995, 2000; Carlisle & Nomanbhoy, 1993; Deacon & Kirby, 2004; Deacon, Kieffer & Laroche, 2014; Singson, Mahoney & Mann, 2000; Windsor, 2000; Wolter, Wood & D'zatko, 2009). The influence of MA has often been characterized as persistent; that is, MA continues to affect reading development even after other reading-related variables such as PA, RAN, PM, vocabulary and intelligence have been controlled for (e.g., Brittain, 1970; Carlisle & Nomanbhoy, 1993; Deacon & Kirby, 2004; Fowler & Liberman, 1995; Mahony, Singson & Mann, 2000; Singson et al., 2000). According to Green (2009), MA can back up word identification, linguistic comprehension and reading fluency because it provides children with analyzing the internal structure of words, thereby decoding them more quickly and accurately. Green (2009) stated that from a challenged reader's point of view, the word *sleeplessness* may appear long, complex, and daunting. However, the reader can overcome this challenge by breaking the word down into its three familiar morphemes (e.g., sleep, less, ness); thus, making it more decodable. In addition, specific knowledge of derivational suffixes and their pronunciations can ease decoding (e.g., the derivational ending -

tion is consistently pronounced *shun* in English). Green (2009) noted that efficient word reading boosts successful comprehension. Green (2009) gave the following example to clarify the role of morphology in comprehension: "A general *indecis**ion*** about the use of nuclear weapons could be a threat to national security" versus "A general *indecis**ive*** about the use of nuclear weapons could be a threat to national security." Here, the two derivational suffixes –*ion* and –*ive* change the meaning of the given sentences and make each sentence to be parsed differently. Correct parsing, in turn, contributes to successful comprehension. Accordingly, the pertinent literature will demonstrate how MA in different languages make a significant contribution to both word-level reading and reading comprehension of children. Meanwhile, because each study applied a various type of MA task, these tasks specific to that study will be explained simultaneously, as the results of the study have been discussed.

To start with, in a study with English speaking children from Grade 2, 3, and 4, Fowler and Liberman (1995) investigated the relation between MA and the reading skill (i.e., word identification and word attack) during the early years of schooling. The participant were classified as low, average and high depending on their levels of reading. Similar to Carlisle (1995), MA was assessed through a test of morphological production in this study. That is, the children were asked to produce the derived target provided as the base form (e.g., *Four. The big racehorse came in______*) or the base target given the derived form (e.g., *Fourth. When he counted the puppies, there were________*). The findings were consistent with the study of Carlisle (1995) reviewed below in that MA skills made a significant contribution to both word recognition and nonword reading beyond the variance explained by children's age and receptive vocabulary knowledge.

In a different study, Mahony et al. (2000) examined the impact of morphological skills on decoding ability (i.e., real and pseudoword reading) in comparison to other factors such as PA and vocabulary knowledge that contribute to reading skill. The Morphological Relatedness Test was applied to test children's awareness of morphology. That is, children in grades three to six were required to distinguish derivationally-related word pairs (e.g., *nature-natural; dirt-dirty*) from false ones that are related in spelling but not in morphology (e.g., *ear-earth*; *eerie-ear*). Overall, all three variables were found to be significantly associated with decoding ability. Of specific interest, the results also showed that children's ability to appreciate the derivational relatedness of two words is significantly related to reading ability across grades, even without the benefit of the indirect effect of vocabulary and PA. Although the size of this unique contribution was small (hovering around 5%), it was persistent by grades three to six, while the contribution of PA, which was around 13%, decreased between the grades.

These two studies reviewed above dealt with MA in relation to children's word reading ability. Several studies investigated the position of MA in both lower and higher levels of reading skills. That is, researchers in MA studies included not only word reading skills but also reading comprehension as dependent variables. In an earlier longitudinal investigation of MA of children from kindergarten to second grade, Carlisle (1995) examined the relative role of MA in pseudoword reading and comprehension. Overall, the researcher found a strong correlation between children's sensitivity to the morphological structure of words and reading success (r= .55). Two different tasks were administered to measure children's MA abilities. The Morphological Production task involves producing the correct form of a word from a given base word to complete a sentence with the last word missing (e.g. *Farm. My* *uncle is a______*. The expected answer is *farmer*.) The Morphological Judgment task was the other test used in the study. The task required the child to judge orally presented sentences as to whether they were correct or incorrect statements in terms of agentive or instrumental relations (e.g., *A person who teaches is a teacher* versus *A person who makes dolls is a dollar*). The children were asked whether each sentence made sense or was nonsense. It was found that children's MA skills in kindergarten were unrelated to their reading ability. However, a year later, first graders' MA skills, especially their performance in morphological production task was found to be a stronger predictor of reading comprehension in comparison with children's PA performance which emerged as the strongest predictor of pseudoword reading. That is, MA assessed in Grade 1 contributed up to 7% of the variance in pseudoword reading and up to10% in reading comprehension in Grade 2. Accordingly, Carlisle (1995) concluded that MA is an essential unique contributor for not just older children but also first and second graders who are gaining basic reading skills. Additionally, based on this study, Carlisle (1995) wrote that MA might critically be important for older students as morphological decomposition and problem-solving might help them understand and learn derived words included in their books.

Following this, Carlisle (2000) conducted another study with the third and fifth graders in English. The children were measured for both word reading ability and reading comprehension. Also, MA was assessed via two different productive tasks called decomposition (e.g., *Express. "OK" is a common ________*) and derivation (e.g., *Driver. Children are too young to_______*). Once again, the results of regression analyses revealed a significant influence of MA on reading achievement in word-level and text-level tasks for both grades. That is, children's awareness of structure and meaning explained large portions of the variance in word reading (41% for third graders and 53% for fifth graders) as well as reading comprehension (43% for third graders and 55% for fifth graders).

The 4-year longitudinal study (Grades 2-5) by Deacon and Kirby (2004) investigated the roles of MA and PA in English with respect to single word reading, pseudoword reading, and reading comprehension. MA was assessed by a Sentence Analogy task which requires children to complete the chain of sentences with another one (e.g., Peter plays at school. Peter played at school. Peter works at home.). Congruent with previous studies, the researchers reported that MA makes a small but significant independent contribution to all reading skills (i.e., single word and pseudoword reading, and reading comprehension), after controlling prior achievement of the target reading ability (i.e., autoregressor), verbal and nonverbal intelligence and PA. The magnitude of this contribution is comparable to that of PA (e.g., Even in the more stringent analyses with the autoregressor and controls of verbal and nonverbal intelligence, MA and PA made similar contributions, between 1 to 5%, to Grade 4 and 5 pseudoword reading and reading comprehension). In addition, the influence of MA on reading comprehension was greater than on single word reading, which was attributed to the greater role of MA in building meaning from text. Further, as in the case of Carlisle (1995), Deacon and Kirby found some evidence for the increasing contribution of MA to pseudoword reading and reading comprehension over reading development in time (e.g., In the autoregressor analyses, the contributions rose from a nonsignificant .007 to 3% for pseudoword reading and from a nonsignificant .004 to 2% for reading comprehension). In addition, when the autoregressor was discarded from the regression equation and only PA and intelligence were controlled, MA was observed to make greater contributions to single word reading (contributing 8% (p <.001), 8% (p <.01); and 5% (p <.05) of the variance at Grades 3, 4, and 5 respectively) and pseudoword reading (contributing 9, 10, and 11% of the variance at Grades 3, 4, and 5 respectively with each p <.001). Similar findings were also reported for reading comprehension (contributing 8, 10, and 7% (each p <.001) of the variance at Grades 3, 4, and 5, respectively).

In another study, Kirby et al. (2012) examined children's MA, PA and verbal and nonverbal skills in relation to multiple reading skills (word reading accuracy, word reading speed, text reading speed and reading comprehension. The researchers were particularly interested in children from Grade 1 to 3 in order to investigate the influence of MA on early literacy skills in English. Word Analogy task in which the participant is asked to provide a missing word based upon a pattern from a set of words (e.g., run: *ran,* walk: *walked* for inflectional morphemes; mess: *messy,* paint: *painter* for derivational morphemes) was used to measure children's MA capacity. The correlational analyses showed that MA scores were significantly correlated between grades with the highest (r=.66) being between Grades 2 and 3. Further, hierarchical regression analyses were used to detect if MA is a unique predictor of reading after taking account of intelligence and PA. It was found that MA measured in Grade 3 was a more powerful precursor of Grade 3 reading ability (explaining 9% of the variance in Text reading speed, 6% of the variance in Passage comprehension, 5% of the variance in Word identification, 4% of the variance in pseudoword reading and 3% of the variance in Word reading speed) compared to MA measured in other grades. According to Kirby and colleagues (2012), the increasing association between MA and reading with grade is in line with the demand for meaning that increase in reading across grades. The researchers further commented that the recognition of morphemes within words might give readers certain advantages.

Processing of larger units (i.e., morphemes rather than letters) helps readers recognize words more quickly and provides them with cues for pronunciation. In addition, as to the role of MA in reading comprehension or text-based tasks, Kirby et al. (2012) argued that greater MA should endow readers with more accurate and efficient decisions on the meanings and syntactic functions of unfamiliar words.

In a more recent longitudinal study, Deacon et al. (2014) administered a battery of reading-related tests and assessed English-speaking children's awareness of morphology, word reading skills, and reading comprehension at Grades 3 and 4, as well as their PA, vocabulary, and nonverbal ability as control measures. Different from other studies mentioned above, this study looked into both direct and indirect contribution of MA on reading comprehension. The results revealed that word reading skills partially moderated the relationship between MA and reading comprehension in Grades 3 and 4. In addition to this indirect influence through word reading skills, the results displayed that MA directly underpins the development of reading comprehension with no mediation by word reading. Further, the study found reciprocal relations between MA and reading comprehension. That is, children's MA at Grade 3 explained their improvement in reading comprehension at Grade 4, and reciprocally, their early reading comprehension abilities predicted MA at Grade 4 (see also Carlisle, 2000; Kuo & Anderson, 2006). Based on the findings, Deacon et al. (2014) proposed the inclusion of MA in models of reading comprehension.

In another recent study which included English-speaking children from Grade 3, Levesque et al., (2017) evaluated four potential intervening variables (i.e., word reading, vocabulary, morphological decoding (e.g., reading low-frequency morphologically derived words or nonwords), and morphological analysis (e.g., choosing the definition that best represented the meaning of the derived word) that are hypothesized to mediate the contribution of MA to reading comprehension. The researchers applied path analyses controlling for children's PA and nonverbal abilities. In parallel with Deacon et al. (2014), this study indicated that MA was tied to reading comprehension across a number of distinct ways, both directly and indirectly. That is, it wielded a unique direct influence on reading comprehension beyond the influence of other variables included in the model. Meanwhile, the results indicated that two indirect effects, namely a *morphological decoding pathway* (MA → morphological decoding → word reading → reading comprehension) and a *morphological analysis pathway* (MA → morphological analysis → reading comprehension) mediated the relation between MA and reading comprehension. According to Levesque and colleagues (2017), lexically, MA indirectly influences reading comprehension by facilitating the reading and understanding of morphologically complex words. Linguistically, MA works as an automatic process that activates and infers word meaning (especially the meanings of unfamiliar complex words). These findings suggest that young readers with good MA will better analyze meaning in morphologically complex words, which, in turn, brings considerable advantages to the understanding of the whole text.

Studies in languages other than English have also provided robust evidence for a significant independent role of MA in reading achievement. Similar to the research in English, several studies on reading development in Chinese, a very different orthography, have pointed to the unique contribution of MA to word reading and reading comprehension beyond PA, vocabulary and word reading (e.g., Ho et al., 2012; McBride-Chang et al., 2005; Shu et al., 2006; Tong, McBride-Chang, Shu & Wong, 2009; Tong & McBride-Chang, 2010; Zhang et al., 2012; Yeung, Ho, Chan, Chung & Wong, 2013).

Cheng, Zhang, Wu, Liu and Li (2016) conducted a study to examine the longitudinal relationship between MA and reading comprehension among Chinese children during the early elementary school years. Unlike English, Chinese has no orthographic shifts and has few phonological shifts when complex words are created. Therefore, provided that the meaning of a particular morpheme is understood, the meaning of other novel compound words which include that morpheme can be quickly grasped. Also, Chinese is rather productive in compounding and the rules of compounding are transparent and straightforward. The children in the study were followed from Grade 1 to 2. The results confirm a reciprocal relationship between MA and reading comprehension. That is, children's MA stably predicted later reading comprehension between Grades 1 and 2 and their early reading comprehension was a precursor of later MA. Cheng et al. (2016) explained that children with enough reading experiences seem to develop abstract understanding of key morphemes and extract the structures and meanings of morphologically compounding words in text, which support the development of MA. Accordingly, Cheng et al. (2016) concluded that MA and reading comprehension are "developmentally intertwined" to each other (p. 10). The study also investigated whether word reading would mediate the relationship between MA and reading comprehension. The findings revealed that in addition to a significant direct contribution, MA made significant indirect contributions to reading comprehension via word reading.

In another Chinese study, Yeung et al., (2013) investigated the interrelationship between fourth graders' reading-related skills (i.e., RAN, MA, syntactic skills, discourse skills, and verbal working memory), and their word reading and reading comprehension. Hierarchical multiple regression analysis was conducted to examine unique contribution of each variable to reading comprehension after controlling for word reading. The study presented significant contributions of the included variables in reading achievement. Within the scope of this section, the path analysis results showed that whereas word reading exerted significant direct effects on reading comprehension, the contribution of rapid naming and MA to reading comprehension was mainly through their influence on word reading. These two variables, however, were strong word-level predictors in Chinese.

The study by Gafoor and Remia (2013) in Malayalam (one of the official languages spoken in India, predominantly in the state of Kerala) echoed the findings from related studies in other languages such as English and Chinese. Data from a sample of 159 primary students from Grade 2 to 4 indicated that reading comprehension is significantly and positively correlated with MA ($r=.49$, $p<.01$), PA ($r=.46$, $p<.01$) and Ravens non-verbal IQ ($r=.31$, $p<.01$). In line with correlation results, MA was detected as the most powerful cognitive variable, explaining 14.66% of the variance in reading comprehension, which is followed by PA (13.32%) and Nonverbal ability (5.39%). Based on these results, Gafoor and Remia (2013) emphasized that children who were better at analyzing and manipulating rhymes, syllables and phonemes as well as identifying root words and their inflected or derived forms presented better performances in reading than children with poor morphological and phonological abilities. Accordingly, the researchers suggested the inclusion of MA and PA in literacy curriculum.

A previously reviewed study of Asadi et al. (2017) in Arabic reported a limited but significant contribution of MA to word level accuracy and fluency only in first and fourth grades. The researchers attributed the contribution in the first grade to inflectional morphological patterns which the first grade readers have to deal with immediately at the beginning of reading instruction in Arabic.

With regard to the Turkish language, Durgunoğlu (2017) underlined the role of morphology in providing hints for syntactic categories. She commented that in morphologically rich languages such as Turkish morphological cues occupy a more critical role than word order as compared to English. According to Durgunoğlu, MA and the suffixes that cause subtle changes in meaning should be taken into account in reading comprehension studies in transparent orthographies such as Turkish. Interestingly, however, considering the rich and complex morphology of the Turkish language, the number of studies that have investigated the role of MA in Turkish reading acquisition has remained scarce. One such study was carried out by Bektaş (2017). As previously reviewed, Bektaş explored the relation of MA to real and nonword reading ability in second and fourth grade children. The results of hierarchical regression analyses with the total sample indicated that MA explained an additional 6 % of the variance in fluent word reading ability, independently from that contributed by RAN and PM. Interestingly, separate analyses for the second and fourth grades revealed that MA lost its significance when other variables (particularly, RAN and PA) were included in the equation. Regarding nonword reading fluency, the addition of MA to the regression model after PM and RAN accounted for an additional 4 % of the variance for the whole group. MA appeared to make a significant contribution to second grade nonword reading, only when it was entered immediately after PM at the second step. MA did not have any predictive value in nonword reading fluency of fourth graders after PM, RAN and PA were taken into consideration. The researcher underscored the role of MA in Turkish, accounting for an additional, significant but small, variance in word reading beyond RAN and PA.

Taken together, MA is an important linguistic awareness skill influencing the development of written language (Apel, 2014). The majority of prior studies in different languages suggest that children's MA skills contribute to their word reading skills and reading comprehension. Some studies also pointed that word reading ability could mediate the link between MA and reading comprehension. In addition, MA seems to make an independent contribution to reading comprehension in various languages, even after controlling for general intellectual ability, PA, vocabulary and word reading. However, it appears that this contribution is not unidirectional. The relationships between MA and reading comprehension could also be reciprocal. In other words, children's ability at manipulating the morphemes within word will foster a deeper understanding of texts. In the other direction, as Deacon et al. (2014) proposed, children might use their understanding of the meaning of the text to grasp the morphemic parts of new words within texts. Given the agglutinative nature of morphology in Turkish, how and to what extent children's insights into the internal structure of words play a role in Turkish reading at both word and text levels constitutes an important research question to be investigated within the scope of the current study.

The following subsection gives a short review of the studies that focused on MA with reference to other variables such as vocabulary knowledge and PA.

2.5.4.3 The relation of MA to other predictors of reading

The predictive unique contribution of MA, independent from variables such as RAN, PA, PM and word-level reading has been reviewed above. Numerous studies have also demonstrated that MA explained unique variance in vocabulary knowledge in children (e.g., Green, 2009; McBride-Chang, Wagner, Muse, Chow & Shu, 2005; McBride-Chang et al., 2005; McBride-Chang, Shu, Wai NG, Meng & Penney, 2007). Green (2009) emphasized that morphological knowledge provides children with an opportunity to considerably increase their vocabulary and comprehension skills by making use of the meanings of familiar base words and suffixes so as to deduce the meanings of unfamiliar derivatives. When a reader, for example, encounters the unfamiliar word *owlet*, he/she could use existing knowledge of the word *piglet* and makes an inference that the suffix *let* changes the base word into a "younger version of itself ". As a result, the reader can deduce that an owlet must be a young owl (Green, 2009).

McBride-Chang et al. (2005) investigated the role of MA in children's vocabulary acquisition in English. Measures of rapid naming, PA, word identification, nonsense word repetition and vocabulary, together with two MA tasks (morphological structure awareness and morpheme identification) were administered to kindergarteners and second graders. The results indicated that phonological processing and reading variables together explained 48% of the variance in children's vocabulary knowledge in the combined sample. In particular, MA was found to be uniquely associated with vocabulary knowledge, predicting an additional 10% of variance in vocabulary knowledge. In another study, based on the data from kindergarteners and second graders in various cultures (i.e., Hong Kong, Beijing and the U.S) McBride et al. (2007) explored whether MA tasks predicts unique variance in concurrently collected data on vocabulary knowledge, controlling for other variables such as phonological processing skills and word recognition ability. The authors reported that in all three cultures, MA was detected as a significant predictor of vocabulary knowledge. More specifically, MA made 2% unique contribution to vocabulary in Beijing. In Hong Kong, it contributed 3% extra variance to the equation. In the U.S data, the MA task added a unique 8% of the variance to vocabulary knowledge. According to McBride et al. (2007), given the importance of phonological and morphological information across all oral languages, it is logical to assume that "the association among phonological awareness, morphological awareness and vocabulary knowledge may be fairly consistent across languages" (p.119).

In another study with Grade 1 and 3 English speaking children, Deacon (2012) emphasized the interaction emerging between PA and MA in English word-level reading. This study will further be reviewed in the OK section. Within the scope of this subsection, the analyses of the study indicated that of the three variables measured in the study (PA, MA, and OK) the only significant interaction happened to exist between PA and MA. According to Deacon (2012) this interaction provides additional support for the idea that MA might be more influential in reading for children with lower levels of PA abilities. A similar explanation was also presented by Bryant, Nunes and Bindman (1998). These authors suggested that some children with a phonological weakness might bring alternative dominant reading strategies that are morphologically based to their early reading attempts. That is, in order to cope with the initial difficulties with phonologically based letter-sound correspondences, poor readers made use of their advantage in the conventional spelling of morphemes in reading.

Apart from the role of MA in word knowledge, some studies examined the variables influencing MA development. Carlisle and Nomanbhoy (1993), for instance, investigated if PA boosted MA performance of first graders (N= 101). The participants' MA ability was measured via morphological judgment and production (including both inflected and derived forms) tasks. PA was assessed through syllable and phoneme deletion tasks. The results revealed that children's PA contributed significantly to performance on MA tasks. It was also reported that children with and without phonemic awareness varied significantly in their ability to produce morphologically complex words.

In sum, MA appears to be a potent predictor, directly influencing children's vocabulary knowledge. It has also been identified as a facilitator of word reading when children are confronted with phonological processing problems. At the same time, research has shown that other factors such as PA might have a substantial impact on MA performance.

Knowledge of orthography has been acknowledged as another important variable determining reading outcomes in literacy research. A concise definition of this construct as well as a brief summary of the studies exploring its effect on reading is presented in the following subsections.

2.5.5 Orthographic knowledge (OK)

2.5.5.1 On the definition of OK

Orthographic processing refers to one's sensitivity to patterns in written language. This sensitivity to the conventions of writing system has been claimed to play a significant role in children's early attempts to read words (e.g., Barker, Torgesen & Wagner, 1992; Deacon, 2012; Stanovich et al., 1991). Apel (2011) mentioned that orthographic processing is an umbrella term including the ability to acquire, store and use both mental graphemic representations (i.e., stored mental representations of specific written words or word parts) and orthographic pattern knowledge. *Orthographic knowledge* (OK), one of the aspects of orthographic processing, refers to information stored in memory that says how to represent spoken language in written form (Apel, 2011*)*. According to Apel (2011), OK has two main components, encompassing 1) *mental graphemic representations* that are word-specific and 2) orthographic rules (i.e., rules about alphabet principle, rules that govern how much speech must be represented in writing such as what letters can or cannot be combined as well as positional and contextual constraint rules for letter combinations). Loveall et al., (2013) renamed these components of OK proposed by Apel (2011) and called them as *Word-specific orthographic knowledge* and *General orthographic knowledge*. *Word-specific orthographic knowledge* is about actual words that children have learned to identify and can be evaluated via choice tasks in which one choice is a real word (e.g., rain–rane). *General orthographic knowledge* entails sensitivity to legal and probable letter combinations but not essentially specific to real words. This knowledge can be measured using choice tasks that include pseudowords as test choices (e.g., filk–filv).

According to Stanovich and West (1989), OK refers to 'the ability to form, store, and access orthographic representations' (p. 404). Emphasizing the important role of knowledge of orthographic structure in the decoding of novel word forms, Perfetti (1984) defines OK as "the knowledge a reader has about permissible letter patterns" (p. 47). Perfetti also stated that skilled readers acquire such knowledge via their experience with patterns of letter strings that they encounter in printed page. According to Georgiou et al. (2008c), OK refers to "children's sensitivity to the orthographic structure of words" (p.568). Wood defines OK as "the ability to visually process letter sequences and patterns in words" (p.97).

Similar to the definitions mentioned above, Barker et al. (1992) pointed that OK includes memory for specific visual/spelling patterns used for identifying individual words, or word parts, on the printed page and OK is likely be acquired via repeated exposure to printed words until a firm visual representation of the whole word, or meaningful subword units, has been achieved. According to Barker et al. (1992), such knowledge about the unique visual patterns of most familiar words helps readers immediately distinguish the word *sheap* as a misrepresentation of the word *sheep* despite the identical phonological representations the two words own. According to Burt (2006), orthographic processing skill reflects orthographic learning that is mostly determined by phonological skills and reading experience or print exposure.

Insofar, what OK entails has been presented by referring to the definitions given by different researchers. It appears that in general, there has been a consensus on the definition of OK: one's knowledge about permissible letter patterns within words. The next subsection will provide the results of some studies with reference to OK and reading.

2.5.5.2 The relationship of OK to reading skills

After many years of attention on phonological skills, theoretical attention started to center on orthographic processing abilities as a potential second source of variance in word recognition ability (Cunningham & Stanovich, 1990). Although phonological skills were recognized as indispensable for word reading, it was realized that these skills were inadequate to explain the whole story in the development of different reading skills. As such, OK has been receiving more and more attention in literacy research in the last few decades. Several studies have shown that variation in orthographic processing skills leads to individual differences in reading acquisition, particularly in word-level reading (e.g., Cunningham & Stanovich, 1990; Cutting & Denckla, 2001; Deacon, 2012). However, it should be underlined that OK studies have predominantly been conducted in the English language. Similar research in other languages have received attention only in recent years (e.g., Arabic: Asadi et al, 2017; Greek: Papadopoulos et al., 2016). Overall, these studies explored the role of OK at word-level reading skills.

An early study with successful and poor readers (Olson, Wise, Conners, Rack, & Fulker, 1989) found that orthographic and phonological skills made strong and independent contributions to level of word recognition performance of poor readers (18% and 30%, respectively) and of normally achieving readers (10% and 8%, respectively) in English. Likewise, Cunningham and Stanovich's (1990) early study with English children from Grade 3 and 4 also demonstrated that orthographic skill still explained an additional 10.2% of the variance in word recognition ability even after age, nonverbal intelligence and phonological ability were controlled.

In a study with Grade 3 children, Barker and colleagues (1992) investigated the unique contribution of orthographic processing skills in English to five types of reading measures, namely nonword reading, untimed isolated word identification, timed word identification, oral reading rate for text and silent reading rate for text. Orthographic skills were measured by orthographic choice task (e.g. *boat* vs. *bote*) and homophone choice task (*What can you do with a needle and thread? so* vs. *sew*). Consistent with the results of previously reviewed studies, a series of hierarchical regression analyses displayed that overall, OK contributed significantly to each type of reading, independent of age, IQ and phonological skills. The level of this contribution, however, changes depending on the type of reading. For example, whereas the contribution was 5% for nonword reading and 7% for timed word identification, it was 20% for speed of oral text reading. That is, the role of orthographic skills varied significantly depending on whether children were reading isolated words or texts. This finding, according to Barker and colleagues, suggest that fluent access to visual word representations facilitates the reading of connected text.

In a more recent cross-sectional study with a large group of children in Grades 1 and 3, Deacon (2012) questioned the independent contribution of OK from that of PA and MA to reading outcomes (real and pseudoword reading accuracy) in English. The researcher was also interested in developmental trajectory of OK, MA and PA in early word reading accuracy. Basically, Deacon (2012) hypothesized that the contribution of each of these variables would be independent and that there might be increases in the contribution specifically for MA and OK. The results indicated that each of the reading-related variables (i.e., OK, MA and PA) independently made significant contributions to both real and pseudoword reading after the controls of age, vocabulary and the two other reading-related variables. Together, it was found that the predictor variables explained the majority of the variance in real word reading and pseudoword reading (R^2 = .824 and R^2= .751, respectively). Individually, the contributions of OK to real word reading were larger (10%) than the contribution of PA (7%). In comparison with other variables, MA made a small, but independent effect on reading (at 0.7%). Conversely, as for pseudoword reading, PA was found to make 7% of contribution, which was larger than that of OK (2%) and MA (1%). Taking grade level into consideration, it is noteworthy that the independent influence of OK increased across grades (5% for Grade 1 and 12% for Grade 3) for pseudoword reading. Once again, PA was observed to have the highest contribution to pseudoword reading across grades (17% for Grade 1 and 15% for Grade 3). The influence of MA on pseudoword reading was relatively small and similar across grades (almost 2% in both grades). Accordingly, the researchers concluded that the contributions of OK along with MA and PA to each measure of reading were relatively stable and consistent across Grades 1 and 3, denoting that these variables continue to influence reading across the early elementary school years.

The previously reviewed study by Cutting and Denckla (2001) also identified OK as a crucial independent component of successful word reading for normally developing beginning elementary readers in English. The researchers reported that OK had a direct effect on word reading with path coefficients of 0.24. Likewise, Ricketts and colleagues' study (2007) with children (aged 8 and 9) reported that OK accounted for significant variance in exception word reading in the regression analyses, controlling for decoding.

The role of OK has recently been explored in other languages. For instance, Papadopoulos et al. (2016) reported that Greek children's OK explained an important portion of variance in reading fluency in both concurrent and longitudinal analyses. For another example, conducting a study with Arabic children from first to sixth grades, Asadi et al. (2017) showed that OK made a significant direct contribution to fluency at word level across all grades. The standardized coefficients (β) ranged from .27 to .51 across grades. In line with grain size theory (Ziegler & Goswami, 2005) the researchers proposed that thanks to OK, the reader moves away from slow reading that relies on grapho-phonemic decoding, to efficient and fluent reading which is based on larger orthographic units.

Similarly, in a cross-linguistic study, the previously reviewed study by Georgiou et al. (2008c) found OK influential in reading fluency in both Greek and English. As an extension of Ziegler and Goswami's grain size theory, the investigators proposed that children in consistent orthographies display some flexibility in applying different grain size units. Under time pressure, when they have to generate a response rapidly, they make use of large grain size units. On the other hand, when they are required to give an accurate response without time limitation, they rely on small grain size units and employ phonological recoding (grapheme-phoneme decoding strategies) because the mapping of graphemes onto phonemes is unambiguous. According to Georgiou and colleagues, the significant effect of orthographic processing in the reading fluency tasks indicated that Greek-speaking children relied on large grain size units in timed condition. These children may adjust the grain size units to match the task demands. When speed is not required there is a reliance upon phonological recoding; however, when a speeded response is needed, bigger grain size units are utilized. Accordingly, the researchers suggested that even in consistent orthographies, children may use either phonological or orthographic routes in reading depending on demands of the reading task.

Some researchers underlined the indirect role of OK in reading comprehension. Bosse (2015) emphasized that becoming an expert reader and speller comprises more than having efficient decoding skills (i.e., to learn grapheme-to-phoneme correspondences and how to use them). It also entails OK, i.e., acquiring knowledge of the written form of thousands of words. According to Bosse, thanks to this knowledge, readers can recognize words at a single glance rather than decoding them sequentially. As a result, readers can read fluently and concentrate on meaning during reading. Likewise, Loveall et al., (2013) argued that efficient use of OK can facilitate reading fluency, which, in turn, boosts comprehension in reading.

In short, research evidence has suggested that the reader's ability to stock orthographic patterns in long term memory facilitates the process of identifying the printed words more automatically and accurately. This rapid and accurate word recognition is also expected to enhance reading comprehension performance.

2.5.5.3 The relation of OK to other predictors of reading

Some of the early studies in English discussed whether the development of orthographic knowledge is entirely dependent upon phonological processing abilities. (e.g., Cunningham & Stanovich, 1990**;** Olson et al., 1989; Stanovich & West 1989). In all these studies, researchers pointed that orthographic processing skills explained significant additional variance in reading ability even after phonological processing had been partialled out. Thus, these researchers proposed that the development of print-specific knowledge is not completely parasitic on phonological processing skills and other factors such as degree of print exposure may determine variation in orthographic processing abilities which is independently linked to word recognition skills. Still, the contribution of PA and phonics skill to the development of OK should not be overlooked. Adams (1990) suggested that the use of phonics to decode words helps the child to scrutinize the letter orders within words, which forms the basis for building up orthographic codes for common letter patterns.

Some researchers investigated PA and OK link in the reverse direction. For example, Castles, Holmes, Neath, and Kinoshita (2003) examined the influence of OK in PA performances of college and Grade 5 children in English. Based on a series of experiments, the researchers identified a direct link between PA and OK; however, this relation was substantially modulated by readers' use of OK to assist in solving PA tasks. More specifically, both adult and child participants were less accurate and spend more time at deletion and reversal PA tasks in which words did not have 1:1 correspondence between the target sounds and their letters (e.g., take the/wə/ from *squabble*) as compared to PA tasks that involved words with straightforward letter-sound correspondences (e.g., take the/rə/from struggle). It was concluded that the written form of words, in addition to their spoken form, automatically influences how well one is able to perform PA tasks. Accordingly, Castles and colleagues suggested that the influence of OK in PA task performance should be taken into account in interpreting data concerning the relationship between PA and reading.

There are also studies which have investigated OK in relation to other reading-related variables. For example, researchers have suggested that RAN relates closely to OK. Conducting a study with English-speaking Canadian children from Grades 1 to 3, Georgiou, Parrila, Kirby and Stephenson (2008d) examined the link between RAN components (i.e. *articulation time* referring to the sum of all correctly articulated times that correspond to the displayed RAN stimuli and *pause time* referring to the sum of the length of pauses that are the intervals between the correctly sequenced articulations), PA, OK, and PS. In contrast to Kail and Hall (1994), Georgiou and colleagues found that RAN components, particularly pause time, were more strongly correlated with OK than with PS and PA. The relationship between RAN pause time and OK was found to increase across time. Further hierarchical regression analyses confirmed that RAN pause time shared more of its predictive variance with OK than with phonological processing or speed of processing. In another study that includes English-speaking children in Grade 2 and 3, Loveall and colleagues (2013) examined the relation of RAN (including both alphanumeric and nonalphanumeric tasks) to OK (including both word specific orthographic knowledge and general orthographic knowledge) in an English orthography controlling for IQ and phonological recoding (Word Attack; i.e., nonword reading). Results demonstrated that phonological recoding had a stronger link with word-specific orthographic knowledge than with general orthographic knowledge. Further, after controlling for both IQ and phonological recoding, alphanumeric RAN accounted for an additional 20% of the variance in word-specific orthographic knowledge whereas non-alphanumeric RAN explained merely 5% of the variance. As for general orthographic knowledge, alphanumeric RAN explained only 7% of the variance; however, non-alphanumeric RAN accounted for a larger 13% of the variance, controlling for both IQ and phonological recoding. According to Loveall et al. (2013), such results are congruent with Wolf and Bowers's (1999) hypothesis in which speed of visual activation enables linking of letters and orthographic structures into words. As alphanumeric RAN is more automatized than nonalphanumeric RAN for children in Grades 2 and 3, it seems logical that alphanumeric RAN would be a stronger predictor of OK. Loveall et al. (2013) also explained that because word-specific orthographic knowledge comprises the mapping of printed words into exact names, it tends to become automatic, which, in turn, gives rise to a stronger relationship between alphanumeric RAN and word-specific orthographic knowledge. Conversely, general orthographic knowledge involves many possible mappings for various orthographic features, making it difficult for this skill to become automatized. In short, Loveall et al. (2013) suggested that separate skills of orthographic processing are differently linked to other reading skills such as phonological recoding and RAN. Also, Loveall et al. (2013) commented that because nonalphanumeric RAN becomes less automatized in Grades 2 and 3, it did not relate more strongly to word-specific orthographic knowledge. Rather, it has a strong association with general orthographic knowledge possibly because both variables are not automatized.

In a previously mentioned study, working with average and reading deficit second graders, Manis et al. (2000) found that compared to phonemic awareness, speed naming of letters explained higher amount of the variance in orthographic processing skill. RAN skills continue to predict OK even after performance on vocabulary knowledge and PA tasks were partitioned out. These findings, according to Manis and colleagues, is parallel to Bowers et al. (1994) proposal that slow naming speed (particularly of letters) constitutes a serious impediment to the recognition and storage of orthographic patterns in printed words. As Bowers and Wolf (1993) also suggested "failure within precise timing processes might result in the slower or disrupted development of orthographic codes and their integration with phonological codes" (p.81).

Conducting a path analysis and post-hoc hierarchical regression analysis, Cutting and Denckla (2001) reported that RAN did not have a direct influence on OK once the effects of PS on RAN was taken into account. According to Cutting and Denckla (2001), rather than RAN, PS contributed to OK probably because it determines how rapidly letter patterns can be processed or responded to. The researchers supported this hypothesis with post-hoc hierarchical regression analysis results: RAN added no significant unique variance to OK after the effects of PS had been controlled. That is, whereas PS accounted for 11% of the variance in OK, RAN did not exert a significant contribution. The researchers proposed that RAN is not a direct predictor of OK. Instead, PS may be "a common linking factor, or association, between the RSN and orthographic knowledge" (p.695).

Taken together, studies that investigated the interconnection between reading-related skills pointed that rather than PA, RAN and PS make a significant contribution to the development of OK. In accordance with Loveall et al. (2013), a task of word specific orthographic knowledge (i.e., orthographic word choice) has been used in this study along with the tasks of alphanumeric RAN. It will be interesting to see the kind of the link between word specific orthographic knowledge and alphanumeric RAN in a language with a transparent orthography. Additionally, no study of young children, to our knowledge, has included controls for RAN, PS, PA, PM, MA, and vocabulary in Turkish. Assessing the relative size of the influence attributable to OK in reading while controlling for these variables would be one of the key extensions of this thesis study.

Keeping the importance of measuring children's weakness and strengths in broader language skills throughout reading development in mind, general processing speed has become another focal point included in this thesis study.

2.5.6 Processing speed (PS)

2.5.6.1 On the definition of PS

Processing speed (PS) is typically defined as how quickly an individual is capable of completing a cognitive task such as matching up visual stimuli (Christopher et al., 2012). PS is related to the amount of time a person needs to perceive information (This can be achieved through any of the senses, but generally through the visual and auditory channels), process information and produce a response. Put simply, it is about the time required to execute an intellectual task or the amount of work that can be completed within a fixed period of time.

2.5.6.2 The relationship of PS to reading skills

According to Christopher et al. (2012), for a successful word reading, a reader needs to match up words with stored representations. PS is assumed to predict to what extent a person could achieve this efficiently and accurately. In addition, Christopher et al., (2012) noted that PS could also be a precursor of reading comprehension because to the extent that readers encode words efficiently, they can read more text and integrate the text and meaning more rapidly. In a similar vein, Catts et al. (2002) regarded reading as an example of a cognitive ability that is time dependent. Skilled reading entails the rapid recognition of letters and words and the access to in conjunction with simultaneous integration of semantic, syntactic and text-level information. Accordingly, Catts and colleagues (2002) pointed that a deficit in speed of processing seems to impact reading achievement significantly.

PS has not commonly been integrated in literacy studies as a precursor of early reading acquisition. As such, the role of processing speed in reading (either directly or indirectly, or both) is not well-defined (e.g., Babür, 2003; Cutting & Denckla, 2001). Further, in contrast to RAN, PA, PM, MA and vocabulary, studies relevant to PS have mostly come from English. Thus, the pertinent literature review on PS is mostly limited to the English language which owns an opaque orthography.

Studies in English have provided substantial evidence for the close link between general PS and reading. In one of these studies, Kail and Hall (1994) stated that children's ability to name familiar objects becomes faster with age, and this rapidity in naming is associated with reading ability. For example, in comparison with 4-year-olds, 8-year-olds process information more rapidly; however, they are much slower than adults in perceptual and cognitive tasks. Such a pattern of change, according to Kail and Hall (1994), suggests that global mechanism is in charge with age-related change in speed of information processing which influence performance in the activities that must be completed in a fixed period. In essence, the claim about speed of processing is grounded on the idea that a) processing speed becomes more rapid with age reflecting changing limits of the global mechanism, which means that (b) processes responsible for performance on a particular task are executed more rapidly and are more likely to be completed in a limited period of time, resulting in (c) superior performance (p. 949, Kail & Hall, 1994). Kail and Hall (1994) brought an alternative interpretation to rapid naming of familiar stimuli such as digits and letters. That is, accessing to name codes for digits, letters and colors may become more rapid with age not because access to name codes becomes automatic with experience but basically because age-related change in the global mechanism accelerates retrieval. On the basis of this interpretation, one should expect a causal relationship between measures of global PS and RAN. In order to examine whether PS predicts rapid naming, Kail and Hall (1994) administered measures of PS, naming speed and reading skills (i.e., word reading and reading comprehension) to the children between the ages of 8 and 13. Overall, the results demonstrated that age was related to speed of processing and this age-related change in speed of processing was connected to more rapid naming, which was connected to word recognition, which was linked to reading comprehension. Further, multiple regression analyses indicated that age explained 49% of the variance in PS which together with age accounted for 62% of the variance in rapid naming. Age, PS and rapid naming explained 62% of the variance in word recognition. Further, when age, PS, rapid naming and word recognition were entered as independent variables into the equation, they explained 72% of the variance in reading comprehension. Naming time was identified as a mediator between PS and word reading and comprehension. Increased PS with age results in faster accessing to names. Such explanations are inconsistent with the traditional view in which automaticity gained with age-related experience is the fundamental link between reading ability and rapid naming of digits, letters and colors. The path analyses, according to Kail and Hall (1994), showed that naming times were predicted by PS times but not by age confirming the view that naming times are constrained by the global mechanism.

In a more recent study, Christopher et al. (2012) investigated the roles of speed of processing and rapid naming in word reading and reading comprehension. The tasks were administered to children and adolescents ranging in age from 8 to 16 years old. The participants were split into two groups as “learning to read” and “reading to learn” in order to address potential developmental changes caused by the transition period. Regarding the results germane to PS, Christopher and colleagues (2012) reported that PS was a significant independent predictor of word reading after controlling for naming speed, working memory and inhibition. However, it has lower contribution to reading comprehension possibly because context can help readers for word recognition in extended text whereas isolated word reading lacks such support. The analyses also displayed that rapid naming of nonalphanumeric stimuli predicted neither word reading nor reading comprehension when general PS was controlled for. But, when the analyses were reran with alphanumeric items (i.e. letters and digits), it was found that naming speed predicted word reading even after PS was controlled for. According to the researchers, the link between rapid naming and word reading after controlling for PS and other cognitive variables shows the overall ability to recognize and use alphanumeric stimuli rather than the ability to overtly name stimuli (i.e., objects or colors). Christopher et al. (2012) concluded that how quickly a person could process visual information and make quick associations between visually presented stimuli and speech sounds are important for both comprehension and word reading.

In a study with poor readers from Grades 2, 3 and 4, Catts et al. (2002) examined the contribution of speed of processing, rapid naming, and PA in reading comprehension. Overall, the study confirmed the hypothesis that many children with reading difficulty are deficient in speed of processing. That is, compared to typical readers, poor readers were found significantly slower on tasks that measure response time in linguistic and nonlinguistic domains that include motor, visual, lexical, grammatical abilities. Poor readers with normal IQ were also identified slower in rapid naming of objects. More specifically, poor readers with normal IQ were 10% slower across processing conditions than skilled readers. Also, multiple regression analyses showed that the performance of the participants in PS accounted for significant variance in reading comprehension after controlling for IQ and PA. However, rapid naming of nonalphanumeric did not predict either word reading or reading comprehension once variance in general PS and IQ were taken into account. Consistent with Kail and Hall (1994), these results suggest that the participants' performance on rapid naming of objects in relation to reading achievement may partly reflect a general deficit in speed of processing. In parallel with this view, the researchers proposed that a speed of processing deficit might appear as an extraphonological factor in some reading disabilities. On the other hand, Catts and colleagues (2002) reminded that in comparison with nonalphanumeric naming used in their study, alphanumeric naming is more closely linked to reading; thus, caution must be taken when extending the conclusions about generalized slow processing found in their study. At this point, this doctoral study may help to enlighten this hypothesis as it includes both measures of PS and of alphanumeric rapid naming.

Interestingly, Cutting and Denkla (2001) did not detect a direct influence of PS on the word reading of elementary school children. Rather, the results of path analyses reported a significant indirect effect of PS on word reading (0.56) which was mediated by RAN, PA, PM and OK . In line with Kail and Hall (1994), the researchers maintained that PS may be reflective of a global mechanism that is responsible for the efficiency of cognitive processes. This argument will further be elaborated in the next subsection when PS is discussed in relation to other variables.

Babur (2003), on the other hand, identified both direct and indirect effects of PS on first and second graders' word reading in English. Specifically, the researcher reported PS's indirect effects on word reading through STM and PA in the first and second grades. It was also found that PS made an indirect contribution to word reading through the effect of STM on alphanumeric RAN because this type of RAN also had direct influences on first grade word reading ability.

In a study with Australian English-speaking fourth grade children, Bowey et al. (2005) found that global PS was related to word-reading ability, replicating previous research studies. More specifically, global PS in fourth-grade children was found to account for 13% of variance in word reading. However, although global PS primarily mediated the association between non-symbol naming speed (e.g., small rectangular color patches and pictures of common objects) and word-reading skill, it did not mediate the association between word-reading skill and serial naming speed for letters and digits. That is, once global PS effects were controlled, alphanumeric naming speed still explained 12% of additional variance in reading. On the other hand, in line with Catts et al. (2002) and Kail and Hall (1994), Bowey and colleagues (2005) still suggested that at all levels of reading development, speed of processing plays a significant role in RAN and reading association.

The previously reported study by Plaza and Cohen (2005) also deserves mentioning herein because this study differently measured PS in a different language, namely in French. Working with French-speaking first graders, Plaza and Cohen (2005) investigated the performance of cognitive PS in different modalities (i.e., auditory-verbal, visual-verbal, visual, and visual-visual) in relation to reading and spelling. The auditory-verbal processing measured the participants' PA (i.e., phoneme awareness) ability in a timed condition. The visual-verbal processing measured naming speed performance. The visual-visual processing was a matching coding task and visual processing was a visual attention task. All tasks were timed. The sample consisted of skilled readers as well as readers who performed worse on all reading and spelling tasks. The results indicated that in comparison with skilled readers, the children with poor reading skills displayed low and slow performance on most cognitive tasks relevant to processing speed. Overall, auditory-verbal and visual-verbal modalities accounted for 66% of the variance in written language skills (a composite of reading and spelling task scores). The visual-visual modality (coding matching task) only significantly correlated with reading when entered in the regression equation at Step 1 or at Step 2, after visual or auditory-verbal processing, and it was not any longer significant when entered after visual-verbal naming-speed tasks.

In conclusion, it has still been under discussion how and why PS influence reading development. Studies have presented conflicting results about the role of PS (direct versus indirect) in reading. Additional studies are needed to clarify the links between speed of processing and reading.

A brief review that focus on the link between PS and other reading predictors will be given in the next subsection. Such a review will also enhance our understanding about the function of PS in reading development.

2.5.6.3 The relationship of PS to other predictors of reading

A high correlation between PS and RAN was presented by Kail and Hall (1994). As in Kail and Hall (1994), Christopher et al. (2012) pointed to a strong relation between PS and RAN skills. However, the independent contribution of each construct to the reading ability in the same study indicated that these two constructs have still separate characteristics that are influential in reading.

Additionally, working with first- through third-grade students, Cutting and Denckla (2001) reported a strong connection between RAN and PS. However, the researchers found an indirect effect of PS on word reading. That is, the relationship between PS and word reading was mediated by RAN, PA, memory span and OK. Cutting and Denckla (2001) proposed that PS influenced all the word-reading predictors due to its close link with IQ. The researchers gave an additional alternative explanation for this result and expressed that PS may reflect multiple processes that could affect a variety of word reading predictors. PS may influence visual perceptual processes, working memory, or the ability to access information from long-term memory. Based on the direct influence of PS on RAN, PA, PM, and OK, Cutting and Denckla (2001) defined a certain level of PS as “a *general entry or lower-level requirement* to be able to develop the specific speed of association necessary for

RSN, orthographic knowledge, phonological awareness, and memory span and for word reading" (p. 698).

However, different from Cutting and Denckla (2001) and from Kail and Hall (1994), Babur (2003) reported that PS did not directly influence alphanumeric RAN in the first and second grades. It only contributed significantly to nonalphanumeric RAN in the first grade, but not in second grade. However, additional multiple regression analyses in the study showed that PS explained a significant amount of variance in verbal STM and it was through this indirect relation that PS had an impact on RAN. In other words, PS affected RAN constructs only through its effects on verbal STM in the first grade. It had neither direct nor indirect effects on RAN constructs (i.e., digits, letters and objects) in the second grade.

In addition, a previously reviewed study by Papadopoulos et al (2016) found a consistent relationship between RAN and PS. Congruent with previous studies (e.g., Kail & Hall, 1994), the researcher argued that RAN may be a manifestation of general PS, which refers to the speed at which cognitive processing are executed. As such, according to Papadopoulos et al. (2016), skilled performance in both naming and reading partly relies on the speed underlying processes. This finding seems to be particularly valid in languages with a transparent orthography in which reading fluency is often the key outcome measure. The researchers proposed that RAN is a powerful predictor of reading fluency partly because speed is an integral part of RAN performance, acting as a common cause variable in the RAN-reading relationship.

It appears that how PS is connected to other predictors of reading requires further exploration. Additional evidence from different languages that focus on the specific associations between PS and other variables will also boost our understanding of how PS acts in reading acquisition. The current study explores how PS is related to reading and other variables in a transparent orthography.

Another variable that should not be downplayed in reading development is vocabulary, which will be the focus of the next section.

2.5.7 Vocabulary knowledge

2.5.7.1 On the definition of vocabulary knowledge

NRP (2000) presented two types of vocabulary knowledge called receptive and productive vocabulary at the conceptual level. Receptive vocabulary is defined as the vocabulary that a person can understand when it is presented to him/her in text or as he/she listens to others speak. Productive vocabulary refers to vocabulary we make use of in writing or when speaking to other. There is a general agreement that receptive vocabulary is much larger than productive vocabulary since individuals often recognize words that they would rarely utilize in practice (NRP, 2000). In another definition, vocabulary is subcategorized as *oral* versus *reading* vocabulary, where oral refers to words that are recognized in speaking or listening while reading vocabulary entails words that are utilized or recognized in print. Sight vocabulary, a subset of reading vocabulary, refers to those words that can be identified without explicit word recognition processing during reading (NRP, 2000).

Given that vocabulary encompasses many definitions from different angles, the format for assessing or evaluating vocabulary is an important variable in both practice and research. In the next subsection, two popular assessment measures will be presented.

2.5.7.2 Vocabulary tasks

In line with the definitions of vocabulary knowledge, evaluation of vocabulary knowledge is commonly measured via *receptive vocabulary* and *expressive vocabulary* tasks in reading acquisition studies. The *receptive vocabulary* task measures a child's semantic knowledge at the receptive level. The child is usually presented with picture options from which he/she is required to designate the one corresponding to the word he/she has heard. Alternatively, in the receptive vocabulary test, the learner is asked to select a definition for a word from a list of alternatives. Conversely, the task could be to choose a word for the definition. *Expressive vocabulary* task assesses a child's semantic knowledge at the production level because it requires the child to generate a definition for a word. The task might be composed of words with different parts of speech (e.g., abstract or concrete nouns, verbs, adjectives, adverbs and prepositions). The child hears a word and is expected to give its definition. In some cases, the child is asked to provide the opposite (i.e., the antonym) for the given word (e.g., Asadi et al, 2017).

The following subsection of this chapter will give a short overview on the results of the research studies with reference to vocabulary and core reading skills.

2.5.7.3 The relationship of vocabulary knowledge to reading skills

According to Stanovich (2000), as in PA, vocabulary knowledge is involved in a reciprocal relationship with reading ability, but different from the case of PA, the relationship continues to remain important through the process of reading development and remains in force for even the most fluent adult readers. Several studies have confirmed the critical role of vocabulary in different aspects of reading, particularly in word reading and reading comprehension (e.g. Babayiğit &

Stainthorp, 2013; Chall et al., 1990; de Jong & van der Leij, 2002; Garlock, Walley & Metsala, 2001; Hart & Rinsley, 1995; Joshi, 2003; Manis et al., 2000; Muter, Hulme, Snowling & Stevenson 2004; Ouellette & Beers, 2010; Ricketts et al., 2007; Wood, 2009). In fact, the significance of vocabulary in reading achievement has been acknowledged for more than half a century (NRP, 2000). Children need knowledge of words that make up the text in order to completely understand the reading text (Ricketts, et al., 2007). Joshi (2003) defines a well-developed vocabulary as “a prerequisite for fluent reading, a critical link between decoding and comprehension” (p. 209). Accordingly, Ouellette (2006) emphasized that a better understanding of the relations between oral vocabulary and reading skills will directly lead theories of literacy acquisition and play a critical role in illuminating individual differences and in guiding instructional approaches to literacy education. Concerning the nature of vocabulary and reading comprehension relation, there seems to be a reciprocal association between these two variables through development, as reading creates an opportunity for learning the meanings of novel words (e.g., Ricketts, et al., 2007; Verhoeven, 2000; Verhoeven & van Leeuwe, 2008; Verhoeven, van Leeuwe & Vermeer, 2011).

In the last few decades, a growing body of research focusing on the relation of vocabulary to reading ability has provided compelling evidence that vocabulary knowledge makes a significant unique contribution to reading success of children in a wide range of languages (Dutch: Verhoeven et al., 2011; English: Nation & Snowling, 1998; Greek: Protopapas et al., 2007, Turkish: Babyiğit & Stainthorp, 2013).

In one of the pioneering studies of vocabulary knowledge led by Jenkins, Stein and Wysocki (1984), students were identified as better comprehenders of the stories when they knew key vocabulary that they had previously read in other passages. Accordingly, the researchers reported that knowledge of key vocabulary contributes to a richer understanding of stories although the main idea of the story may be adequately grasped in spite of incomplete vocabulary knowledge.

Studies with children who have poor reading comprehension skills have provided additional evidence for the close link between vocabulary and reading comprehension. In one of these studies, Nation and Snowling (1998) identified that children with specific reading comprehension problems have poorer vocabulary knowledge and have weaker semantic abilities and word recognition skills for exception and low-frequency words than children with normally developing reading abilities. Likewise, Nation, Clarke, Marshall and Durand (2004) indicated that children who are poor comprehenders are also inclined to have relatively low levels of vocabulary knowledge in comparison with readers who are successful in reading comprehension. Although poor comprehenders read fluently and accurately and had normal IQ, these children were unsuccessful at understanding the texts they read. In accordance with this, Joshi (2003) pointed the Matthew Effect and wrote that students who have poor vocabulary struggle with understanding written text. These students with poor vocabulary knowledge, then, tend to read less and thus acquire fewer new words, whereas their peers with better vocabulary knowledge read more and expand their comprehension ability.

In a comprehensive longitudinal study, Cunningham and Stanovich (1997) found that first-grade vocabulary knowledge accounts for 33% of the variance in reading comprehension measured in eleventh grade in English. Congruent with this study, Manis et al. (2000) presented that vocabulary explained a sizable proportion of the variance in reading comprehension (23.4%) for second graders in English.

Using a series of hierarchical multiple regression analyses, Babayiğit and Stainthorp (2013) also questioned the role of kindergarten vocabulary in explaining individual differences in Grade 1 and 2 reading comprehension levels in Turkish. The three component skills (i.e., vocabulary, grammar and VSTM) along with non-verbal reasoning were entered into the regression model at Step 1 and listening comprehension was entered into the model at Step 2. Babayiğit and Stainthorp (2013) reported that the overall model accounted for 44% of the variance in Grade 1 and 31% of the variance in Grade 2 reading comprehension levels. The researchers noted different predictors play differential roles across the two developmental periods. That is, whereas kindergarten VSTM, listening comprehension and grammatical skills were detected as statistically significant unique predictors of Grade 1 reading comprehension, only vocabulary was identified as a significant unique predictor of Grade 2 reading comprehension in Turkish.

Insofar, the reviewed studies above generally investigated vocabulary only in relation to reading comprehension ability. Several models stress the role of vocabulary knowledge as an essential steps in word recognition (Adams, 1990; Perfetti, 1985; Perfetti & Stafura, 2014). As such, many studies focused on vocabulary with regard to children’s reading ability at both word and text levels. Ricketts and colleagues (2007), for example, shed additional light on the critical link between vocabulary and reading comprehension by including a set of reading-related measures administered longitudinally. The researchers aimed at assessing the reading skills (nonword reading fluency, regular and irregular/exception word reading, text reading accuracy, and reading comprehension) predicted by oral (i.e., productive) vocabulary skills. The children were tested for their expressive vocabulary knowledge in which they were asked either to verbally define the given words or to provide two distinct definitions for words with multiple meanings (e.g., For the word *bat*: the thing you hit a ball with and an animal that flies). The researchers also explored the relation between oral vocabulary and exception word reading in children with poor reading comprehension. PA, OK, and print experience were also assessed in the study. A large sample of children (N= 83) between the ages of 8 to 9 was included in the study. Poor comprehenders and skilled comprehenders were also chosen from this sample for separate analyses based on the population norm. This subgroup was tested twice. Hierarchical regression analysis showed that oral vocabulary accounted for concurrent reading comprehension (17.8%) and exception word reading (10.9%) (i.e., word that have inconsistent grapheme-phoneme correspondence) but not text reading accuracy, fluent nonword reading, or regular word reading for the whole sample. The researchers proposed that vocabulary predicts some word recognition skills as well as reading comprehension. Further, Ricketts et al. (2007) found that reading comprehension measured at Time 1 explained 11% of the variance in vocabulary when measured at Time 2. Accordingly, Ricketts et al. (2007) suggested an interactive and reciprocal relationship between vocabulary and reading comprehension. In addition, regarding poor comprehenders, consistent with Nation and Snowling (1998), the researchers noted that these children read fewer exception words accurately and they exhibited weakness in vocabulary both concurrently and longitudinally. As in skilled readers, vocabulary explained poor readers' exception word reading concurrently and longitudinally even after decoding skill was controlled.

Additional support for the prediction regarding the unique contribution of vocabulary knowledge to understanding texts as well as to word reading comes from Nation and Snowling (2004). The study included 72 English-speaking children followed from the age of 8.5 to 13 years old. The children were administered tests of reading skills (i.e., word recognition, nonword reading, exception word reading and reading comprehension), oral language skills (i.e., expressive vocabulary, listening comprehension and semantic skills) and phonological skills (i.e. rhyming skills) and tested at two points in time (Time 1 when the children were 8.5 and Time 2 when they were 13 years old). After controlling for strong influences of age and nonverbal ability (12.3%, together), and phonological skills (20%), vocabulary (25.2%), listening comprehension (30.8%) and semantic skills (15.1%) accounted for unique variance in reading comprehension at Time 1. The hierarchical regression analyses were also computed to identify the longitudinal predictors of reading comprehension. In line with concurrent results, longitudinally, semantic skills, vocabulary and listening comprehension all accounted for significant portions of unique variance in reading comprehension (4.5%, 4.9% and 14.1%, respectively). Nation and Snowling (2004) were also concerned with concurrent and longitudinal predictors of word recognition. A series of hierarchical regressions evaluating the concurrent predictors of word recognition indicated that age and nonverbal ability explained 21% of the variance. When nonword reading and phonological skills entered, they accounted for an additional 72% of the variance. However, the individual contribution of each oral language measure to word recognition was unique but rather small (vocabulary explaining 3.8%, semantic skills explaining 4%, listening comprehension explaining 3%). A similar pattern of results was obtained from the regression analyses conducted for the longitudinal predictors of word recognition. As for exception word reading, longitudinally, the proportion of the unique variance explained by vocabulary was 2%. Listening comprehension accounted for 4.2% of the variance. Nation and Snowling (2004) concluded that oral language skills, particularly vocabulary knowledge and listening comprehension beyond phonology accounted for additional variance in word recognition over and above decoding skills both concurrently and longitudinally.

Further evidence for the role of vocabulary in word reading and comprehension is offered by Verhoeven et al. (2011). The researchers, in a longitudinal study, followed Dutch-speaking children during elementary school years and examined the children's basic (i.e., vocabulary knowledge in the first and second grade) and advanced vocabulary (i.e., vocabulary knowledge in the third and fourth grade) in relation to the development of word reading fluency and reading comprehension. The study of lexical growth in Dutch is interesting because Dutch orthography has highly consistent mappings between letters and phonemes. Concerning developmental progression, the children's vocabulary, fluent word reading and reading comprehension made a significant and consistent progression from one grade to the next. The level of lexical growth observed at the beginning of reading instruction predicted both the levels of word reading fluency and reading comprehension. But the association between early vocabulary and fluent word reading was weaker compared to that of reading comprehension. Verhoeven and colleagues suggested that due to the high transparency of Dutch orthography, early vocabulary is less decisive for the development of fluent word reading ability in comparison with its role in reading comprehension. Additionally, children's second-grade word reading was found to foster their third-grade vocabulary development. The researchers, thus, regarded efficient word decoding as a key to ongoing vocabulary development, helping children acquire new associations between orthographic forms and their meanings. A bidirectional link between vocabulary and reading comprehension was also observed in lower grades of elementary school.

That is, the children's vocabulary in the first-grade predicted their reading comprehension in the second-grade, which predicted, in turn, their third-grade vocabulary. Verhoeven and colleagues (2011) concluded that basic oral vocabulary appears to fuel children's early reading acquisition, and early reading skill consequently fuels children's advanced vocabulary development.

Ouellette (2006) approached the critical link between vocabulary and reading skills from a different angle. The researcher evaluated a sample of Grade 4 English-speaking students on measures of decoding (i.e., pseudoword reading), visual word recognition (i.e., irregular word reading) and reading comprehension as well as on measures receptive and expressive vocabulary that tests different facets of vocabulary, namely vocabulary breadth (i.e., how many words are known) and depth of vocabulary knowledge (i.e., how well the meanings are known). The results indicated that receptive vocabulary breadth was a unique predictor of children's decoding performance whereas expressive vocabulary breadth predicted visual word recognition. Further, depth of vocabulary knowledge indirectly predicted visual word recognition through its link with expressive vocabulary in addition to its direct contribution to reading comprehension beyond the measures of vocabulary breadth.

The study by Protopapas et al. (2007) is also noteworthy. Working with Greek children from Grades 2, 3 and 4, Protopapas et al. (2007) displayed the mediating role of vocabulary knowledge between fluent and accurate word reading and comprehension. Protopapas et al. (2007) reported that word reading skills (both fluent and accurate word reading) remained modestly but significantly correlated with reading comprehension through the fourth grade. However, this correlation disappeared once vocabulary knowledge was taken into account. Parallel to this, the unique contribution of word reading to comprehension lessened to a great extent after measures of vocabulary knowledge (both receptive and expressive lexical skills) were added to the model in hierarchical regression analyses. The researchers suggested that consistent with lexical quality hypothesis, most of the variance contributed to reading comprehension by word reading skills may be mediated by vocabulary knowledge, particularly in higher grades.

To sum up, there is considerable amount of evidence that individual differences in vocabulary skills play a critical role in reading comprehension development. Furthermore, the results of the studies have confirmed that vocabulary might be essential for word reading skills, more specifically for inconsistent words. Moreover, some studies have shown that vocabulary and word reading facilitate each other, referring to a bidirectional relationship between these two variables. Such relation has also been identified between vocabulary and reading comprehension. Finally, in addition to its direct effect on reading, vocabulary might be a mediator, influencing the relationship between word reading and comprehension.

Thus far, the findings of previous research on the relative role of vocabulary knowledge in predicting different reading skills have been reviewed. Vocabulary has also been found connected to other predictors of reading. Accordingly, the next subsection is devoted to the link between vocabulary knowledge and other variables of reading.

2.5.7.4 The relation of vocabulary knowledge to other predictors of reading

The relation of vocabulary knowledge to PM and MA was previously given in PM and MA sections. Research studies also presented findings on the strong connection between a child's socioeconomic status (SES) and vocabulary knowledge. Hart and Rinsey (1995) conducted a longitudinal study to investigate the causes of discrepancy in linguistic/academic progress among children from different socioeconomic backgrounds. According to researchers, the amount of words children are exposed to from very early years could explain the size of children's vocabulary knowledge and why children from lower SES perform worse on standardized vocabulary tests than children from middle SES backgrounds. Hart and Rinsley (1995) identified qualitative and quantitative differences in the words that children from lower SES and from higher SES families encounter. They found that children from higher SES families were exposed to about 30,000 words per year whereas children from lower SES families were exposed to almost 10,000 words. Furthermore, the characteristics of parent talkativeness or "sociableness" to their infants accounted for a correlation between SES and the children's later linguistic/academic development. As for the quality of vocabulary knowledge, the words that children with higher SES background were exposed to were much more encouraging, supportive, and clarifying and the interaction between the parent and the child was characterized as more conversational. Conversely, as parent-child interaction in the lower SES group involved directives, the lower SES children were exposed to vocabulary that focused more on negative words and commands (e.g., Don't do that!).

Likewise, Chall and Jacobs (2003) commented on SES, vocabulary knowledge and reading development relation based on their longitudinal study (see Chall et al., 1990). The researchers examined the skills and abilities of low-income children in comparison with children in the normative population to shed further lights on why some children are struggling while others are not during the transition period from Stage 2 to Stage 3 in Chall's developmental model of reading. The model highlights that the process of reading is subjected to ongoing changes as the reader becomes more able and proficient. That is, according to this model, changes in reading development fall into six stages. Starting at Stage 3 (Grades 4-8), students utilize reading as an instrument for learning as texts involves new words and ideas, becoming more varied, complex and challenging linguistically and cognitively. Chall and Jacobs (2003) put forward that unless children are fluent word readers and have expanding vocabulary knowledge, they might unable to make the critical transition from Stage 2 to 3 (i.e., from *learning to read* to *reading to learn*), which severely challenges their academic success. Using this developmental stage model of reading, Chall and Jacobs (2003) concentrated on the Stage 2-3 transition, which is also labeled by teachers as *fourth-grade slump* in literacy development, especially for low-income children. Accordingly, in the study, low-income children from grades 2, 4 and 6 were followed for two years and were tested for vocabulary knowledge (word meaning), word recognition, word analysis, oral reading, reading comprehension and spelling. The performance of these children was then compared with their counterparts from the normative population. The results showed that both low-income children and the children in the normative population achieved well in all subtests conducted in Grades 2 and 3. Consistent with Chall's stages of reading development, however, starting in Grade 4, the children in low-income group lag behind the children in the normative group. The first and strongest gap was observed in vocabulary knowledge. That is, in comparison with a normative population, the low-income children were greatly challenged by defining more abstract, academic, literary and less common words on the word meaning test. By Grade 7, these children were more than two years behind norms. Their scores on word recognition, spelling, oral reading and later on silent reading comprehension began to fall behind norms in Grades 6 and 7. The deceleration on word meaning scores, according to

Chall and Jacobs, ultimately influenced reading comprehension of low-income children. The researchers further pointed that students with reading difficulties in the intermediate grades will eventually have trouble with the study of science, social studies, literature, mathematics as well as other content study that are mostly dependent upon written text.

The relation of vocabulary with other variables such as PA and PM has also been emphasized in some research studies. For example, based on a series of experiments with English-speaking preschoolers and first graders, Metsela (1999) found that the development of phonological skills such as isolating initial phoneme, phoneme blending, onset-rime blending was linked to basic vocabulary growth. That is, the results (Experiment 3) revealed that 3 to 4-year-olds' PA scores accounted for unique variance in their vocabulary knowledge even after children's short-term memory span (measured by digit span) were taken into consideration. Also, vocabulary was found to be strongly associated with nonword repetition scores for 3- to 5-year olds in the same study. In contrast to Gathercole and colleagues (e.g., Gathercole & Baddeley, 1989, 1990; Gathercole et al., 1992; Gathercole, Service, Hitch, & Martin, 1997), according Metsela (1999), rather than phonological short-term memory, PA mediates the relationship between nonword repetition and vocabulary knowledge. The results of the study (Experiment 2) reported that on each PA task, children who scored in the top half of vocabulary development performed better than those in the bottom half. As such, the researcher also suggested that vocabulary growth, operationalized in terms of absolute size, word familiarity, and phonological similarity relations between word items (i.e., phonological neighborhoods) provides an explanation for individual differences in emerging PA and nonword repetition. In another longitudinal study, McBride-Chang, Wagner and

Chang (1997) found that vocabulary ability contributed uniquely to growth in phoneme deletion ability between kindergarten and Grade 1.

To conclude, children's SES seems to shape their vocabulary knowledge qualitatively and quantitatively, which ultimately influence reading comprehension skills. Also, vocabulary knowledge appears to be connected to linguistic and cognitive variables such as PA and PM. Accordingly, it appears that to fully make sense of the development of skilled reading and of the important connection between oral and written language, one must take a broader range of reading-related skills into consideration in conjunction with potentially important components of oral language. In this respect, the present study investigates the role of oral (i.e., expressive/productive) vocabulary in different reading skills of real word reading, pseudoword reading, and reading comprehension in Turkish. Further, Joshi (2005) suggested inclusion of vocabulary assessment and instruction as important components of reading programs for readers who were challenged by vocabulary problems so as to overcome so-called Matthew Effect. Therefore, given the prominence of vocabulary in the reading process, this thesis study includes a task on expressive vocabulary of Turkish children to identify how vocabulary functions in word and nonword reading and reading comprehension along with its link with other variables such as children's SES, PA, PM, RAN, MA capacities in Turkish.

Variation in fluent reading skills may not always be fully explained by cognitive and linguistic variables, suggesting the exploration of other factors behind the development of fast and accurate reading, and adequate reading comprehension skills. In addition to the cognitive and linguistic variables that have been reviewed thus far, it is also important to explore to what extent a child's socio-economic background shapes his/her level of reading success as an independent and a controlling variable. Thus, the last subsection of this review chapter is devoted to the studies that have investigated the role of SES in reading achievement.

2.5.8 Socioeconomic status (SES)

2.5.8.1 On the definition of SES

SES can be defined as the social standing or class of an individual or a group. It is generally measured as a combination of education, income, and occupation (American Psychology Association [APA], 2017). According to APA, an investigation on SES often exhibits unfair differences in access to resources, along with issues related to privilege, power, and control. Likewise, in a meta-analysis study, Sirin (2005) identified six types of SES components: Parents' education, occupation, income, free or reduced-price lunch, neighborhood, and home. Of these six types of SES elements, parental education was the most commonly preferred SES constituent by the researchers between the years 1990 and 2000. Sirin (2005) also identified family SES background as one of the strongest correlate of academic performance. The researcher also noted that the magnitude of this relationship between SES components and academic achievement increased significantly across school levels, from primary school to middle school.

Socioeconomic background is one of the contextual variables that has been extensively measured in education research (Sirin, 2005). Literature pertinent to SES components (parental income, education level, and occupation) reported a significant link between children's socioeconomic background and measures of academic achievement (White, 1982). Studies in literacy acquisition, however, generally control SES by selecting the sample children from a similar SES background. A few studies investigated SES in relation to overall reading development. These studies will shortly be reviewed in the next subsection.

2.5.8.2 The relationship of SES to reading skills

Certain background variables such as one's parental SES may create inequalities in educational achievement more than other factors (Jehangir et al., 2015). More specifically, some studies have recognized SES as an important predictor that can lead to individual differences in reading success (e.g., Aikens & Barbarin, 2008; Bowey, 1995; Jehangir et al., 2015).

Whitehurst and Lonigan (1998) stated that a significant disparity exists between what many children bring to their first school experience and what schools expect of them in order to be successful learners. This gap is often called *school readiness* and is strongly related to family income. Whitehurst and Lonigan (1998) also noted economically disadvantaged children might experience deficiencies in emergent literacy skills such as letter knowledge, phonological sensitivity and emergent writing and are at very high risk of reading failure.

Numerous factors might moderate the link between SES and reading achievement. According to Heath (1989), extended reading, writing and talking activities such as sharing knowledge and skills from multiple sources, building collaborative activities from and with written materials and switching roles and trading expertise and skills in reading, writing, and speaking are situated at the very center of being literate. Yet, Heath (1989) wrote that children in low-income were exposed to these occasions inadequately. In accordance with this, Adams (1990) estimated that the typical middle-class child will have been exposed 1,000-1,700 hours of one-on-one picture book reading by the time he/she starts first grade whereas a child from a low-income family will just have 25 hours of storybook experience on average. Likewise, some studies in Turkish validated the disparity that children experience in academic language features before starting formal schooling due to SES differences. Aarts, Demir, and Vallen (2011) conducted a study with Turkish 3-year-old children in Netherlands. The mothers who had different levels of education and SES background were expected to read a book and discussed a picture with their child. The results of the qualitative study showed that a large individual variation existed in the extent to which characteristics of academic language (e.g., lexical diversity, decontextualization, or high-level abstraction, and complex syntactic structure) are used by mothers while interacting with their young child. Part of this variation was attributed to the SES and literacy levels of the mothers. Durgunoğlu (2017) also emphasized the wide diversity that exists in the home environments of Turkish children. She wrote that Turkish children come to school with highly diverse language skills due to their home environment and early childhood experiences.

It seems that children's SES background gives rise to qualitative and quantitative discrepancies in the activities and the language children are exposed to even before they enter primary school. In addition to these studies, some other studies examined the effect of SES during school years. Using data from both public and private schools in a number of countries (i.e., Austria, Belgium, Finland, Indonesia, Ireland, Japan, The Netherlands and Chine Taipei) Jehangir et al. (2015) found that students' socio-economic backgrounds was strongly related to reading achievement in almost all countries included in the study even after controlling for school type (public vs. private) and study orientation. In this study, SES was defined by the possessions at home, the highest educational level of the parents and the highest occupational status of the parents.

In another study, Aikens and Barbarin (2008) investigated the relation between SES and children's reading growth from kindergarten to Grade 3. Here, SES was composed of five pieces of information, namely father's or male guardian's education, mother's or female guardian's education, father's or male guardian's occupation, mother's or female guardian's occupation, and household income. Other characteristics related to the child's school (e.g., children's classroom peers, classroom literacy instruction, and teacher background and beliefs) and neighborhood conditions (e.g., neighborhood safety, community support) were also controlled in the study. It was displayed that as SES increased, so did children's achievement in reading outcomes. That is, in general, the study emphasized that high-SES children started off as better readers and gained more rapid progress than did low-SES children, across the three time periods, with the biggest gap being observed between the spring of kindergarten and the spring of first grade. Further, it was reported that the relations between SES and children's initial reading competence as well as their reading success in early elementary grades were mediated by family-related factors (e.g., home literacy environment, number of books available within the home to the child, parental involvement in the school, parental role strain and warmth, and provision of center-based care prior to kindergarten), school (e.g., the number of children reading below grade and the presence of low-income peers) and neighborhood characteristics (e.g., safety of home neighborhood, community support for learning).

Likewise, in a study with reading-disabled English-speaking children (N= 54), Cornwall (1992) reported that children's SES was a significant precursor of their scores in both word attack (β= .23, p<.05) and word identification tasks (β= .23, p<.05). The researcher suggested assessing family background variables along with intelligence, memory, PA, RAN at the same point in time to determine the relative importance of each variable in the child's educational development.

Furthermore, some studies were particularly interested in the association between SES and reading comprehension. In one of these studies, Cheng and Wu (2017) found that SES defined as parents' educational attainment, current occupations, and family income was a significant predictor of first graders' reading comprehension performances in Chinese. In particular, the study reported concurrent mediating effects of vocabulary and MA on the relationship between SES and reading comprehension. That is, the researchers suggested that children from more educated and advantaged parents have a higher level of MA and vocabulary skills which in turn indirectly contribute to an increase in their reading comprehension.

Taken together, there are limited number of studies that investigated how SES acts particularly in the development of reading skills during elementary school years. These studies overall proposed that SES is an influential factor in reading outcomes. This study took parental education level as a component of SES as it is considered one of the most firm aspects of SES (Sirin, 2005). That is, parental education level is characteristically established at an early age and does not change over time (Sirin, 2005). Additionally, parental education is an important index for parent's income as income and education have been found associated in Turkey and other countries such as the United States (Çalışkan, 2007; Hauser &Warren, 1997). To our knowledge, there exists no study that has explored the particular role of parents' education level in children's reading fluency and comprehension in Turkish.

Thus, the results of this current thesis study will provide essential insights about SES-reading association.

2.5.8.3 The relationship of SES to other predictors of reading

The role of SES in vocabulary gaining was previously discussed in the vocabulary subsection above. Herein, within the scope of this thesis study, the study by Bowey (1995) investigated SES in relation to other reading-related predictive variables and provided evidence of differences in preschoolers' phonological abilities due to parental SES which was based upon parents' occupation and level of education. Bowey reported that these differences remained significant even after children's IQ and verbal ability scores were statistically controlled for. Congruent with this, the data showed that the preexisting differences in phonological skills partly mediated SES differences in first-grade word-level reading achievement. Bowey (1995) also found that the children in high SES group performed better on preschool vocabulary, digit span, sound identity, phoneme identity, rhyme oddity and letter name knowledge than the children from lower-SES group. The researcher concluded that SES discrepancies in kindergarteners' phonological abilities led to differences in their early reading achievement in the first grade.

Studies in Turkish have not directly explored the influence of SES on fluent word reading and reading comprehension. However, the study by Aksu-Koç (2008) pointed to significant differences between the children coming from middle-class and the children from working-class families in terms of their oral language production and comprehension. The study reported that whereas word definition score was 13 on average for the children with middle-class families, it was 8 for the children with working-class family background.

Durgunoğlu (2017) also underlined the role of SES in MA. She noted that although children take formal instruction on the morphological structure of the language and building vocabulary through derivational and inflectional analysis to assist comprehension in language arts classes, the considerable variability in the home environments of children should be taken into consideration. That is, children start school with diverse linguistic skills due to their home environment and early childhood experiences.

To conclude, some studies have documented substantial variation in the reading ability of children as a function of the economic status of their parents. SES appears to be an important factor that should be taken into account when assessing children's reading skills. There seems to be fundamental social class differences in children's exposure to practices (e.g., frequency of shared reading activities, book ownership; the quality and the quantity of parents' talk to their children) and conditions (e.g. the characteristics of school and neighborhood) that might boost or handicap the development of literacy skills. Such additional factors are linked to children's parental SES and might moderate the relationship between SES and reading outcomes.

2.5.9 Summary

Overall, the results of the studies from various languages have suggested that variables such as RAN, PA, PM, MA, OK, PS, vocabulary, and parents' level of education trigger variability in the development of reading skills. However, further evidence is needed to explain how these variables function in reading development in Turkish, an orthographically transparent language. Several studies have also provided evidence that different interconnections between RAN, PA, PM, MA, OK, PS, vocabulary, and SES may mediate the relationship between these variables and reading skills. Accordingly, a model of reading was developed (see Figure 2 on p. 162) on the basis of theories and empirical studies discussed in the preceding sections above. The model basically reflects the hypothesized direct and indirect relationships among the proposed variables. The model was then tested via path analysis in order to explore the possible direct and indirect causal relationships between reading skills (word-level reading and reading comprehension) and RAN, PA, PM, MA, OK, PS, Vocabulary, and Parents' Education Level. It was estimated that some paths in the model might or might not be significant; however, the results would offer some crucial evidence for factors underlying reading development in Turkish, at least for typical readers.

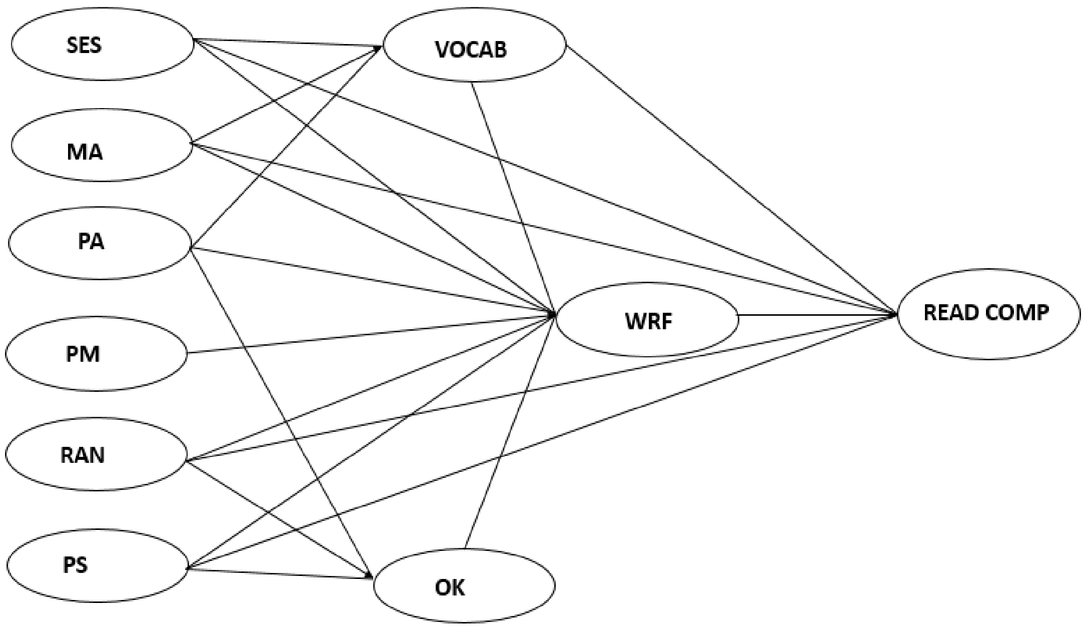

Figure 2. A proposed model of reading

In this chapter, the results of studies from various languages on certain variables (i.e., alphanumeric RAN, PA, PM, MA, OK, PS, Vocabulary, and Parental Education Level) along with a proposed model of reading have been presented. The next chapter will summarize the phonological, morphological, and orthographic characteristics of the Turkish language. The chapter will also provide an overview on how children are taught reading and writing skills in Turkish primary schools.

CHAPTER 3

CHARACTERISTICS OF THE TURKISH LANGUAGE AND THE TURKISH INSTRUCTIONAL CONTEXT

Turkish is a language spoken by more than 80 million people worldwide, including the Balkans, the Middle East and Europe (Durgunoğlu, 2017). It is predominantly spoken in the Republic of Turkey as an official language. Originally coming from Central Asia, the Turkish language is labelled as an Altaic language (Durgunoğlu, 2017; Topbaş, 1997). Although the basic word order of Turkish is Subject-Object-Verb (SOV), a variety of word order forms are accepted in both spoken and written language in order to make a reference to the discourse (Topbaş, 1997). It is also defined as an agglutinating language in which words are polymorphemic and each morpheme corresponds to a single lexical meaning.

This chapter gives the language characteristics of Turkish under three subheadings. First, phonological characteristics of Turkish consonants and vowels are briefly presented. Next, morphological structures of the Turkish language is provided. Finally, Turkish orthography and its typical features are discussed. Following the most prominent features of Turkish in phonology, morphology, and orthography, Turkish literacy instruction context will be briefly discussed with specific reference to the Sound Based Sentence Instruction Method (SBSIM).

3.1 Turkish phonology

A consonant is a speech sound that is articulated with some degree of constriction in the air flow as they are passing through vocal tract (Erguvanlı-Taylan, 2007). The

Turkish language is composed of twenty-three phonemically distinctive consonants that differ from each other with regard to *the point/place of articulation*, *the manner of articulation,* and *the feature of voicing* (i.e., *voiced* or *voiceless)*. Consonant sounds in Turkish are categorized as *bilabial, labio-dental, dental, alveolar, alveo-palatal, palatal, velar* and *glottal* with respect to the place of articulation. They are also classified into seven groups on the basis of the manner of articulation: *stops, plosives, affricates, fricatives, nasals, laterals* and *glides*. The Turkish consonant inventory is given in detail in Table 1 (Erguvanlı-Taylan, 2007, p. 17).

Table 1. Turkish Consonants

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

Vowels are produced with an open vocal tract. The Turkish language owns eight phonemically distinctive vowels, namely *a, e, ı, i, o, ö, u, ü.* These vowels are categorized depending on the features of *backness, height*, and *rounding*. The position of tongue in the mouth characterizes vowels as *front* or *back*. The height of tongue from the roof of the mouth defines vowels as *high*, *mid*, and *low*. Finally, vowels are labelled as *rounded* or *unrounded* according to the position of lips. Table 2 illustrates Turkish phonetic vowels based on these criteria (Erguvanlı-Taylan, 2007, p.10):

Table 2. Turkish Vowels

	Front		Back	
	Non-round	Round	Non-round	Round
High	*i*	*Y (ü)*	*ɯ (ı)*	*u*
Mid	*e*	æ (ö)		*o*
Low	ε		a	

Vowels in Turkish can occur at the beginning, end of words, and between two consonants. In native Turkish, /o/ and /ö/ emerge only in the first syllable, excluding the words that include the imperfective suffix *–Iyor* (Göksel & Kerslake, 2006).

Except for some borrowed words from Arabic or Persian (e.g., *şair* [ʃa:iɾ] 'poet' or *arif* [a:ɾif] 'wise person'), the pronunciation of the vowels in Turkish is lax, i.e., short, rather than tense. Vowels can be lengthened when they precede the consonant, soft g (ğ). Vowel lengthening is not generally indicated in orthography.

In addition, Turkish vowels are syllabic. That is, a syllable in Turkish can be composed of one vowel along with one or more consonants. The possible syllable patterns are as follows: V/ VC/CV/CVC/VCC/CCVC/CVCC/CCVCCC (Çapan, 1989). Among these patterns, the four simple syllable forms, i.e. V, VC, CV, and CVC constitute ninety-eight percent of all Turkish syllables (Durgunoğlu & Öney, 1999). The most frequent syllable form is the CV structure, with over fifty percent of all Turkish syllables being comprised of that pattern. Because the common syllable types do not include consonant clusters, it is easier to distinguish phonemes within the syllable compared to other languages such as English. Likewise, as Turkish words have very clear syllabic boundaries, they can be divided into syllables easily. These characteristics of Turkish syllable structure, in turn, may help children learning Turkish improve awareness of syllables more readily than children learning English which has complicated syllable structure with many consonant clusters (Durgunoğlu & Öney, 1999). In addition, the pattern of syllabication is automatic and is not restricted with suffixation as illustrated in the following example (Çapan, 1989):

kapat-tir-acak (suffix segmentation)

ka-pat-tı-ra-cak (syllable segmentation)

Vowel harmony is one of the most fundamental and salient characteristics of Turkish phonology. It is a left-to-right process along syllables and governs the distribution of vowels within a word (Durgunoğlu, 2017). In vowel harmony, any of the eight vowels (a, e, u, ü, o, ö, ı, i) may appear in the initial syllable of the word. However, each subsequent vowel is conditioned by the vowel which immediately precedes. In other words, the vowels in following syllables are determined by the preceding vowels based on their frontness and rounding properties (Durgunoğlu & Öney, 1999). To illustrate, the inflection -*lar* is used to pluralize the word, *top* 'ball' as *toplar* whereas -*ler* is added to the word, *tip* 'type' to reach its plural form, *tipler* (Durgunoğlu, 2017).

Regarding the acquisition of Turkish phonology, normally developing children seem to master most sounds by age 3 (Topbaş, 1997). Turkish children acquire some sounds such as /b/, /d/, /k/, and /m/earlier than the sounds /n/, /t/, /j/ and /p/. The sounds /g/, /v/ and /s/ are acquired at later stages. The flap /r/ and its allophonic variations, and velar fricative /ɣ/ (soft g) were identified as the latest sounds that appear in Turkish children (Topbaş, 1997).

The emergence of Turkish phonological features in normally developing Turkish children follows universal tendencies as well as language-specific patterns (Topbaş, 1997). Further, the acquisition of certain phonological skills (e.g., syllable awareness, final phoneme deletion) in Turkish is facilitated by the phonological characteristics of spoken Turkish (e.g., a more consistently-defined salient syllable structure, limited number of possible syllable types, vowel harmony and voicing assimilation that necessitate attention to subtle changes in word endings) and the transparency of orthography (1:1 letter-sound correspondences) in Turkish (Babayiğit & Stainthorp, 2007; Durgunoğlu & Öney, 1999; Durgunoğlu, 2017; Topbaş, 1997).

Upon giving a short summary on the outstanding properties of Turkish phonology, a brief description of Turkish morphology is presented in the next section.

3.2 Turkish morphology

Turkish morphology is described as agglutinative and suffixing (Kornflit, 1990). In other words, words in Turkish are formed by productive affixations of derivational and inflectional morphemes to root words (Oflazer, Göçmen & Bozşahin, 1994). Except for some loan words (e.g., *bihaber* ‘non-knowledgeable’, *hemfikir* ‘co-idea’) and reduplication of the first syllable in intensifying adjectives and adverbs (e.g., *bembeyaz* ‘completely white’, çarçabuk ‘very fast’), the main word formation process in Turkish is suffixation; that is, the formation of a new word by attaching an affix to the right of a root (Durgunoğlu, 2017; Göksel & Kerslake, 2006; Kornflit, 1990).

Turkish is rich and productive in terms of inflectional and derivational morphology. As a consequence, Turkish words are usually characterized as long and multisyllabic. For example, the sentence, “It is said that they won't be able to come”, is expressed in a single word- *gelemeyeceklermis* (Öney & Durgunoğlu, 1997). Suffixes can mark voice, aspect, modality, mood, person, or number in nouns and verbs (Durgunoğlu, 2017). There are also numerous suffixes that attach to verbs, nouns, adjectives, or adverbs to create new verbs, nouns, adjectives, and adverbs. The productivity of Turkish morphology is illustrated by some examples in Table 3.

Table 3. Examples of Derivational Morphology in Turkish

Derived	From nouns	From verbs	From adjectives
Nouns	*göz-gözlük* *eye-eyeglasses*	*bil-bilgi* *know-knowledge*	*uzak-uzaklık* *distant-distance*
Verbs	*toz-tozlan* *dust-get dusty*	*ovmak-ovalamak* *scrub-scrub repeatedly*	*uzak-uzaklaş* *far-move away*
Adjectives	*toz-tozlu* *dust-dusty*	*bil-bilgiç* *know- knowledgeable*	*uzak-uzakça* *far-somewhat far*

Source: Durgunoğlu (2017, p. 442)

Vowel and consonant harmony in Turkish shapes the sounds of morphemes. That is, the initial consonant in some suffixes and the vowels in almost all suffixes might change depending on the consonants or vowels that precede them. To illustrate, the plural morpheme *ler* becomes *lar* when it follows words with the vowels *a* or *o,* but stays the same if it follows words that contains the vowels *i* or *e*

(Öney & Durgunoğlu, 1997). For another example, the perfective suffix takes eight forms, -dı, -di, -du, -dü, -tı, -ti, -tu, -tü as in *kaldı* ‘remained’ but *düştü* ‘fell’, where both the consonant and the vowel of the suffix undergo modifications to achieve vowel harmony and the voicing assimilation on the final consonant (Göksel & Kerslake, 2006). All phonological forms that morphemes take on are reflected in print (Öney & Durgunoğlu, 1997). All these morphemic features of the Turkish language differ from English in which morphemes are invariant.

In spite of the complexity of morpheme structure, it was found that Turkish children make very few errors when choosing the right morphophonological form on the course of language acquisition (Aksu-Koç & Slobin, 1985). One reason for this might be the predictable order of morpheme attachment in word formation: Derivational morphemes precede inflectional morphemes, which always appear in the word final position. Such a predictable sequence also exist among the same type of morphemes (i.e., inflectional or derivational). For instance, the order in which nominal inflectional suffixes appear on the stem is as follows: number-possession-case as in *çocuk-lar-ın-a* ‘to your children’ (Göksel & Kerslake, 2011). For another example, the tense suffix comes before the person suffix in verbs as in *geldim* ‘I went’ (*gel-di-m*: go+past tense+first person, not * *gel-im-di*. A shift in the sequence of the morphemes creates either ungrammatical forms or a change in meanings (Göksel & Kerslake, 2011). Accordingly, some probabilistic information on morphotactics is applied by speakers to know which suffixes can come after in Turkish (Durgunoğlu, 2017). That is, because the rich suffixation carries most of the meaning, listeners and readers have to give particular attention to the order of suffixes and the sequences allowed in iterative loops (Durgunoğlu, 2017). Furthermore, in Turkish, each suffix that is attached to a root verb or noun has a distinct range of meaning and maintains its separate phonological and semantic identity along with its relative position in the string. Also, in general, morphemes in Turkish are not homonymous. All these morphemic features, i.e., clear mapping of form to meaning, richness and regularity of Turkish morphology appear to ease the learning of grammatical morphology at early ages (Acarlar & Johnson, 2011; Topbaş, Maviş & Başal, 1997). Studies that examined the development of morpheme acquisition in Turkish have boosted this idea and revealed that typically developing Turkish-speaking children start to use inflectional morphemes (e.g., case, number, tense, aspect, person, negation and interrogation) as early as one-word stage and master these morphemes by the age of two to three (Aksu-Koç, 1998; Aksu-Koç & Slobin, 1985; Ketrez, 1999; Topbaş et al., 1997).

In sum, Turkish is a morphologically rich language with abundant number of grammatical morphemes. Due to its agglutinating typology, multiple suffixes are added to root nouns and verbs. With respect to the development of morphemes, studies emphasized productive use of different suffixes at earlier ages in Turkish. Some orthographic features of the Turkish language is presented in the following part.

3.3 Turkish orthography

Turkish orthography is highly transparent due to its recent history and language reforms in 1920s. It is characterized by one-to-one correspondences both from spelling-to-sound and from sound-to-spelling. In spite of this regularity in orthography, the silent letter soft g (ğ), rounding of some sounds in fast speech and in different dialects (e.g., *gidiyorum* pronounced as *gidiyom*) and voicing assimilation (e.g., *kitap- kitabı*) cause challenges and spelling errors for Turkish spellers (Durgunoğlu, 2017).

The Turkish alphabet is composed of twenty-nine letters, with eight vowels and twenty-one consonants. The order of the alphabet corresponds to that of English, except for the dotted letters (i, ü, ö, ç, ş) that follow immediately the corresponding undotted ones (ı, u, o, c, s) (Çapan, 1989). There are some restrictions on the sequences of letters within syllables. To illustrate, Turkish does not allow initial consonant clusters. Thus, an epenthetic high vowel is mostly inserted between the initial consonant clusters when pronouncing loanwords. For instance, the sounds /ɯ/ and /i/ are inserted between the initial consonant clusters of the following borrowed words: *trafik* [tʰɯɾafikʰ], *traş* [tʰɯɾaʃ], *plak* [pʰilak], prens [pʰiɾens] (Erguvanlı-Taylan, 2007). However, consonant clusters can exist at the end of words (e.g., *kent* 'city', *çift* 'pair') (Durgunoğlu, 2017).

2.5.9

Studies in Turkish showed how certain characteristics of Turkish orthography influence reading outcomes (Öney & Goldman, 1984). By comparing Turkish and American children in Grades 1 and 3, Öney and Goldman (1984) investigated the general question of whether it is less challenging to learn to read in a language with regular and predictable grapheme-phoneme correspondences. The study gave important preliminary results for the relationship between orthography and reading success by comparing two languages (i.e., Turkish and English) with different orthographic transparency (transparent orthography vs. opaque orthography). The children were assessed for their decoding and comprehension skills. Pseudoword reading was used to evaluate decoding proficiency in each language. Two paragraph-length texts followed by questions were presented to measure children's comprehension performances. The results showed that regarding decoding speed, Turkish subjects at both grades were faster than their American counterparts at the same grade levels. With respect to decoding accuracy, Turkish subjects were found to be more accurate (94.6%) than the Americans (73.2%). Öney and Goldman (1984) noted that the greater regularity of the Turkish language results in high levels of correct decoding by the end of first grade. Based on the speed and accuracy data, the researchers also concluded that the regularity in letter-sound correspondence in the Turkish language seems to facilitate the acquisition of decoding skills. As for the comprehension, overall, comprehension performances in both groups increased over grades. However, Turkish students at the first-grade level were superior to American first graders on the comprehension task. This advantage did not any longer exist at the third-grade level once the influence of decoding proficiency on comprehension got smaller. The findings also displayed a decreased relationship between decoding and comprehension once learners are beyond initial reading.

The 1997 study by Öney and Durgunoğlu is another pioneering research that includes important findings about the association between orthography and early reading acquisition in Turkish. This study also offers insights about how language orthography influences children's PA, decoding and comprehension skills. According to Öney and Durgunoğlu (1997), phonologically transparent orthography in Turkish provides a clear advantage to beginning readers. That is, the invariant one-to-one correspondences between letters and sounds let beginning readers use this knowledge efficiently in word decoding. Consistent with this, the researchers put forward that as word reading accuracy develops relatively quickly and efficiently, the facilitative effects of PA should be found only in the very early stages of literacy development in Turkish. In the study, the researchers tested several reading-related factors such as PA, letter knowledge, syntactic awareness and listening comprehension as well as word and pseudoword recognition, reading comprehension and spelling. The study included Grade 1 children whose literacy development was assessed three times during the year. The researchers came up with a number of important findings. First, based on PA scores, Öney and Durgunoğlu (1997) verified that syllable manipulation is easier than phoneme manipulation in Turkish. Stepwise regression analyses also showed that blending task explained a significant amount of variance in word reading beyond letter identification. In addition, in each of the testing sessions, children's recognition of words and nonwords were strongly correlated, which, according to researchers, reflecting the influence of a transparent orthography. Further, children's performance in word and pseudoword recognition dramatically increased between the testing sessions. This rapid growth suggested that systematic letter-sound correspondences made Turkish children to become efficient decoders and spellers. That is, the researchers found that by the end of first grade, the Turkish children were at ceiling on both decoding and spelling. Congruent with this finding, they suggested that the contribution of PA is limited to the early stages of decoding and spelling. Thanks to the transparency of Turkish orthography, children (including those with lower level of PA abilities) presented a sharp improvement in both decoding and spelling accuracy and are almost perfectly accurate in decoding words and pseudowords by the end of first grade. As for reading comprehension, once children's word recognition performance was high, only proficiency in listening comprehension was identified as a significant predictor. Decoding proficiency measured by accuracy did not play a significant role in reading comprehension. In other words, children's decoding problems did not appear to influence their reading comprehension performance. However, Öney and Durgunoğlu pointed that such a pattern needs to be verified via decoding speed in addition to decoding accuracy.

Despite the transparent nature of the Turkish orthography and its facilitative role in reading development, Turkish speaking children experience difficulty in their handwritings. In one study, diacritic omission (e.g., *arkadas* instead of *arkadaş* 'friend'), grapheme substitution (e.g. *dedeciyim* instead of *dedeciğim* 'grandpa', *kaplunbağa* instead of *kaplumbağa* 'turtle') and grapheme omission errors (e.g., *biti* instead of *bitti* 'finished') were identified as the most common error types. It was also found that soft g errors were very common (e.g., aşada instead of aşağıda 'below') because its phoneme-to-grapheme mapping is challenging for children. The children were also found to confuse a-o, m-n, and e-i pairs in their spellings (Sönmez, 2015).

3.4 Turkish literacy instruction context

With respect to reading and writing education in Turkey, Sound Based Sentence Instruction Method (SBSIM) has been adopted in Turkish primary schools since 2005-2006 educational year. The characteristics of SBSIM have been summarized as follows in the guidebook of Ministry of Education (2005) prepared for Turkish Course instruction program between Grades 1 and 4. In this method, sounds are the starting point for literacy instruction. As certain sounds that can provide meaningful compositions have been presented, students are given syllables, words and sentences that involve those previously learned sounds. Thus, it is claimed that learning proceeds from easy items to difficult ones. The method mainly promotes synthesis technique. Both reading and writing go hand in hand from the beginning of literacy instruction. In other words, a child can read what he/she can write and vice versa.

The method requires the child to actively participate in reading-writing process. It contributes to the child's ability to form novel sentences and to create longer reading passages. Instead of teaching reading with one type of limited number of sentences, SBSIM provides learners with a variety of syllables, sentences and texts, which boosts learners' creativity, thinking abilities and intelligence. Thus, rather than sentence memorization, SBSIM is claimed to require comprehending sentences, which promotes learners' comprehension skills (MEB, 2005). Additionally, because there is one to one correspondence between sounds and letters in Turkish, this method is claimed to be suitable for Turkish sound structures. Learners can recognize the similarities between spoken and written language and realize that writing is composed of letters based on their experience with sounds in the spoken language. In addition, because SBSIM focuses on the sounds that the child hears and articulates, the child will become conscious of the sounds, which, in turn, contributes to his/her overall language development (e.g., correct pronunciation, fluency, separating sounds) (MEB, 2005, p. 232-234). Concerning writing, with the recent changes made by MEB, cursive writing is no longer obligatory in spelling instruction.

According to Akyol and Temur (2008) SBSIM, in essence, helps learners construct new information on the basis of previous knowledge that they own. Before a particular sound is presented, examples from daily life are given to make learners "feel" that sound. In this way, it is also aimed that learners can use their background knowledge about that sound. For example, the sound */a/* should be given in a meaningful context: A teacher can create a surprising event and can make all students feel surprised. All students are expected to express their surprise by saying "aaaaaa" (Akyol & Temur, 2008). After the first sound */a/* has been given, the sound

/l/ can be presented to learners. Akyol and Temur (2008) stated that the teacher does not necessarily use the same imaginary situation but can make use of pictures of objects that include the sound */l/* (e.g. gü*l* [rose], fi*l* [elephant], ba*l* [honey], ke*l*ebek [butterfly]). Another context can be created for this sound and the teacher and the students together can make up a new story focusing on */l/*. Later on, the teacher can give the word "al" (take) that consists of these two sounds. Using the word, "al", students can take and give their pencils, erasers and books to each other to practice the new word. Finally, students can form new sentences by using this word together with visuals (e.g. a picture of a ball).

Studies on SBSIM reported both positive and negative criticisms about the role of SBSIM in the duration that children start reading, children's reading fluency and reading comprehension performances (e.g. Aktürk & Mentiş Taş, 2011; Durukan & Alver, 2008; Tok, Tok, & Mazı, 2008; Yılmaz & Ağırtaş, 2009). According to Güneş (2006), for example, this method helps children become active, creative and productive. In a survey study done by Yurduseven (2007), teachers generally presented positive ideas (on the level of "partially agree") about SBSIM. The teacher participants in the study gave positive opinions about the materials and sources used in the program. In addition, the method was thought to enhance students' active participation. Further, according to the teachers who participated in the study, there were very few students who could not reach the gains at the end of the program. Kayıkçı's (2008) study conducted with 345 first grade teachers and 65 primary education inspectors showed that this method provides some advantages and disadvantages. Based on the teachers' and inspectors' opinions, the result of the study displayed that the program encourages group work activities that improve collaboration among students. Further, with the interactive learning techniques the method was found to offer options and variety that multiple intelligence necessitates. The participants in the study also stated that SBSIM minimizes memorization. On the other hand, both teachers and inspectors stated that first graders experience difficulty in understanding long reading passages and accessing the whole from pieces. The teachers also expressed that children are segmenting syllables incorrectly during reading in this method. Based on a study that evaluates the reading skills of two groups of children who learned reading via different methods, namely SBSIM and Sentence Method, Akyol and Temur (2008) found that there were no differences between the methods in terms of the children' performances in reading comprehension, reading speed and the number of words read in a minute. The researchers also detected similar mistakes (i.e., syllabification, substitutions, insertions, repetition, self-corrections, and omissions) during reading in both groups. Except for insertion, the students in Sentence Method made more mistakes in all types. However, the researchers noted that because the participants were all first graders, such mistakes could be called "sweet mistakes", specific to first grade in the reading acquisition process. Akyol and Temur (2008) stated that as long as students are provided with adequate parental support, a favorable home literacy environment (e.g., buying a daily newspaper or a book that has been recently published) and extra curriculum activities and have self-confidence while reading, they can read successfully regardless of the reading instruction method they are exposed to. Other factors such as parents' level of education, the number of siblings and pre-school education were also found to be influential in reading acquisition in the study. In a meta-analysis study, Baştuğ and Erkuş (2016) reviewed thirty-five SBSIM- related research studies conducted between the years 2005 and 2015. All studies in the analysis displayed that students begin to read more easily and in a shorter period of time in SBSIM. However, whereas 12 studies found SBSIM successful in fostering students' reading speed, 9 studies identified the method as ineffective and emphasized that although it takes a very short time for children to learn how to read in SBSIM, children could not read fluently and rapidly. Additionally, 8 studies (out of 15) that were included in the meta-analysis reported that students who learn reading via SBSIM were not successful enough in reading comprehension, a result, which contradicts with the objectives of MEB (2005). SBSIM was also criticized for forcing children learn italic handwriting which was made optional in 2017-2018 academic year by the Ministry of Education.

Within this literacy instruction context, addressing a wide diversity of variables, this thesis study is expected to shed further light upon how these variables concurrently influence reading skills of second, third, and fourth grade primary school children in Turkish.

This chapter has provided a general overview on the phonological, morphological, and orthographic properties of the Turkish language. It also reviewed the results of some Turkish studies that reported the potential effects of certain Turkish language characteristics on reading. Further, how children are taught literacy skills in Turkey was discussed with specific reference to SBSIM. The next chapter introduces the methodology of the current study, including the research questions, the participants, the setting and the instruments.

CHAPTER 4

METHODOLOGY

This chapter presents: 1) details of the research design including research questions and hypotheses of the current study, 2) detailed descriptions of the participants, 3) setting, 4) data collection instruments, 5) implementation of the measures (procedures), and 6) a brief explanation over statistical data analysis types computed in this study.

4.1 Research design

A cross-sectional research design was adopted to concurrently measure children's performances in alphanumeric RAN, PA, PM, PS, MA, OK and vocabulary as well as the effects of their parents' educational background in relation to reading skills (i.e., word reading fluency and reading comprehension). This study design provided the researcher with an opportunity to compare different sample population groups (Grades 2 and 4 in this study) at one point in time. It also allowed the researcher to measure multiple variables at the same time.

4.2 Research questions and hypotheses

The current study is primarily concerned with the role of alphanumeric RAN, PA, PM, MA, OK, PS, vocabulary, and Parents' Education Level in word-level reading fluency and reading comprehension performances of children in Grades 2 and 4 in Turkish, a transparent orthography. Additionally, this study was intended to investigate the possible interrelations between the independent variables (viz., OK in relation to PS, PA, and alphanumeric RAN and Vocabulary in relation to Parents' Education Level, MA, and PA) and how such interconnections mediated the relationship between dependent and independent variables.

Accordingly, this study attempts to answer the following questions:

1. To what extent do RAN, Phonological Awareness, Phonological Short-Term Memory, Morphological Awareness, Orthographic Knowledge, Processing Speed, Vocabulary and Parents' Education Level together and/or independently contribute to word-level reading fluency? Do these contributions remain the same across grades?
2. To what extent do RAN, Morphological Awareness, Processing Speed, Vocabulary, Parents' Education Level, and WRE together and/or independently contribute to reading comprehension? Do these contributions remain the same across grades?

On the basis of the research questions above the following hypotheses were assumed:

1. With regard to word reading fluency, it was assumed that alphanumeric RAN, the ability to access familiar visual symbols rapidly (i.e., numbers and letters in this study), would make a direct and independent contribution and increase children's word-level reading fluency irrespective of children's grade levels. (Albuquerque, 2017; Georgiou et al., 2008c; Kirby et al., 2010). RAN was expected to be the strongest and the most consistent correlate and predictor of word fluency in Turkish. Further, taking the extreme transparency of the Turkish language and the nature of the reading measures (word fluency tasks) administered in the study into consideration, PA was not assumed to have a direct and independent

influence on children’s word-level reading speed in Grade 2 and 4; as children in these grades should already gain more reading experience in a transparent orthography (Turkish) (Babayiğit & Stainthorp, 2007; Öney & Durgunoğlu, 1997; Vaessen et al., 2010). As in the case of PA, it was further presumed that, children’s grade level and phonological characteristics of Turkish orthography would mediate the relationship between PM and word reading fluency. That is, the influence of PM on children’s word reading speed would not be observed in Grades 2 and 4 because children in these grades should already practice grapheme-phoneme correspondence rules in Turkish, which has a highly consistent orthography. The high consistency between graphemes and phonemes was expected to ease the burden on phonological short-term memory during reading in these grades. Furthermore, processing of larger units (i.e., morphemes rather than letters) provides readers with recognizing words more rapidly (Kirby et al., 2012). Thus, children’s awareness in morphology was thought to increase their performance in word reading speed, particularly in Turkish, a language with rich morphology (Carlisle, 1995; Deacon & Kirby, 2004). Additionally, in the literature, OK, or one’s sensitivity to the patterns in written language, has been consistently identified as an essential predictor, explaining considerable amount of variance in word reading (Barker et al., 1992; Cunningham & Stanovich, 1991; Deacon, 2012). Accordingly, readers with better OK were expected to display better performances in word-level reading fluency. It was also hypothesized that participants with increased processing speed would read words more fluently in comparison with those who have slower speed of processing (Christopher et al., 2012; Kail & Hall, 1994). In addition, children’s vocabulary knowledge was expected to increase their fluency in word reading. Further, background variables such as parental educational level that children bring to the educational setting may lead to individual differences more than other factors (Jehangir, et al., 2015). Accordingly, the children with high parental education level were presumed to outperform the children with low parent education level in word-reading speed. It was also assumed that alphanumeric RAN, PS, and PA would have indirect effects on word fluency through OK. That is, PA was assumed to explain a significant amount of variance in OK because PA helps children form letter patterns (Adams, 1990). Likewise, PS was presumed to explain a significant amount of variance in OK as it reflects a global mechanism that is responsible for the efficiency of cognitive processes, in line with Kail and Hall (1994) and Cutting and Denckla (2001). Further, a close link between alphanumeric RAN and OK was expected because fast naming speed (particularly of letters) facilitates the recognition and storage of orthographic patterns in printed words. (Loveall et al., 2013). However, RAN's influence of OK would disappear after PS would be taken into account (Cutting & Denckla, 2001). Additionally, RAN was expected to be correlated with PA and PM due to its phonologically based features (Torgesen et al., 1997).

2. Concerning reading comprehension, it was hypothesized that word-reading fluency would be a powerful predictor of reading comprehension in both grades as fluent recognition of words frees cognitive capacity for higher order processes of comprehension (de Jong & van der Leij, 2002; LaBerg & Samuels, 1974; Perfetti, 2007; Protopapas et al., 2007). Additionally, it was hypothesized that children with high MA would present better performances in reading comprehension as high MA helps children build meaning from the reading passage and make more accurate and efficient decisions on the meanings and

syntactic functions of unfamiliar or derived words within the reading text (Carlisle, 1995; Deacon & Kirby, 2004). That is, young readers with better MA should be more skillful at analyzing meaning in morphologically complex words, which, in turn, brings considerable advantages to the understanding of the whole text (Levesque et al., 2017), especially in an agglutinative language such as Turkish in which words are usually long and multisyllabic and are composed of suffixes. In addition, children with poor vocabulary are challenged by understanding written texts (Joshi, 2003). Accordingly, children's expressive vocabulary knowledge was assumed to aid their reading comprehension in Turkish (e.g., Babayiğit & Stainthorp, 2013; Cunningham & Stanovich, 1997; Nation & Snowling, 2004; Perfetti & Stafura, 2014; Verhoeven et al, 2011). Besides, it has been indicated that how quickly a person could process visual information influences comprehension through word fluency (Catts et al., 2002; Christopher et al., 2012; Kail & Hall, 1994). Accordingly, PS was expected to make an indirect contribution to children's reading comprehension in both grades via word reading fluency. Likewise, rapid naming of letters and numbers were presumed to play an indirect role in reading comprehension through word reading fluency. Finally, the children with high parental education were presumed to surpass the children with low parental education in reading comprehension scores (Chall & Jacobs, 2003). On the other hand, it was not expected that alphanumeric RAN would make direct contributions to reading comprehension. Rather, its effect would be mediated by word reading fluency. In addition, it was anticipated that the influences of PA, MA, and level of parental education on reading comprehension would be mediated by Vocabulary (Chall & Jacobs, 2003; Green, 2009; Hart & Rinsley, 1995; McBride et al., 2007; Metsela, 1999).

4.3 Participants

Participants were 100 primary school children (49 boys, 43 girls) in Grade 2 and 4 from two public schools in urban school district in Ordu, a Black Sea Region city in the north of Turkey. Eight participants were identified as outliers and excluded from the analysis. Therefore, the sample size was reduced to 92. This sample size is in line with Field (2005) who suggested, as a rule of thumb, that researchers should target at least 15 subjects per predictor to come up with a reliable regression model. The participants in the study were selected among those who were accessible and agreed to collaborate with. All children speak Turkish as their mother tongue. The age of the participants ranged from 7;1 to 10;8 years (M= 8;7, SD=1.13). All of the participants were receiving reading instruction typical for Turkish children. Further, none of the participants had previously been diagnosed with emotional, behavioral and sensory deficits (e.g., uncorrected hearing or vision problems), or IQ problems. The students were attending regular classrooms in an elementary school. None of the children received any special education services nor had they repeated any grade. Permission consent was obtained from Ordu Ministry of Education, school directorate, parents/guardians and each participant. This study evaluates the performances of children in Grade 2 and Grade 4 because important changes in the cognitive dynamics of both reading accuracy and speed have been reported in these grades (Vaessen & Blomert, 2010). In other words, Grade 2 and 4 reflect a period when word identification skills are undergoing rapid development and orthographic skills are well-developed in many children by this age. Table 4 reports the participants' demographic information including the number of females and males by grade level and the means and standard deviations for students' ages.

Table 4. Participant Demographics

Grade	Gender		Age (Months) $\bar{x}$	SD
2	Male	25 (51%)		
	Female	24 (49%)		
	Total	49	7;7	.33
4	Male	24 (55.8%)		
	Female	19 (44.2%)		
	Total	43	9;8	.38

The educational backgrounds of the participants' parents were obtained from the school system with the permission of the parents and the school administration. Parents' level of education, i.e., Mother Education Level or Father Education Level, was used as an index for the SES variable in the current study because it is regarded as one of the most robust components of SES (Sirin, 2005). In the current study, parental education level was formed based on the parents' years of formal education. As demonstrated in Table 5, the percentage of Mothers with primary school was higher than other levels in Grade 2. The fathers in Grade 2 were mostly high school graduates. In Grade 4, the highest percentage in level of education appeared in high school for both fathers and mothers.

Table 5. Parental Education Background

Level of Education	Overall		2nd Grade		4th Grade	
	Mother N=92 %	Father N=92 %	Mother N=49 %	Father N=49 %	Mother N=43 %	Father N=43 %
Primary School	22.8	20.7	26.5	24.5	18.6	16.3
Secondary School	16.3	6.5	20.4	8.2	11.6	4.7
High School	39.1	46.7	24.5	36.7	55.8	58.1
College	12.0	5.4	20.4	10.2	2.3	--
University	9.8	20.7	8.2	20.4	11.6	20.9

4.4 The study setting

Two state schools in Ordu were chosen as sample schools in the study. Although these two schools are located in the city center and are not very far from each other (2km), they have different SES backgrounds. The first school is a very popular primary school in Ordu. Accordingly, the students in this school were in general coming from socioeconomically (in terms of income, education and occupations) high-income families. Parent education level for this school varied from primary school to two or more years of college. On the other hand, students in the second school generally belong to low-income families. The level of parent education ranged from illiterate to high school at most. The mothers were either a housewife or a laborer. Similarly, the fathers were laborers in this group.

4.5 Data collection instruments

Multiple measures were used to assess children's cognitive and linguistic abilities in the study. These tests include Test of Word Reading Efficiency in Turkish (Türkçe'de Kelime Okuma Bilgisi Testi [KOBIT], Babür, Haznedar, Erçetin, Özerman & Erdat-Çekerek, 2013), Turkish version of Woodcock Johnson Reading Comprehension Test, Test of Phonological Awareness Skills Screener (Fonolojik Farkındalık Tarama Testi [FFTT], Babür, Çekerek, Erçetin, Haznedar, Müderrisoğlu), Turkish naming speed (Hızlı Otomatik İsimlendirme [HOTI], Bakır & Babür, 2009), Turkish Comprehensive Test of Phonological Processing Phonological Memory Nonword Repetition Subtest (Kapsamlı Fonolojik Farkındalık Testleri [KFFT] Sessel hafıza anlamsız sözcük tekrarı alt testi; Babür, Haznedar, Erçetin, Özerman & Erdat-Çekerek, 2013), the Wechsler Intelligence Scale for Children (Wechsler Çocuklar İçin Zeka Ölçeği [WISC-R Turkish] translated and adapted to Turkish by Savaşır and Şahin, 1995) WISC-R Phonological Memory Digit Span Subtest, WISC-R Vocabulary Knowledge Subtest, WISC-R Processing Speed Subtest and tests for MA and OK developed by Kuzucu Örge (2015). A brief explanation for each of these measures is given below.

4.5.1 Turkish test of word reading efficiency (KOBIT)

Kelime Okuma Bilgisi Testi (KOBIT) developed by Babür et al. (2013) was administered to examine children's ability to decode isolated words of varying difficulty. It is a reliable and valid measure of word reading accuracy and fluency which are prerequisites for reading proficiency in Turkish. The items included in the tests were harmonious with the characteristics of Turkish phonology and grammatical structure. It is also useful for the diagnosis of reading difficulties in older children and young adults. KOBIT is composed of two subtests: Sight-Word Efficiency (SWE) and Phonemic Decoding Efficiency (PDE).

Sight-word efficiency (SWE)

This task is a measure of speeded reading of real words printed in vertical lists. It assesses the number of real words that the examinee can accurately identify within 60 seconds. The examinee is presented with a list of 104 real words, which are arranged in order of increasing difficulty and asked to read them as quickly as possible within one minute. The examinee is provided with practice items prior to the test. Whereas frequent and short words such as *bir* [one] are set at the beginning of the test, less frequent multisyllabic words such as *gerçekleştirilmemiş* [unrealized] are placed through the end of the test. The total score is the number of words that are correctly read in 60 seconds.

Phonemic decoding efficiency (PDE)

PDE is comprised of pronounceable printed pseudowords that are in accordance with phonological, orthographic and morphological characteristics of Turkish. Nonword-reading speed is widely considered a measure that reflects the automaticity of essential phonics and blending skills and is usually strongly correlated with word-recognition skills (Torgesen, Wagner, & Rashotte, 1999). As in SWE, the PDE test includes 63 items that are ordered in level of increasing difficulty (e.g. ge, siltarsa, cübürücümakala). Before the test begins, the examinee is given practice words to make him or her familiarize with the task. Then, the examinee is required to decode nonwords accurately and quickly within 60 seconds. The examinee's score is the total number of words accurately read within one minute.

4.5.2 Turkish reading comprehension test

This test was developed by Haznedar, Babür and Erçetin. It evaluates the child's understanding of what was read. The child starts with reading a sentence and continues with reading paragraphs that get longer as the child proceeds. The child is expected to read each test item silently and then answer the following comprehension question related to that passage. There is no time limitation for the test. The highest score for this test is 35. The total score is the number of correct answer given for each question.

4.5.3 Turkish phonological awareness skills screener (FFTT)

Blending, rhyme production, segmenting and elision subtests from the test of Fonolojik Farkındalık Tarama Testi (Phonological Awareness Skills Screener) which was originally developed by Mather in collaboration with Podhajski, Rhein and Babur and adapted to Turkish by Babür were implemented to measure phonological abilities of the participants.

Blending (FFTT)

This task measures the child's ability to combine sounds to make a whole word. The subtest includes training items followed by 16 test items which are arranged in order of difficulty (e.g., a-t [horse], g-ö-l [lake], ç-a-b-u-k [quick]). For example, the child is prompted to merge the sounds in *m-a-s-a*. The correct response is *masa* [table]. The administrator ceases giving feedback after the first three test items. The testing is terminated after three consecutive errors. The total number of correct answers becomes the child's score for this subtest.

Rhyme production (FFTT)

In this task, the child is provided with a word as a test item and expected to produce another word that rhymes with the target word (e.g., *yat*-*kat*). For instance, the examinee is presented with the word, *baş* [head] and is required to produce another word such as *kaş* [eyebrow] rhyming with the test item. The subtest includes 10 items that are preceded by practice items. The administration is finished when the examinee makes three subsequent errors. The total number of correct responses is the child's score for this subtest.

Phoneme segmentation- Real words (FFTT)

This subtest was administered in order to assess the participants' ability to segment words into phonemes. This 10-item subtest requires that the examinee repeat a word and then segment it into its sounds. For example, the administrator prompts the examinee with "Say *'yazı'* [writing]. *Now say 'yazı' one sound at a time."y*-*a*-*z*-*ı"* is the expected answer. Similar to other subtests, feedback is provided for the practice and the first three test items. The administrator finishes the testing after three consecutive errors. The total raw score is the total number of correct test items.

Phoneme segmentation- Nonwords (FFTT)

In this subtest the examinee is asked to divide pseudowords into individual sounds. The task includes 4 training and 10 test items. The examinee, for instance, is given the nonword, *rin*. He or she is then asked to separate it into its phonemes as in the following: Say "*rin". Now say rin one sound at a time? r*-*i*-*n* is the correct answer. The task is stopped when the examinee misses three subsequent test items.

Syllable deletion (FFTT)

This subtest was administered in order to assess the participants' ability to delete syllables within words. The task consists of 10 test items preceded by 4 training items. Feedback is supplied after all practice items. The administrator first says the word, and asks the examinee to repeat the word again. Then, the administrator asks him or her to remove the syllable in the initial or final position. For example, the examinee is prompted, "Say *resim* [picture]. Now say it without saying *re*". The correct response is *sim*. As in other subtests, the test is finished when the examinee makes 3 consecutive errors. The examinee's raw score is the total number of correct responses.

Phoneme deletion (FFTT)

This subtest includes 10 items that measure the extent to which the examinee can delete target phonemes within words in Turkish. It has 4 training items. The administrator first says the word, and then asks the examinee to repeat the word. Next, the administrator asks the examinee to say the word again, with one of the phonemes taken away from the beginning or end of the word. For example, the examinee is instructed, "Say 'nal' [horseshoe]. Now say 'nal' without /n/. The expected response is al. Feedback is provided for all the practice and the first three test items. Administration is discontinued when the child makes three consecutive errors. The total raw score is the total number of correct test items produced by the examinee.

4.5.4 Phonological memory tests

Two measures were administered to test the children's performance of phonological short-term memory: Memory for Digits from WISC-R Turkish and Nonword Repetition from Kapsamlı Fonotik Farkındalık Testi ([KFFT], Turkish Comprehensive Test of Phonological Awareness) developed by Babür et al. (2013) in Turkish.

Memory for digits (WISC-R Turkish)

Memory for digits applied in this study is one of the subtests of WISC-R Turkish. This 16-item task measures the child's ability to repeat back a series of numbers in correct order immediately after they hear the target numbers. For example, the examinee is provided with a series of digits (e.g., "9, 7, 4"), and expected to immediately repeat them back in the same order. If the child achieves this, he or she is given a longer list (e.g., "3, 1, 4, 7"). 1 point is given for each test item that is repeated without error. The testing is finished after the examinee misses three test trials in a row.

Nonword repetition (KFFT)

This is a subtest of a standardized measure (i.e., KFFT) that assesses the examinee's performance in single and multi-syllable pseudowords repetition (e.g., kun, cum, şildekmaska). The test involves 3 practice and 18 test items, which are phonologically and orthographically legitimate or plausible in Turkish. That is, each test item was produced in accordance with the phonological and orthographic characteristics of the Turkish language. The examinee is prompted with a nonword and asked to repeat it immediately after he or she hears it. The administration is discontinued after the examinee makes three subsequent errors. The total raw score is the number of items repeated correctly.

4.5.5 Turkish RAN tests (HOTI)

Hızlı Otomatik İsimlendirme Testleri (HOTI) in Turkish were created by Bakır and Babür (2009). The child perceives familiar visual symbols such as objects, pictures, colors, letters or digits and is expected to retrieve the name for the target item as rapidly and accurately as possible. RAN letter and number subtests were used in this study.

Rapid digit naming (HOTI)

Rapid Digit Naming measures the child’s ability to name digits rapidly. During the test, the child is asked to name a series of 50 items presented as 5 rows with 10 items per row from left to right. The child is prompted to read aloud the rows as fast and accurately as possible. The test is composed of the numbers, 2, 4, 6, 7, and 9. Training items are provided prior to the test to guarantee that the examinee is capable of recognizing test items. If he or she cannot identify the practice items, the subtest is not applied. A stopwatch is used to keep timing. The score for this subtest is the number of seconds that it takes the examinee to name all of the numbers on the card.

Rapid letter naming (HOTI)

As in Rapid Digit Naming, the task of Rapid Letter Naming evaluates how fast the examinee can orally name a serial array of letters. This subtest includes frequent lowercase letters such as *b, k, s, m, t,* which are randomly placed in five rows. The examinee is encouraged to name the stimuli as quickly and correctly as possible.

Children who are not capable of identifying the letters in the practice section are not administered the test. Timing is started as soon as the examinee pronounces the first letter. It is halted when the examinee utters the last test item. All response times and errors are recorded. As in Rapid Digit Naming, the number of seconds that it takes the examinee to label all of the letters on the card is saved as the total score of this subtest.

4.5.6 Test of vocabulary knowledge (WISC-R Turkish)

Vocabulary was measured using the vocabulary subtest of the WISC-R Turkish (1995). This subtest is a measure of expressive vocabulary in which children are asked to verbally define words (e.g., *"tavşan" ne demek?* [What does "rabbit" mean?]). There are 34 words in the test. The test is stopped when the examinee is unable to utter definitions for five consecutive test items. The administrator assesses the examinee's definitions on the basis of a standardized answer key. The examinee's score is the total number of words that he or she defines correctly.

4.5.7 Test of processing speed- Coding (WISC-R Turkish)

Coding, a core speed of processing subtest of WISC-R Turkish (1995), was administered to measure how quickly a child is able to perform a cognitive task under time pressure. More specifically, Processing Speed-Coding (PS-coding) measures visual-motor dexterity, associative nonverbal learning as well as nonverbal short-term memory. Motor dexterity, speed, accuracy and the ability to use a pencil affect success in this task. The test has two formats for the children above and below the age of 8. For children above 8, a key is presented before the practice and test items. The key entails boxes where a numeral in the top line and a symbol in the bottom line are placed. There are 9 numbers and 9 symbols under each number. The examinee must write the correct symbol corresponding to each numeral in 120 seconds. The child is given 1 point for each correctly matched answer. The highest score is 50 for this task. For children below 8, the test has a key in the first line. The key includes 5 shapes (e.g., a star, a triangle and a square) in which a sign such as a circle, plus or minus is located. The child is expected to put the correct sings within the shapes in 120 seconds so that they match the key. 93 is the highest score in this format. The examinee does some practice before the test begins in both formats.

4.5.8 Test of morphological awareness

The participants' awareness of morphemes was measured by an unstandardized test that was developed by Kuzucu Örge (2015). This test includes 23 items that assess the examinee's awareness in both inflectional and derivational morphology. Regarding inflections, the test measures both nominal inflectional suffixes and verbal inflectional suffixes. Nominal inflectional suffixes entails possessive pronouns, singular and plural suffixes, comparative suffixes, nouns with dative, accusative, locative and ablative. Verbal inflectional suffixes are possessive pronouns and tense suffixes. During the test, the examiner verbalizes two sentences (e.g., *Kuş uçuyor* vs **Kuşta uçuyor*.) and asks the examinee to choose the one with the correct suffix. As for derivational morphemes, the examinee is orally provided with a context (e.g., Ablamın çok fazla *palemleri* var. *Palemleri* koyduğu yere ne denir?) that includes a pseudoword. The examinee is expected to choose the pseudoword including the correct derivational suffix (*palemci* versus *palemlik. Palemlik* is the correct answer.). The aim of using pseudowords in derivatial MA test is to test the examinee's morphemic capacity rather than measuring his/her vocabulary skills. Kuzucu Örge

(2015) pointed that the derivational suffixes that were measured in the task were chosen from the study of Karadağ and Kurudayıoğlu (2010), which shows frequently used derivational suffixes in each grade. Overall, the MA test was reported to have a very strong reliability (α=.88). To be more specific, Kuzucu Örge (2015) found that the values of Cronbach Alpha were .61 in derivational awareness and .87 in inflectional awareness.

4.5.9 Test of orthographic knowledge

This test was developed by Kuzucu Örge (2015) and designed to measure the child's knowledge of conventional spelling patterns. It involves 27 test items. In this task each test item involves a real word and a nonsense alternative. Such orthographic knowledge is identified as *Word-specific orthographic knowledge* by Loveall et al. (2013). During the task, the child is presented with two letter strings that sound alike (e.g., *tapak* vs *tabak)* and is expected to pick the word with the correct spelling. Subsequent to three practice trials, the child receives test items on paper and is required to circle the correct option. The test items include phonologically confused Turkish letters like k-g, b-p (e.g., *atkı* vs **atgı* [scarf]. There are also test items that measure the child's orthographic awareness in words whose pronunciation differ from their spellings (e.g., *spor* vs **sipor* [spor], *kaplumbağa* vs **kaplumba* [turtle], *aile* vs **ayile* [family]). The child's score is the number of items responded correctly. The reliability of the test was reported to be very high (Cronbach α= .90).

Figure 3 below presents an overview of the measures used for this study.

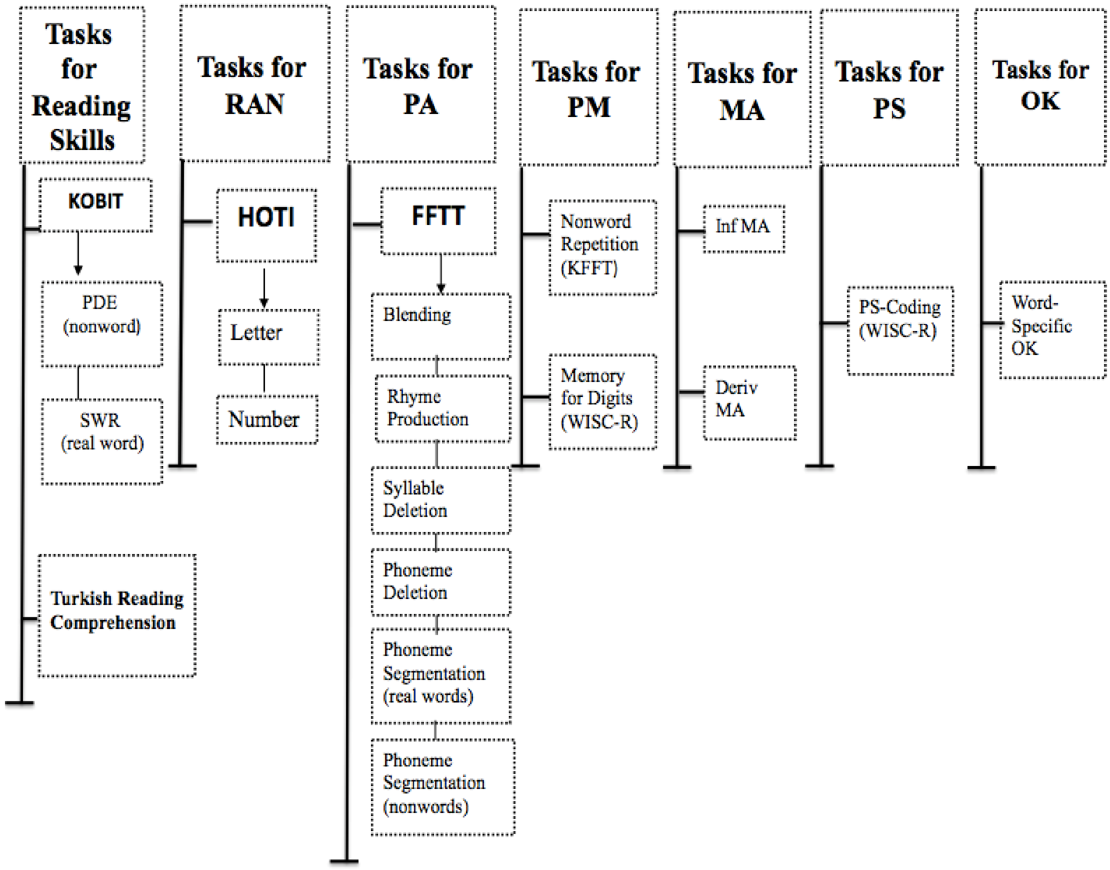

Figure 3. Tasks used in the study

4.6 Procedure

All the tasks were carried out in the second semester of 2015-2016 academic year. Before the tests were implemented, permission from Ordu Ministry of Education, school administrations as well as children's parents was taken (see Appendix A for an example of the consent form). The tests were administered to all participants over a period of 8 weeks in three sessions. The participants first took KOBIT, HOTI and FFTT subtests. They were then administered Memory for Digits, Nonword Repetition, subtests of WISC-R for speed of processing and vocabulary, Turkish test of morpheme awareness and of orthographic awareness. Finally, Turkish reading comprehension test was applied. Each session took about 30 minutes. It is important to note that in the sessions where multiple tasks were implemented, the order of the subtests was randomized for each participant so as to mitigate the influence of mental or physical fatigue on the participant' responses. All tests were individually conducted and hand scored. Because the school administrations and parents gave their consent, the participant's responses were recorded with a laptop camera and a recorder during the testing session.

All children took the tests during the school day. The thesis investigator and an examiner carried out the data collection. Before the testing began, the examiner had taken comprehensive training for the application of the task so as to achieve uniformity in test administration. All collaborative teachers were informed before the testing and given a list of children who would receive the tests. The teachers introduced the researchers to the class, thereby making the children acquainted and comfortable with them. Following this, each child was taken out of the classroom and completed the tests in a quiet room in the school. Prior to testing, oral assent was also taken from each child. All children were provided with the same instruction and given practice trials prior to each testing session. During the practice, they received feedback and were permitted to ask questions about the tasks. After all data collection was completed, the thesis investigator transcribed the data and entered the scores of each task for each child to SPSS.

4.7 Statistical analysis

The relative roles of multiple variables (i.e., alphanumeric RAN, PA, PM, MA, OK, Vocabulary and SES) in Turkish reading were statistically analyzed by utilizing SPSS 22.0. All statistical tests were assessed by means of an alpha level of .10 if not otherwise specified. Because the study was intended to be exploratory in nature, a more liberal and inclusive alpha value was adopted in order not to exclude any potentially useful relationships, as proposed by Babür (2003).

Preliminary analyses were performed to ensure there was no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity in the data set (N= 100). Because the number of participants in each grade was below 50, the Shapiro-Wilk test was used to interpret the results of normality test. The results indicated that the variables, WRE, SWR, PDE, PM, PS, and Vocabulary were normally distributed whereas the remaining variables, i.e., alphanumeric RAN, PA, MA, and OK were not normally distributed. For the variables that did not show normality, the raw scores were z-transformed to ensure normality. Further, an examination of correlations revealed that no independent variables were highly correlated. The collinearity statistics (i.e., Tolerance and VIF) were all within accepted limits, meeting the assumption of multicollinearity. The Mahalanobis' distance statistics checked the data for outliers and depicted eight outliers greater than 10. These outliers were excluded from the analyses. Residual and scatter plots indicated the assumptions of normality, linearity and homoscedasticity were all satisfied. In addition, the performances of girls and boys in all subtests were compared by means of Independent Samples *t* Test to evaluate if gender is a potential variable influencing dependent variables. The results indicated that there were no statistically significant differences between the mean scores that girls and boys had in each task. Therefore, the data from girls and boys merged and used together.

Descriptive statistics were gained for Grade 2 and Grade 4 across all variables. Then, the means of the two grade levels were compared via Independent Samples *t* Test in order to determine whether the observed differences in the mean scores yielded statistically significant results. The results were reported in the descriptive statistics section.

Following this, Pearson r correlation and a set of multiple regression analyses as part of a classical path analysis were computed based on the data collected from 92 primary school children in Grades 2 and 4 in order to answer the research questions in the current study. More specifically, Pearson r correlation was applied to measure the degree of the relationship between the related variables. Multiple regression analyses were carried out so as to learn more about the relationship between several IVs and the DVs. The general purpose of multiple regression is to determine how well IVs predict or explain the DV either singly or in combination. Regardless of whether multiple regression is being conducted for predictive or explanatory purposes, there is usually interest in finding out the degree to which each IV contributes to successful predictions or valid explanations by examining standardized beta weights (β) (Huck, 2012). In this way, the researcher determines which IV is a stronger predictor of the DV. Different types of multiple regression exist. Simultaneous multiple regression in which the data associated with all IVs are entered into the equation at the same time were computed for path analysis. In this kind of regression analysis, an IV might fail to yield a significant contribution to explaining variance in the DV although it is highly correlated with the DV. In this case, the researcher should keep in mind that other IVs reduce the unique contribution of that IV. Therefore, when interpreting the results of the regression analysis, both the full correlation and the unique contribution of the IV should be taken into account (Tabachnick & Fidell, 2001). Furthermore, because of the extended overlaps among variables and in order not to miss important relationships, the alpha level was selected .10 in the current study (e.g., Babür, 2003).

Simultaneous multiple regression analyses formed the basis for classical path analysis. The regression analyses were conducted for each grade to examine how much unique and/or shared variance each independent variable explains in the dependent variables. Path coefficients (beta weights) for each grade were examined to determine the appropriateness of the proposed path model (see Figure 2 on p. 162) and to show the potential direct and indirect (mediating) effects of the IVs on the DVs. Finally, the proposed model was modified to indicate the magnitude and significance of the relationships in each grade. Classical path analysis and its rationale will be thoroughly discussed in the upcoming section. Prior to conducing multiple regression and path analyses, the relevant assumptions of these statistical analyses were tested. The following subsections gives the details of classical path analysis.

4.7.1 Definition of classical path analysis

One of the concerns of this thesis study is to see if multiple variables influencing word reading fluency and reading comprehension are the same across grade levels (in Grade 2 and Grade 4) and how these variables (either directly or indirectly, or both) account for these dependent variables. Because the number of participants for each grade is inadequate for structural equation modeling (SEM), a classical path analysis using multiple regression was computed in order to achieve this aim. Classical path analysis allows the testing of individual path coefficients with small sample sizes (Babür, 2003). That is to say, after conducting Pearson correlations and defining the intercorrelations among the variables, the appropriateness of the proposed path models (see Figure 2 on p. 162) which depicted the hypothesized direct and indirect influence of each variable was tested via multiple regression analyses. The path lines in the path diagram shows the effect of each IV. The strength of those paths were examined via computing a set of multiple regression analyses. At this point, it is important to give detail explanation of this type of path analysis to better make sense of the logic behind it.

Acting as an extension of multiple regression, classical path analysis is applied to understand and assess the effects of a set of variables on a specified outcome via multiple causal pathways. Further, this statistical method can effectively distinguish direct from indirect effects and test the strength of hypothesized patterns of causal relationships. Herein, it is important to emphasize that path analysis is utilized "not to discover causes but to shed light on the tenability of the casual models a researcher formulates based on knowledge and theoretical considerations" (Pedhazur, 1997, p. 770).

Because the relationships among variables are statistically calculated by a series of structured linear regression equations, path analysis is bound by the same set of assumptions as linear regression along with additional restrictions that describe the allowable pattern of relations among variables.

The path diagram graphically displays the hypothesized pattern of causal relations among a set of variables. The causal flow depicted in the diagram is unidirectional rather than reciprocal. The variables included in the model can be both exogenous (a variable whose variation is assumed to be determined by causes outside the hypothesized model) and endogenous (a variable whose variation is explained by exogenous or other endogenous variables in the model). The researcher does not attempt to explain the variability of an exogenous variable or its relations with other exogenous variables but can show the correlation between them by a curved (or straight) double-headed arrow, indicating that the researcher does not conceive of one variable being a cause of the other. Causal relationships between variables are depicted with a single-headed straight arrow that show the direction of the effect (Pedhazur, 1997).

The path coefficients in the path diagrams (i.e., standardized beta weights from multiple regression analysis) indicate the direct effect of a variable (i.e., IV) hypothesized as a cause of a variable taken as an effect (i.e., DV) (Pedhazur, 1997). These standardized beta weights (β) are then used to calculate indirect effects. Finally, the information about direct and indirect are combined to calculate the total effects. A detail explanation about direct and indirect effect calculation is presented in the following subsection.

4.7.1.1 Direct and indirect effect calculation rule (Path tracing or Path decomposition)

The direct effect in classical path analysis can be defined as the effect that a given variable has on another variable without mediation by other variables. The indirect effect refers to the part of the effect of a variable that is mediated by at least one additional variable. The total effect reveals the sum of the direct and indirect effects (Pedhazur & Schmelkin, 1991). Figure 4 illustrates an example of how direct and indirect effects are shown in a path diagram using path coefficients. As can be seen in Figure 4, both X_1 and X_2 have direct effects on Y. These direct effect are not moderated by another variable in the model. It should, however, be noted that X_1 also has an indirect effect on Y via X_2. The effect of X_1 on Y is mediated or facilitated by X_2. Table 6 displays the calculation of direct, indirect, and total effects of the variables in a path diagram (see Table 6).

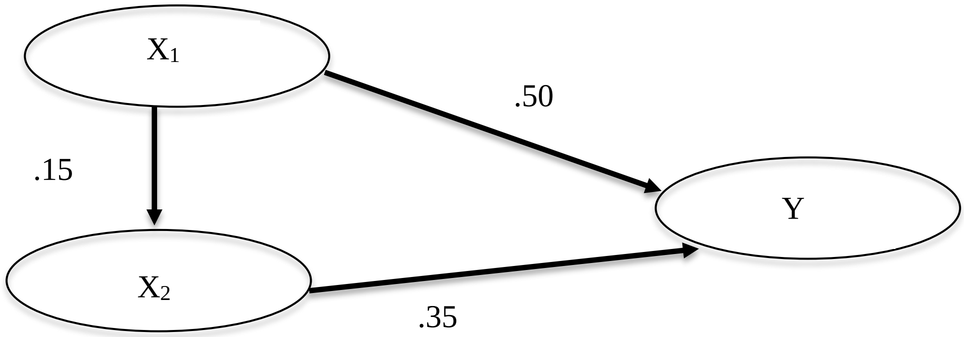

Figure 4. Direct and indirect effects in a path model[2]

Example:

$X_1 \rightarrow Y$ = .50 (direct effect of X_1 on Y)

$X_2 \rightarrow Y$ = .35 (direct effect of X_2 on Y)

$X_1 \rightarrow X_2$ = .15 (direct effect of X_1 on X_2)

$X_1 \rightarrow X_2 \rightarrow$ Y is .15 (.35) = .052 (indirect effect of X_1 on Y through X_2)

Table 6. Calculations of Direct and Indirect Effects in a Path Diagram

	Direct effect	Indirect effect	Total effect
X_1	.50	(.15) (.35)= .052	.50+.052= .552
X_2	.35	--	.35

[2] This diagram was drawn based on the example given in Babür (2003).

CHAPTER 5

RESULTS

This chapter is designed around the research questions and reports the results of correlation, multiple regression and path analyses based on the data gathered from the students in Grade 2 and 4. Simultaneous multiple regression analyses were conducted to examine the unique and shared contribution of each variable to word-level reading fluency and reading comprehension. In addition, because alphanumeric RAN, PA, PM, MA, PS, OK, parents' education level (Mother Education Level or Father Education Level) and vocabulary are often identified as significant predictors of word reading fluency and of comprehension, path analyses were conducted to explore whether these skills have direct or indirect effects on word reading fluency and comprehension.

Descriptive statistics for the measures administered are first reported to provide a general picture of children's performance on the tasks. Following this, correlations among all variables were given with respect to the first research question. Simultaneous regression analyses results were then presented followed by path analyses results to answer the remaining research questions.

Descriptive statistics for each grade are given in Table 7 below. The table presents the means and standard deviations for the key measures as well as the minimum and maximum scores that show the range of responses for each measure. All of the scores are presented as raw scores.

Table 7. Descriptive Statistics for Grade 2 and Grade 4

Tasks	Grade 2 (n= 49) M	SD	Min	Max	Grade 4 (n= 43) M	SD	Min	Max
WRE (KOBIT Composite)	70.48	22.84	21	113	82.02	24.16	26	124
SWR (real word)	45.53	14.81	13	77	53.55	15.61	15	78
PDE (nonword)	24.95	8.64	8	38	28.46	8.97	9	46
COMP	21.68	3.23	15	27	24.86	2.95	17	30
RAN (Composite)	57.36	9.11	42	73	47.67	7.62	34	67
PA (Composite)	49.59	12.37	19	64	53.23	7.70	33	65
PM (Composite)	18.22	3.78	9	27	19.32	3.73	12	28
MA (Composite)	19.91	2.47	13	23	21.13	2.54	13	23
OK	23.26	3.34	15	27	24.74	2.21	19	27
PS	35.18	8.43	19	49	42.09	10.08	18	63
VOCAB	29.14	9.82	10	51	37.90	6.78	23	49

Note. WRE= Word Reading Efficiency (Composite), SWR= Sight Word Reading, PDE= Phonemic Decoding Efficiency, COMP= Comprehension, RAN= Rapid-automatized Naming (Composite), PA= Phonological Awareness (Composite), PM= Phonological Memory (Composite), MA= Morphological Awareness (Composite), OK= Orthographic Knowledge, PS= Processing Speed, VOCAB= Vocabulary Knowledge

As seen, Table 7 includes the means of both composite and subtests scores (i.e., real word reading and nonword reading) of word reading fluency. For other variables which have subtests, the means of composite scores are provided. The composite scores for word reading fluency, alphanumeric RAN, PA, PM and MA were calculated by merging the subtests of each target task.

Overall, descriptive statistics revealed that fourth graders outperformed second graders in both reading measures as well as in all cognitive and linguistic tasks. More specifically, regarding overall word reading performance, children scored a mean of 70.48 (out of 168) in Grade 2 whereas the mean scores of Grade 4 was 82.02 for word reading fluency. On the comprehension task (out of 35), the mean number of correct responses was 21.68 for Grade 2. The mean score in comprehension was 24.86 for Grade 4. Concerning overall RAN performance, Grade 2 children appeared to be slower in processing visual stimuli than Grade 4 children (*M*=57.36 *vs.* 47.67). As for the overall performances in PA (out of 66), the fourth graders seemed to surpass the second graders. That is, the mean number of correct responses was 49.59 for PA in Grade 2 whereas it was 53.23 for PA in Grade 4. Regarding PM composite performance (out of 34), the mean scores were very closed to each other (*M*= 18.22 for Grade 2; *M*= 19.32 for Grade 4). As to the overall performance in MA (out of 23), the mean score of Grade 2 children was 19.91. It was 21.13 for Grade 4 children. On the OK task, the mean number of correct responses was 23.26 (out of 27) for Grade 2. The children in Grade 4 scored 24.74. With respect to PS, fourth graders appeared to be quicker than second graders in responding a mental task. The mean score of Grade 2 was 35.18 (out of 50 for children under the age of 8) in PS whereas the children in Grade 4 had the mean scores of 42.09 (out of 93 for children aged 8 and over). Regarding vocabulary, once again children in Grade 4 achieved superiority over Grade 2 children. The mean scores of Grade 2 and Grade 4 children were 29.14 and 37.90 respectively (out of 68).

In order to explore whether these observed differences in children's mean scores were statistically meaningful, Independent Samples *t*-test was performed for the variables (i.e., WRE, SWR, PDE, PM, PS, and Vocabulary) that showed normal distribution. As for the variables (i.e., alphanumeric RAN, PA, MA, and OK) that did not display normality, Mann Whitney U test was carried out.

To begin with, the assumption of homogeneity of variance was checked for the independent samples-t test conducted for each variable. The results revealed that the equality of homogeneity of variance was met for all normally-distributed variables. The t-test results indicated that level of grade led to statistically significant differences in children's WRE ($t(90)= -2.35$, $p.<05$), SWR ($t(90)= -2.52$, $p.<05$), PS ($t(90)= -3.57$, $p.=.001$), and Vocabulary performances ($t(90)= -4.90$, $p.<001$). In other words, the children in Grade 4 were significantly better at word reading, speed of processing, and vocabulary knowledge in comparision with the children in Grade 2. On the other hand, in terms of nonword reading capacity, there was not any statistically significant differences between fourth graders (*M*= 28.46, SD= 8.64) and second graders (*M*= 24.95, SD= 8.97); t(90)= -1.90, p>.05). Likewise, Grade 4 children's mean score ((*M*= 19.32, SD= 3.73) in PM did not statistically differ from that of Grade 2 children (*M*= 18.22, SD= 3.78), t(90)= -1.40, p>.05.

In addition, Mann Whitney U test revealed that fourth graders (*Mdn*= 47) performed significantly better than second graders (*Mdn*= 47) in alphanumeric RAN, U= 456.00, p<.001. Likewise, OK was greater for Grade 4 children (*Mdn*= 25) than for Grade 2 children (*Mdn*= 24), U= 791.50, p= .03. Also, fourth graders (*Mdn*= 22) presented better performances than second graders (*Mdn*= 20) in MA, U= 687.00, p= .004. On the other hand, children's mean scores in PA did not significantly differ from each other in Grade 2 (*Mdn*= 53) and Grade 4 (*Mdn*= 55), U= 935.00, p= .35.

In addition, Pearson product-moment correlation coefficients were calculated for each grade to determine whether alphanumeric RAN, PA, PM, MA, OK, PS, vocabulary and Parents' Education Level were significant correlates of word reading fluency and reading comprehension. Pearson correlation analyses also presented the correlational relationships among IVs. These correlation findings then formed the basis for multiple regression analyses. Table 8 and Table 9 present the correlation matrixes for Grade 2 and Grade 4 respectively. The tables include the correlations among composite scores. The composite scores were calculated for the variables that have subtests, namely for word reading fluency, RAN, PA, PM and MA. As mentioned previously, the composite scores for word reading is composed of the scores that the participants took from sight word reading for real words and phonemic decoding efficiency for pseudowords. This composite score is called *Word Reading Efficiency* ([WRE], Wagner, Torgesen & Rashotte, 1999). A total composite score of RAN was included in the correlation matrix by adding the total scores of RAN Letter and RAN Number together. A total score of rhyme production, syllable deletion, phoneme blending, phoneme deletion, phoneme segmentation for real and pseudowords constituted the composite score of PA. PM composite score was attained by combining and adding the scores the participant had from memory for digits and nonword repetition tests. Finally, the subtest scores for MA inflectional morphemes and MA derivational morphemes were added together to gain MA composite score.

Table 8. Correlation Matrix for Interrelations among Measures in Turkish for Grade 2 (n= 49)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1.WRE (Composite)	--												
2. SWR (real word)	.99**	--											
3. PDE (nonword)	.96**	.89**	--										
4. COMP	.66**	.65**	.62**	--									
5. RAN (Composite)	-.56**	-.56**	-.53**	-.36*	--								
6. PA (Composite)	.53**	.53**	.49**	.57**	-.40**	--							
7. PM (Composite)	.44**	.46**	.38**	.48**	-.36*	.59**	--						
8. MA (Composite)	.41**	.41**	.39**	.55**	-.14	.53**	.55**	--					
9. OK	.71**	.75**	.61**	.59**	-.35*	.65**	.52**	.52**	--				
10. PS	.54**	.49**	.57**	.30*	-.54**	.30*	.22	.21	.43**	--			
11. VOCAB	.49**	.52**	.41**	.67**	-.15	.59**	.53**	.67**	.71**	.32*	--		
12. MOTHER EDU	.34*	.34**	.32*	.39**	-.38**	.27	.33*	.30*	.28	.35*	.34*	--	
13. FATHER EDU	.47**	.47**	.42**	.63**	-.36*	.41**	42**	.48**	.54**	.41**	.57**	.63**	--

Note.* p <.05, ** p <.01

WRE= Word Reading Efficiency (Composite), SWR= Sight Word Reading, PDE= Phonemic Decoding Efficiency, COMP= Comprehension, RAN= Rapid-automatized Naming (Composite), PM= Phonological Memory (Composite), MA= Morphological Awareness (Composite), OK= Orthographic Knowledge, PS= Processing Speed, VOCAB= Vocabulary Knowledge, Mother Edu= Mother Education, Father Edu= Father Education

As Table 8 displays, all variables were significantly correlated with each other in Grade 2 except for the relationships between MA and alphanumeric RAN, Vocabulary and alphanumeric RAN, PA and Mother Education Level, PS and PM, PS and MA, and OK and Mother Education Level. To our interest, concerning word reading fluency, the correlation between WRE and other variables varied from .34 to .99 in Grade 2. As expected, WRE was strongly correlated with its subtests, i.e., SWR and PDE (*r*= .99, p<.01; *r*= .96, p<.01 respectively). Apart from these subtests of word reading, overall, WRE yielded strong correlations with Comprehension (*r*= .66, p<.01) and OK (*r*= .71, p<.01). On the other hand, a significant but lower correlations existed between WRE and MA (Comp) (*r*= .41, p<.01), and WRE and Mother Education Level (*r*= .34, p<.05). As to Comprehension, it was significantly correlated with all IVs. The highest significant correlation appeared between Comprehension and Vocabulary (*r*= .76, p<.01). Comprehension was also strongly related to WRE (*r*= .66, p<.01) and Father Education Level (*r*= .63, p<.01). However, the correlations of Comprehension with PS and with Mother Education Level were weaker (*r*= .30, p<.05; *r*= .39, p<.01 respectively).

Table 9. Correlation Matrix for interrelations among Measures in Turkish for Grade 4 (n= 43)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1.WRE (Composite)	--												
2. SWR (real word)	.99**	--											
3. PDE (nonword)	.97**	.93**	--										
4. COMP	.66**	.64**	.66**	--									
5. RAN (Composite)	-.74**	-.72**	-.73**	-.51**	--								
6. PA (Composite)	.61**	.59**	.63**	.59**	-.40**	--							
7. PM (Composite)	.52**	.52**	.50**	.61**	-.30*	.46	--						
8. MA (Composite)	.25	.21	.29**	.43**	-.12	.27	.43**	--					
9. OK	.72**	.73**	.68**	.48**	-.43**	.48**	.50**	.18	--				
10. PS	.66**	.64**	.66**	.55**	-.56**	.58**	.45**	.25	.57*	--			
11. VOCAB	.64**	.62**	.64**	.68**	-.56**	.61**	.69**	.45**	.50**	.60**	--		
12. MOTHER EDU	.52**	.51**	.50**	.68**	-.32*	.45**	.49**	.28	.39*	.43**	.52**	--	
13. FATHER EDU	.40*	.42**	.35*	.42**	-.23	.39**	.38*	.22	.32*	.21	.27	.69**	--

Note.* p <.05, ** p <.01

WRE= Word Reading Efficiency (Composite), SWR= Sight Word Reading, PDE= Phonemic Decoding Efficiency, COMP= Comprehension, RAN= Rapid-automatized Naming (Composite), PM= Phonological Memory (Composite), MA= Morphological Awareness (Composite), OK= Orthographic Knowledge, PS= Processing Speed, VOCAB= Vocabulary Knowledge, Mother Edu= Mother Education, Father Edu= Father Education

Table 9 above presents the correlation results for Grade 4. The results produced some similarities along with variations in terms of the relationships among variables compared to the correlation findings in Grade 2. Taking word reading fluency into account, the results revealed that except for MA, WRE was significantly linked to other variables with correlations ranging from .40 to .99. The nonsignificant correlation of WRE with MA observed in this grade level is dissimilar from that of Grade 2 where MA was found moderately correlated with WRE. As expected, the highest correlation appeared between WRE and its subtests (r= .99, $p<.01$ for SWR; r= .97, $p<.01$ for PDE). Similar to the results in Grade 2, WRE was highly associated with Comprehension (r= .66, $p<.01$) and OK (r= .72, $p<.01$). However, different from Grade 2, it was most strongly correlated with alphanumeric RAN (r= -.74, $p<.01$). The correlations of WRE with PA, PS, and Vocabulary were higher than those appeared in Grade 2 (r= .61, $p<.01$; r= .66, $p<.01$; r= .64, $p<.01$ respectively). Regarding Comprehension, there were significant correlations between Comprehension and the IVs in this grade level. Similar to Grade 2, Comprehension was most strongly associated with Vocabulary (r= .68, $p<.01$), Mother Education Level (r= .68, $p<.01$), and WRE (r= .66, $p<.01$). However, unlike Grade 2, rather than Father Education Level, Mother Education Level yielded a higher significant correlation with Comprehension in this grade level. Comprehension was highly correlated with PM (r= .61, $p<.01$) and PA (r= .59, $p<.01$) as well. The correlations of Comprehension with alphanumeric RAN, PS, MA, OK, and Father Education Level were lower compared to other predictor variables (r= -.51, $p<.01$; r= .55, $p<.01$; r= .43, $p<.01$; r= .48, $p<.01$; r= .42, $p<.01$ respectively). Considering the intercorrelations among IVs, in general, the predictor variables were significantly correlated with each other with the exception of MA. MA did not significantly correlated with other predictor variables except for PDE (nonword reading), Comprehension, PM, and Vocabulary.

In sum, the correlation findings in Grade 2 and Grade 4 reveal certain parallelisms as well as differences. Overall, word reading fluency is most strongly associated with alphanumeric RAN and OK in both grade levels. However, unlike Grade 2, interestingly, word reading fluency was not related to MA in Grade 4. With respect to Comprehension, Vocabulary, WRE, and Parents Education Level were the strongest correlates of Comprehension in both grades. The difference lies in the way Parents Education Level was correlated. That is, Father Education Level yielded higher correlation with Comprehension than Mother Education Level in Grade2. On the other hand, Mother Education Level was more strongly associated with Comprehension in Grade 4.

After giving the preliminary results, the following subsection will present the results of this study based on the research questions.

5.1 Presentation of research findings

5.1.1 Research question 1

To what extent do RAN, Phonological Awareness, Phonological Short-Term Memory, Morphological Awareness, Orthographic Knowledge, Processing Speed, Vocabulary and Parents' Education Level together and/or independently contribute to word-level reading fluency? Do these contributions remain the same across grades?

This section reports the effects of independent (alphanumeric RAN, PA, PM, MA, PS and parents' education level[3]) and mediator variables (OK and Vocabulary) on word reading fluency (WRE) for normally developing readers in Grades 2 and 4. The

[3] Either Mother Education Level or Father Education Level was selected as parents' education level for regression analyses depending on their correlations with reading skills and other predictors of reading.

direct and indirect influences of these variables on WRE was examined through a series of multiple regression analyses as part of a proposed path model of reading comprehension developed for normally achieving readers in Turkish. As previously stated, the developed full path model is composed of three layer multiple regression. In this section, the results of the first two layers of the proposed path diagram are reported with respect to first research question. In the first layer of the path analysis, in line with literature, the contributions of Parents' Education Level, MA, and PA to Vocabulary (mediator) and the contributions of PA, alphanumeric RAN, and PS to OK (mediator) were assessed through simultaneous multiple regression analyses. In the second layer of the path modelling, the contributions of all measured variables (alphanumeric RAN, PA, PM, MA, PS, and Parents' Education Level) and of mediators (Vocabulary and OK) to WRE were examined via a set of simultaneous regression analyses. The results of the first and second layers of the proposed path model for Grade 2 and Grade 4 are reported in the following paragraphs, respectively. Multiple regression results for each layer are illustrated in tables and path diagrams. Overall, the tables include the unstandardized regression coefficients (*B*), standardized regression coefficients (β), squared semi-partial correlations (unique variance), observed *t* value, and significance level for each unstandardized coefficient. As previously mentioned, the criterion significance level was selected as .10. The path diagrams display significant with bold lines and nonsignificant paths with dashed lines.

With respect to Grade 2, separate simultaneous regression analyses were run to measure the influence of Parents' Education Level (Mother Education Level), MA, and PA on Vocabulary (mediator) and of PA, alphanumeric RAN, and PS on OK (mediator) in the first layer of the proposed path diagram. Regarding Vocabulary, the results indicated that whereas PA [t(45)= 2.51, p<.05, β= .30] and MA [t(45)= 3.85, p<.001, β= .47] were significant predictors of Vocabulary, Mother Education Level [t(45)= 1.06, p= .295, β= .11] was a nonsignificant contributor. Thus, Mother Education Level was excluded from the equation. The analysis was done again with PA and MA. The model together explained 52% of the variance in Vocabulary (F_{change}= 24.90, p<.001). The squared semi-partial correlations showed that MA and PA accounted for 27% and 13% of unique variance, respectively, in Vocabulary. Table 10 below reports the regression results pertaining Vocabulary. The direct effects of the variables on Vocabulary in the first layer of the path model for Grade 2 is also shown in Figure 5. The dashed lines in the diagram represents the nonsignificant paths in the model.

Table 10. Summary of Simultaneous Regression Analysis for Variables predicting Vocabulary in Turkish for Grade 2 (n= 49)

Dependent Variable	Independent Variable	*B*	*β*	Squared Semi-Partial Correlation	*t*-value	*p*
Initial Step			Initial Model with Three Variables			
Vocabulary	PA	2.99	.30	.12	2.51	.016
	MA	4.64	.47	.25	3.85	<.001
	PARENTS' EDU (Mother Edu)	.86	.11	.02	1.06	.294
Note. R^2= .53, (*p*= .10), R^2_{adj}= .50, $F(3, 45)$= 17.02, *p*= <.001						
Final Step			Final Model with Two Variables			
Vocabulary	PA	3.16	.32	.13	2.67	.010
	MA	4.88	.49	.27	4.12	<.001
Note. R^2= .52, (*p*= .10), R^2_{adj}= .50, $F(2, 46)$= 24.90, *p*= <.001						

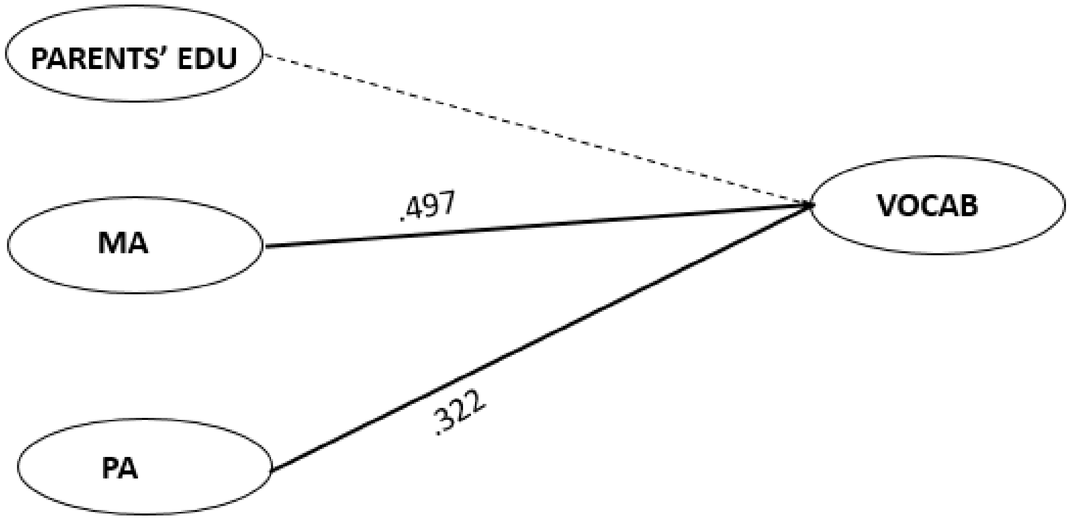

Figure 5. Direct effects of parents' education level, MA and PA on vocabulary for Grade 2

As for OK, while PS [t(45)= 2.17, p<.05, β= .27] and PA [t(45)= 4.97, p<.001, β= .58] made significant contributions, alphanumeric RAN [t(45)= .292, p= .772, β= .03] did not contribute significantly. Therefore, the analysis was re-run without alphanumeric RAN. The model that included PA and PS accounted for 49% of the variance in OK (F_{change}= 21.74, p<.001). The squared semi-partial correlations displayed that the unique contribution of PA (37%) to OK is larger than that of PS (11%). Table 11reports the regression results for OK. Figure 6 displays the direct effects of the variables on OK in the first layer of the path model for Grade 2 Nonsignificant paths are shown with dashed lines in the model.

Table 11. Summary of Simultaneous Regression Analysis for Variables predicting OK in Turkish for Grade 2 (n= 49)

Dependent Variable	Independent Variable	*B*	*β*	Squared Semi-Partial Correlation	*t*-value	*p*
Initial Step			Initial Model with Three Variables			
OK	PS	.03	.27	.12	2.17	.035
	PA	.58	.58	.25	4.97	<.001
	RAN	.04	.03	.02	.29	.772
Note. R^2= .49, (p= .10), R^2_{adj}= .45, F(3, 45)= 14.23, p= <.001						
Final Step			Final Model with Two Variables			
OK	PS	.03	.26	.11	2.34	.023
	PA	.57	.57	.37	5.17	<.001
Note. R^2= .49, (p= .10), R^2_{adj}= .46, F(2, 46)= 24.90, p= <.001						

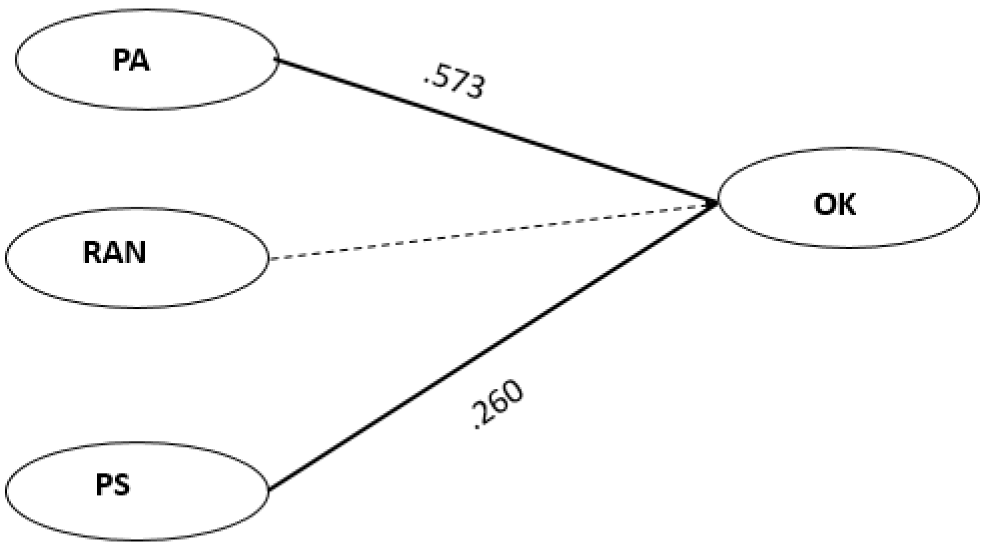

Figure 6. Direct effects of PA, alphanumeric RAN, and PS on OK for grade 2

Concerning Grade 4, in the first layer of the proposed path model, the direct impact of Parents' Education Level (Mother Education Level), MA, and PA on Vocabulary (mediator) and of PA, alphanumeric RAN, and PS on OK (mediator) were assessed through simultaneous regression analyses as in Grade 2. As for Vocabulary, the results showed that all variables, namely Mother Education Level [t(39)= 2.01, p=.051, β= .25], MA[t(39)= 2.24, p=.030, β= .26], and PA [t(39)= 3.29, p=.002, β= .42] significantly contributed to Vocabulary. The model explained 51% of the variance in Vocabulary (F_{change}= 13.56, p<001). Here, different from Grade 2, Mother Education Level emerged as a significant predictor of Vocabulary. Its unique contribution to Vocabulary was 9%. PA made the biggest contribution. It explained 22% of the variance in Vocabulary. Finally, MA made 11% of unique contribution to Vocabulary. Table 12 summarizes the regression results in relation to Vocabulary. Figure 7 displays these results on the first layer of the developed path model.

Table 12. Summary of Simultaneous Regression Analysis for Variables predicting Vocabulary in Turkish for Grade 4 (n= 43)

Dependent Variable	Independent Variable	*B*	*β*	Squared Semi-Partial Correlation	*t*-value	*p*
Initial Step			Final Model with Three Variables			
Vocabulary	PA	2.84	.42	.22	2.51	.002
	MA	1.80	.26	.11	3.85	.030
	PARENTS' EDU (Mother Edu)	1.52	.25	.09	1.06	.051

Note. R^2= .51, (*p*= .10), R^2_{adj}= .47, *F*(3, 39)= 13.56, *p*= <.001

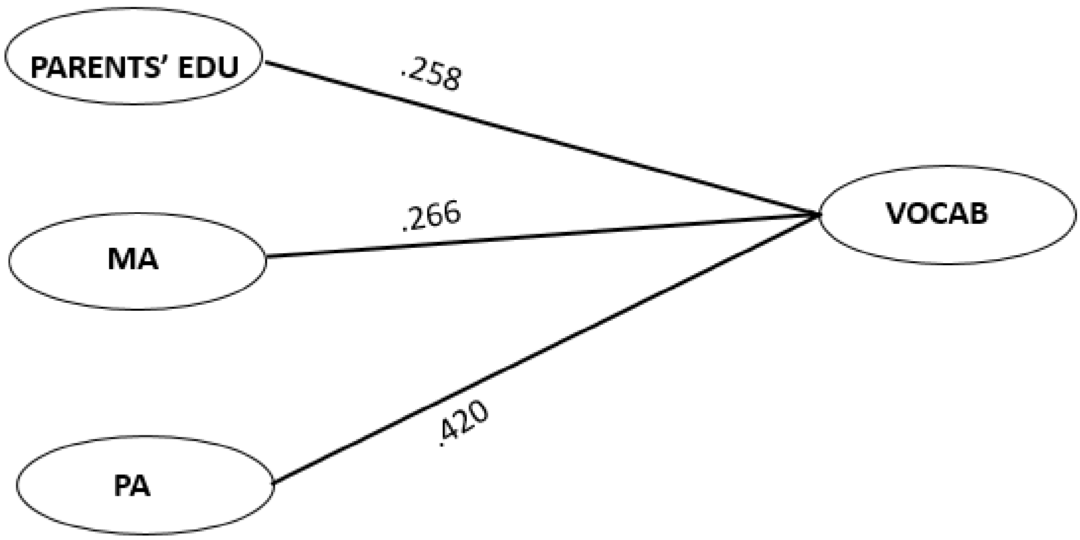

Figure 7. Direct effects of parents' education level, MA and PA on vocabulary for Grade 4

As part of the first layer of the proposed path model, similar analyses were computed for OK, another mediator in Grade 4. The results showed that PS [t(39)= 2.15, p=.038, β= .37] was the only variable that made a significant contribution to OK. Different from Grade 2, neither alphanumeric RAN [t(39)= -.84, p=.404, β= -.13] nor PA [t(39)= 1.33, p=.191, β= .20] was a significant predictor of OK. As such, these variables were eliminated from the model. The model with PS explained approximately 33% of the variance in OK. These effects are illustrated in Figure 8. The results of the regression analyses are also summarized in Table 13 below.

Table 13. Summary of Simultaneous Regression Analysis for Variables predicting OK in Turkish for Grade 4 (n= 43)

Dependent Variable	Independent Variable	*B*	*β*	Squared Semi-Partial Correlation	*t*-value	*p*
Initial Step			Initial Model with Three Variables			
OK	PS	.08	.37	.07	2.15	.038
	PA	.46	.20	.02	1.33	.191
	RAN	-.28	-.13	.01	-.84	.404
Note. R^2= .37, (p= .10), R^2_{adj}= .32, F(3, 39)= 7.65, p= <.001						
Final Step			Final Model with One Variable			
OK	PS	.05	.57	.33	4.45	<.001
Note. R^2= .33, (p= .10), R^2_{adj}= .31, F(1, 41)= 19.86, p= <.001						

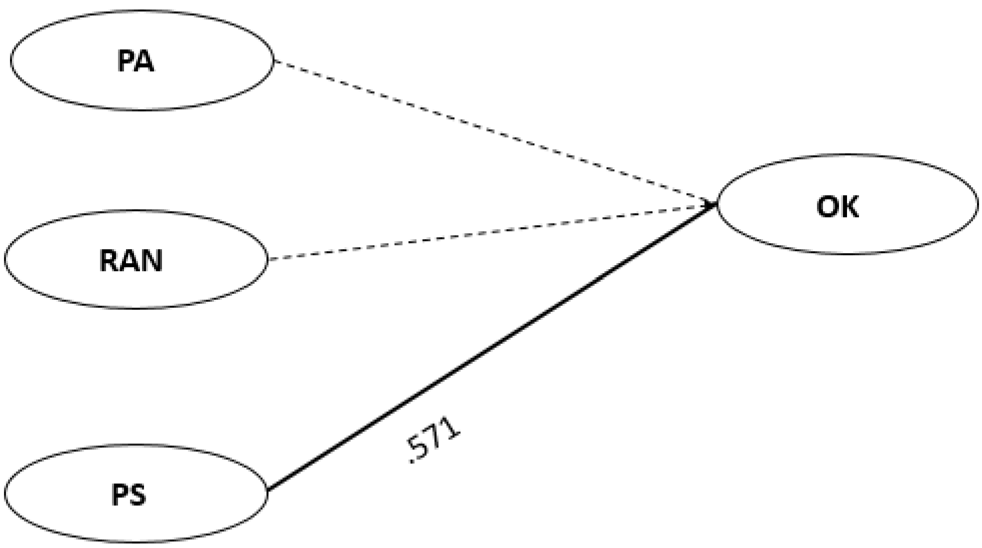

Figure 8. Direct effects of PA, alphanumeric RAN, and PS on OK for grade 4

In the second layer of the proposed path model, the effect of all IVs (alphanumeric RAN, PA, PM, MA, PS and Parents' Education Level) and mediators (Vocabulary and OK) on WRE was investigated. The correlation matrixes (in Table 7 and Table 9) illustrate that both independent variables (except for MA in the fourth grade) and mediator variables included in the present study were significantly related to WRE in both grades with values ranging from -.74 to .40. In accordance with these correlational results, in order to explore the shared and unique effects of alphanumeric RAN, PA, PM, MA, OK, PS, Vocabulary and Parents' Education Level, a series of multiple regression analyses were run for each grade, with word-level reading as the dependent variable.

As for the analyses for Grade 2 (n= 49), in the first step, all the variables, namely alphanumeric RAN, PA, PM, MA, OK, PS, Vocabulary, and Parents' Education Level (Mother Education Level) were entered into the equation simultaneously. The results indicated that OK [t(40)= 3.43, p= .001, β= .53] and alphanumeric RAN [t(40)= -.2.27, p= .028, β= -.29] were significant precursors of WRE whereas PM [t(40)= -.02, p= .979, β= -.003], PA [t(40)= -.05, p= 954, β= -.008], Vocabulary [t(40)= -.18, p= .856, β= -.03], MA [t(40)= .61, p= .541, β= .08], PS [t(40)= 1.07, p= .289, β= .13] and Mother Education Level [t(40)= .22, p= .820, β= .02] were nonsignificant predictors. Of eight variables, because PM had the highest p value (.979), it was excluded from the model. In the second step, because PA, MA, PS, Vocabulary and Mother Education Level were still nonsignificant, these variables were also eliminated from the model and the regression was re-estimated with alphanumeric RAN and OK which were detected as variables contributing significantly to the equation. The model that included these two variables accounted for 62% of the variance in WRE, ($F_{2, 46}$= 38.07, p< .001). In this final model, both alphanumeric RAN and OK contributed significantly to WRE, with OK recording a higher beta value (β= .59, *t* = 6.12, *p*< .001) than alphanumeric RAN (β= -.35, *t* = -.3.71 p= .001). More specifically, squared semi-partial correlations showed that OK and alphanumeric RAN explained 45% and 23% of unique variance, respectively, in WRE. Overall, the inclusion of Mother Education Level, Vocabulary, PA, PM, PS and MA in the model did not significantly improve prediction in spite of their significant correlations with WRE (*r*= .34 for Mother Education Level; *r*= .49 for Vocabulary; *r*=. 53 for PA; *r*= .44 for PM; *r*=. 54 for PS; *r*= .41 for MA). Such a result might stem from the strong intercorrelations between the IVs. That is, the strong and moderate correlations between OK and PA (*r*= .65), OK and PM (*r*= .52), OK and MA (*r*= .52), OK and Vocabulary (*r*= .71), OK and PS (*r*=. 43), alphanumeric RAN and PS (*r*= .54), and alphanumeric RAN and PA (*r*= .40) might have suppressed the predictive power of PA, PM, MA, PS and Vocabulary in WRE. Accordingly, alphanumeric RAN and OK were excluded from the model and the analysis was run with PA, PM, MA, PS, Vocabulary, and Mother Education Level. The results indicated that PA [t(42)= 1.54, p= .130, β= .23] ,Vocabulary [t(42)= .75, p= .458, β= .12], MA [t(42)= .31, p= .755, β= .05], PM [t(42)= .74, p= .461, β= .11], and Mother Education Level [t(42)= .46, p= .643, β= .05] were still nonsignificant predictors of WRE. The exclusion of alphanumeric RAN and OK from the regression model improved only the predictive power of PS [t(42)= 2.98, p= .005, β= .36] in WRE. Squared semi-partial correlations showed that PS made approximately 29% of contribution to WRE once OK, alphanumeric RAN, and other nonsignificant variables were excluded from the model. Such results suggested that the overlaps between PS and OK as well as PS and alphanumeric RAN reduced the unique effect of PS β, causing it to be nonsignificant in the full model. However, it should be noted that the model with OK and alphanumeric RAN resulted in higher R^2, implying that OK and alphanumeric RAN were better predictors of WRE (R^2= .62 and R^2_{adj}= .61) in comparison with the model that included PS (R^2= .29 and R^2_{adj}= .27, $F_{1, 47}$= 18.85, p<.001). Because the model with

OK and alphanumeric RAN has a higher predictive power, Table 14 below reports the results of this model in Grade 2.

Table 14. Summary of Simultaneous Regression Analysis for Variables predicting Word Reading Efficiency in Turkish for Grade 2 (n= 49)

Dependent Variable	Independent Variable	*B*	*β*	Squared Semi-Partial Correlation	*t*-value	*p*
Initial Step			Initial Model with Eight Variables			
WRE	RAN	-6.71	-.29	.10	-2.27	.028
	PA	-.18	-.008	.00008	-.05	.954
	PM	-.02	-.003	.01	-.02	.979
	MA	1.91	.08	.008	.61	.541
	OK	12.18	.53	.22	3.43	.001
	PS	.35	.13	.02	1.07	.289
	VOCAB	-.06	-.03	.0004	-.18	.856
	PARENTS' EDU (Mother Edu)	.44	.02	.0009	.22	.820
Note. R^2= .64, (p= .10), R^2_{adj}= .57, F(7, 41)= 8. 87, p= <.001						
Final Step			Final Model with Two Variables			
WRE	RAN	-8.18	-.35	.23	-3.71	.001
	OK	13,49	.59	.45	6.12	.000
Note. R^2= .62, (p= .10), R^2_{adj}= .61, F(2, 46)= 38.07, p= <.001						

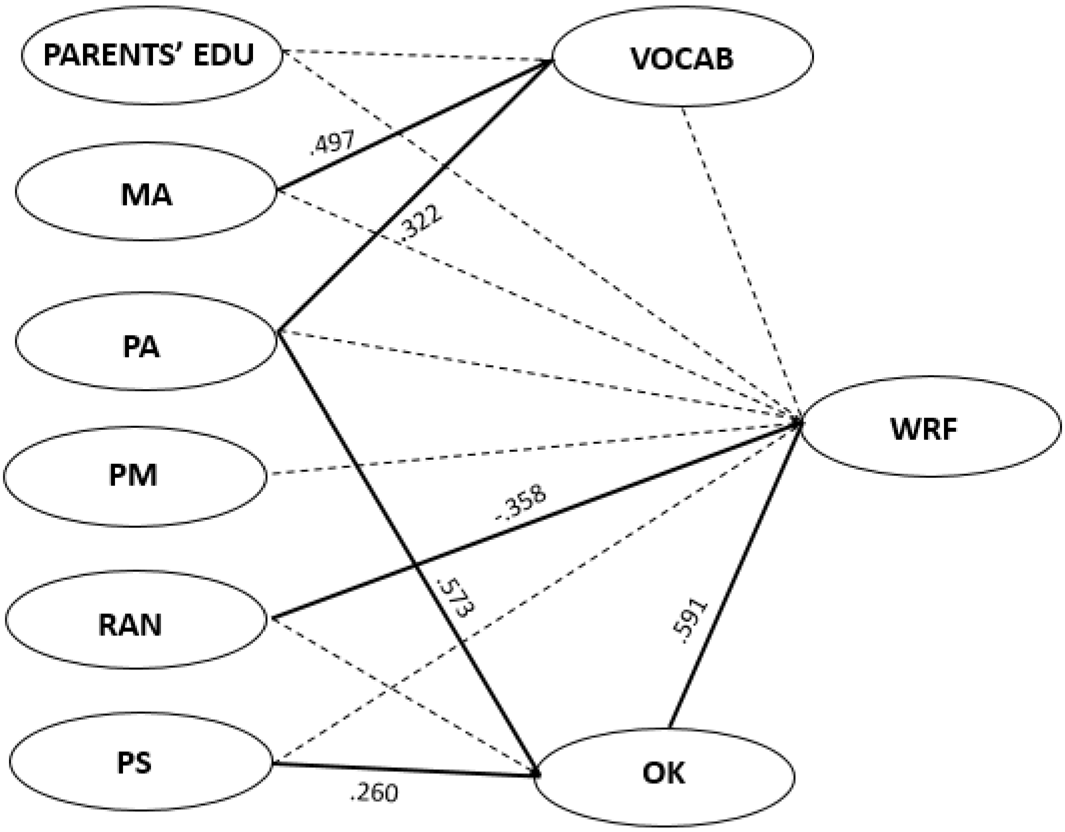

Figure 9. Direct effects of alphanumeric RAN, PA, PM, MA, OK, PS, vocabulary, and parents' education level for grade 2

In accordance with Grade 2, in the second layer of the path modelling for Grade 4, a series of simultaneous regression analyses were performed to check if the contribution of each variable to WRE remains similar across grades (see Table 15). Initially, all the variables, namely alphanumeric RAN, PA, PM, MA, OK, PS, Vocabulary and Parents' Education Level (Mother Education Level) were entered simultaneously. In this first step, although alphanumeric RAN and OK were significant precursors, PA, PM, MA, PS, Vocabulary, and Mother Education Level did not significantly contribute to WRE. Thus, MA, which owned the highest p value [$t(34)= .28$, $p= .780$, $\beta= .02$] was dropped from the model and the analysis was done again with seven variables, namely alphanumeric RAN, PA, PM, OK, PS, Vocabulary and Mother Education Level. The exclusion of MA did not change the results and PA [$t(35)= 1.66$, $p= .104$, $\beta= .17$], PM [$t(35)= .53$, $p= .517$, $\beta= .07$], Vocabulary [t(35)= -.27, p= .783, β= -.03], PS [t(35)= .33, p= .743, β= .03], and Mother Education Level [t(35)= 1.30, p= .202, β= .12] were detected as nonsignificant variables. Accordingly, these variables were eliminated from the analysis although they had significant correlations with WRE(*r*= .61, p<.01 for PA; *r*= .52, p<.01 for PM; *r*= .66, p<.01 for PS; *r*= .64 for Vocabulary; *r*= .52 Mother Education Level). In the final step, only alphanumeric RAN and OK were entered to the equation as these variables have significant predictive power in WRE. The results showed that overall, these two variables accounted for a significant amount of variance in WRE, R^2= .75, R^2_{adj}= .73, *F*(2, 40)= 58.87, *p*<.001. When squared semi-partial correlations were inspected, the analysis revealed that alphanumeric RAN made the highest unique contribution to WRE, explaining approximately 47% of variance. Similarly, OK accounted for 45% of the unique variance in WRE. A summary of the regression analyses is reported in Table 15. Similar to Grade 2, OK and alphanumeric RAN were the most powerful predictors, making strong contributions to WRE in Grade 4. In addition, when the correlation matrix (see Table 5.2) was thoroughly examined, the intercorrelations of alphanumeric RAN and OK with other variables, i.e., alphanumeric RAN and PS (*r*=. 56), alphanumeric RAN and PA (*r*= -.40), alphanumeric RAN and Vocabulary (*r*= -.56), alphanumeric RAN and Mother Education Level (*r*= -.32), OK and PA (*r*= .48), OK and PM (*r*= .50), OK and PS (*r*= .57), OK and Vocabulary(*r*=. 50), and OK and Mother Education Level (*r*= .39) might have influenced the results and diminished the predictive power of PA, PM, MA, PS, Vocabulary, and Mother Education Level. Thus, the analysis was re-run without OK and alphanumeric RAN. The results displayed that of the six variables included in the equation, PS [t(36)= 2.28, p= .028, β= .33] was the sole variable that had the significant contribution to WRE when OK and alphanumeric

RAN were excluded from the analysis. On the other hand, Vocabulary [t(36)= 1.11, p= .271, β= .20], PA [t(36)= .1.40, p= .168, β= .20], MA [t(36)= -.51, p= .607, β= -.06], PM [t(36)= .57, p= .569, β= .08], and Mother Education Level [t(36)= 1.09, p= .279, β= -.14] did not have any significant influence on WRE. Accordingly, nonsignificant variables were dropped from the analysis. A linear regression analysis with PS indicated that PS explained almost 44% of the variance in WRE ($F_{1, 41}$= 31.92, p<.001). It appears that the overlap between variables reduced the unique effect of PS. However, the model with OK and alphanumeric RAN had higher predictive power (R^2= .75) than the model with PS (R^2= .44). A Summary of the regression analyses are reported in Table 15. Figure 10 illustrates the direct effects of alphanumeric RAN, PA, PM, MA, OK, PS, Vocabulary, and Parents' Education Level in Grade 4.

Table 15. Summary of Simultaneous Regression Analysis for Variables predicting Word Reading Efficiency in Turkish for Grade 4 (n= 43)

Dependent Variable	Independent Variable	*B*	*β*	Squared Semi-Partial Correlation	*t*-value	*p*
Initial Step			Initial Model with Eight Variables			
WRE	RAN	-11.04	-.45	.37	-4.49	<.001
	PA	4.16	.17	.07	1.64	.108
	PM	.42	.06	.009	.56	.575
	MA	.60	.02	.002	.28	.780
	OK	8.82	.36	.28	3.60	.001
	PS	.08	.03	.002	.31	.753
	VOCAB	-.16	-.04	.003	-.33	.739
	PARENTS' EDU (Mother Edu)	2.51	.12	.04	1.26	.213
Note. R^2= .80, (*p*= .10), R^2_{adj}= .76, *F*(8, 34)= 17.13, *p*= <.001						
Final Step			Final Model with Three Variables			
WRE	RAN	-12.61	-.52	.47	-5.93	<.001
	OK	12,11	.50	.45	5.70	<.001
Note. R^2= .75, (*p*= .10), R^2_{adj}= .73, *F*(2, 40)= 58.87, *p*= <.001						

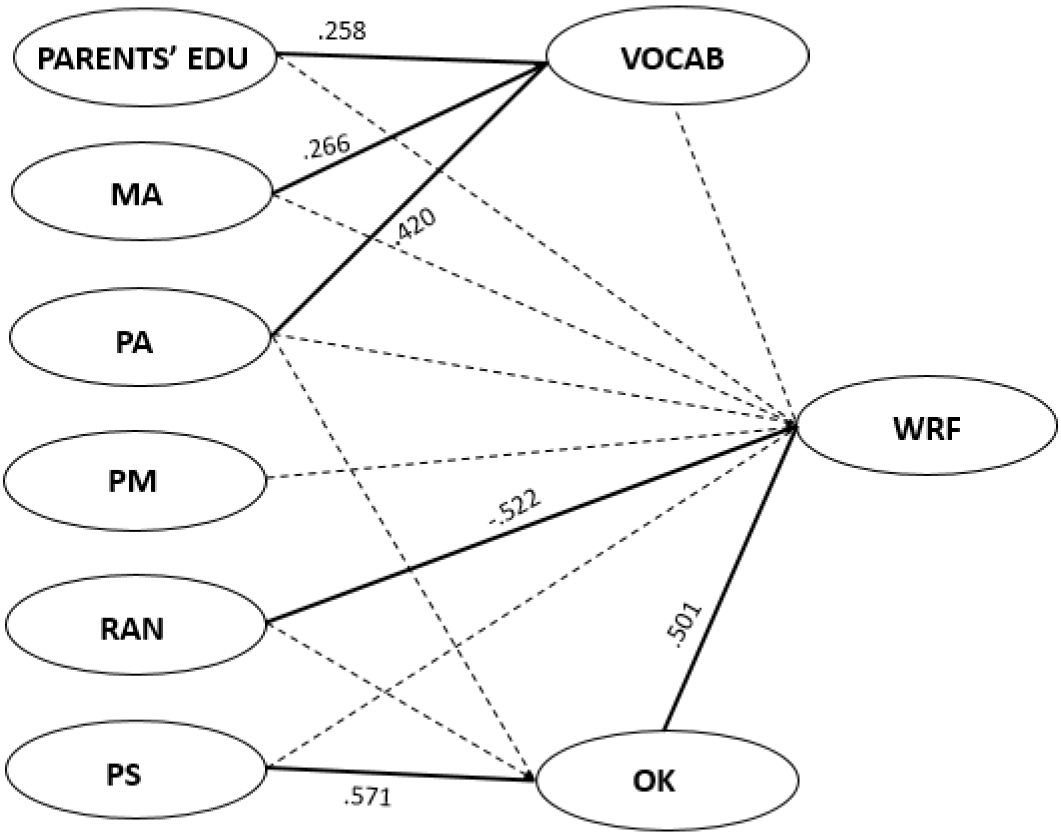

Figure 10. Direct effects of alphanumeric RAN, PA, PM, MA, OK, PS, vocabulary, and parents' education level on WRE for grade 4

5.1.2 Research question 2

To what extent do RAN, Morphological Awareness, Processing Speed, Vocabulary, Parents' Education Level, and WRE together and/or independently contribute to reading comprehension? Do these contributions remain the same across grades?

In the third layer of the path analysis, simultaneous multiple regression analyses were conducted to evaluate how well the hypothesized IVs predicted comprehension in each grade and to examine if there is a pattern in terms of the contributions of these IVs across grades. In line with literature, alphanumeric RAN, MA, PS, Vocabulary, Parents' Education Level (Mother Education Level or Father Education Level), and WRE were presumed to influence children's performance in reading comprehension. The correlation matrixes (see Table 8 and Table 5.3) also show that these variables were significantly correlated with reading comprehension in both

Grade 2 (*r*= -.36 for alphanumeric RAN; *r*= .55 for MA; *r*= .30 for PS; *r*= .67 for Vocabulary; *r*= .63 for Father Education Level; *r*= .66 for WRE) and Grade 4 (*r*= -.51 for alphanumeric RAN; *r*= .43 for MA; *r*= .55 for PS; *r*= .68 for Vocabulary; *r*= .68 for Mother Education Level; *r*= .66 for WRE). Thus, these IVs were included in the regression equation.

With regard to Grade 2, as in the previous regression analyses, initially, alphanumeric RAN, MA, PS, Vocabulary, Parents' Education Level (Father Education Level[4]), and WRE were entered simultaneously into the regression equation. In this initial analysis, whereas Father Education Level [t(42)= 2.32, p= .025, β= .27], Vocabulary [t(42)= 2.29, p= .027, β= .31], and WRE [t(42)= 3.02, p= .004, β= .39] predicted Comprehension significantly, PS [t(42)= -1.56, p= .126, β= -.18], alphanumeric RAN [t(42)= -.67, p= .506, β= -.18], and MA [t(42)= .53, p= .593, β= .06] did not make any significant contribution. Since MA [t(42)= .53, p= .593, β= .06] had the least effect level, it was dropped from the equation. In the second step, alphanumeric RAN [t(43)= -.66, p= .508, β= -.08] and PS [t(43)= -1.63, p= .110, β= -.18] were still nonsignificant whereas Vocabulary, Father Education Level, and WRE remained as significant predictors of Comprehension. Accordingly, in the final step, alphanumeric RAN and PS were excluded from the equation, and the regression analysis was re-estimated with three variables, namely Vocabulary, Father Education Level, and WRE. The variables in the model together made 63% of contribution to Comprehension in Grade 2 ($F_{3, 45}$= 25.98, p<.001). Squared semi-partial correlations indicated that WRE was the most powerful unique predictor of Comprehension (explaining 21% of the variance) followed by Vocabulary (16%), Father Education Level (11%). The results of the regression analyses for Grade 2 are

[4] Father Education Level was selected as SES variable as it was more strongly correlated with comprehension.

displayed in Table 16below. As part of the third layer of the proposed path model, Figure 11 displays the direct effects of the variables on Comprehension in Grade 2.

Table 16. Summary of Simultaneous Regression Analysis for Variables predicting Reading Comprehension in Turkish for Grade 2 (n= 49)

Dependent Variable	Independent Variable	*B*	*β*	Squared Semi-Partial Correlation	*t*-value	*p*
Initial Step			Initial Model with Six Variables			
COMP	RAN	-.26	-.08	.01	-.67	.506
	MA	.21	.06	.006	.53	.593
	PS	-.07	-.18	.05	-1.56	.126
	VOCAB	.10	.31	.11	2.29	.027
	PARENTS' EDU (Father Edu)	.63	.27	.11	2.32	.025
	WRE	.05	.39	.18	3.02	.004
Note. R^2= .66, (*p*= .10), R^2_{adj}= .61, *F*(6, 42)= 13. 45, *p*= <.001						
Final Step			Final Model with Three Variables			
COMP	WRE	.05	.36	.21	3.42	.001
	VOCAB	.11	.33	.16	2.90	<.001
	PARENTS' EDU (Father Edu)	.60	.26	.11	2.33	.02
Note. R^2= .63, (*p*= .10), R^2_{adj}= .61, *F*(3, 45)= 25.98, *p*= <.001						

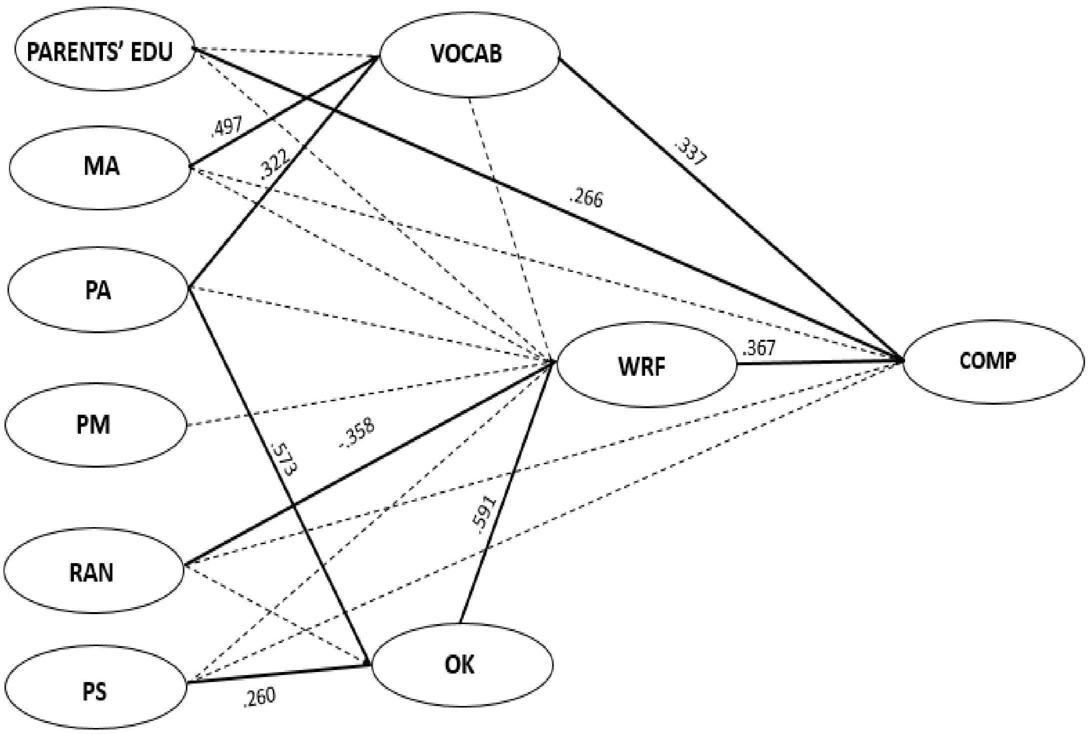

Figure 11. Full path model of reading comprehension for grade 2

In the last layer of the path analysis, simultaneous regression analyses were also run to test if children's alphanumeric RAN, MA, PS, Vocabulary, Parents' Education Level (Mother Education Level[5]), and WRE performance predicted their Comprehension ability in Grade 4. In the first step, only Mother Education Level significantly predicted Comprehension. Alphanumeric RAN [t(36)= .-.46, p= .648, β= -.06], PS [t(36)= .30, p= .759, β= .04], MA [t(36)= 1.36, p= .182, β= .14], Vocabulary [t(36)= 1.47, p= .149, β= .22], and WRE [t(36)= 1.24, p= .220, β= .21] were the variables that did not significantly predict Comprehension. Thus, PS and alphanumeric RAN which had the least effect level were eliminated from the model, and the analysis was carried out again with four variables. In the second step, because MA remained nonsignificant and had the least influence (p=.191), it was dropped from the analysis. The final model included Mother Education Level,

[5] In Grade 4, because Mother Education Level was more strongly correlated with reading comprehension, it was selected as SES variable (r= .68).

Vocabulary, and WRE, all of which significantly predicted Comprehension. These variables together explained 65% of the variance in Comprehension (F_{change}= 24.11, p<001). Squared semi-partial correlations indicated that Mother Education Level and Vocabulary were the most important contributors to Comprehension, each explaining 22% and 13% of unique variance, respectively. The predictive power of WRE was weaker compared to other variables. It accounted for approximately 10% of the variance in Comprehension. The results of the regression predicting the contribution of the IVs to Comprehension for Grade 4 are reported in Table 17 below. Figure 12 presents the full path model for Comprehension in Grade 4.

Table 17. Summary of Simultaneous Regression Analysis for Variables predicting Reading Comprehension in Turkish for Grade 4 (n= 43)

Dependent Variable	Independent Variable	*B*	*β*	Squared Semi-Partial Correlation	*t*-value	*p*
Initial Step			Initial Model with Six Variables			
COMP	RAN	-.20	-.06	.005	-.46	.648
	MA	.44	.14	.05	1.36	.182
	PS	.02	.04	.002	.30	.759
	VOCAB	.09	.22	.05	1.47	.149
	PARENTS' EDU (Mother Edu)	.96	.37	.22	3.13	.003
	WRE	.02	.21	.04	1.24	.220
Note. R^2= .66, (*p*= .10), R^2_{adj}= .61, *F*(6, 36)= 12.09, *p*= <.001						
Final Step			Final Model with Three Variables			
COMP	VOCAB	.13	.31	13	2.45	.019
	PARENTS' EDU (Mother Edu)	.98	.38	.22	3.29	.002
	WRE	.03	.26	.10	2.06	.046
Note. R^2= .65, (*p*= .10), R^2_{adj}= .62, *F*(3, 39)= 24.11, *p*= <.001						

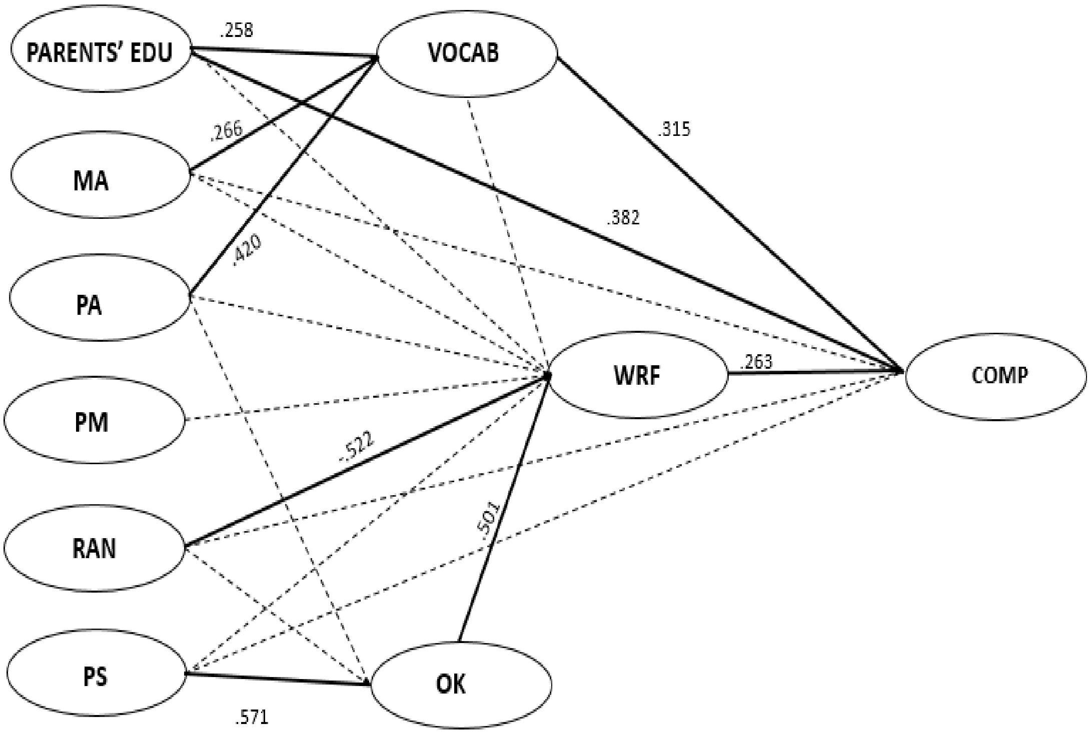

Figure 12. Full path model of reading comprehension for grade 4

5.1.3 Total effects of variables on word reading fluency and reading comprehension

This study intends to explore the potential direct and indirect influence of different variables (alphanumeric RAN, PA, PM, MA, OK, PS, Vocabulary, and Parents' Education Level) on word-level reading fluency and reading comprehension. To achieve this aim, first of all, a proposed path model was developed in accordance with literature and the direct effects of the IVs were assessed through a set of multiple regression analyses. The direct influence of each variable on word-level reading fluency and reading comprehension were reported parallel to the research questions of the study. Herein, the total influences of the proposed variables is reported based on direct and indirect effects of each variable.

With reference to fluent word reading, the results indicated that alphanumeric RAN and OK were the sole variables that had significant direct effects in both Grade 2 and 4. PS did not have a significant direct effect on word reading fluency; but, it had an indirect influence via OK (β= .15 in Grade 2; β= .29 in Grade 4). Similarly, PA did not have direct influence on word reading, but indirectly affected word fluency through OK. However, this indirect effect was restricted to Grade 2 (β= .33). Other variables, namely Parents' Education Level, MA, and PM had neither direct nor indirect influence on word fluency in both grades. Table 18 and Table 19 present the total effects of the variables on the basis of these direct and indirect effects on word reading fluency for Grades 2 and 4, respectively.

Table 18. Total Effects of Variables on Word Reading Fluency in Grade 2

Outcome	Determinants	Direct Effect	Indirect Effect	Total Effect
WRE	RAN	-.35	--	-.35
	PA	--	(.57) (.59)	.33
	PM	--	--	--
	MA	--	--	--
	OK	.59	--	.59
	PS	--	(.26) (.59)	.15
	VOCAB	--	--	--
	PARENTS' EDU	--	--	--

Table 19. Total Effects of Variables on Word Reading Fluency in Grade 4

Outcome	Determinants	Direct Effect	Indirect Effect	Total Effect
WRE	RAN	-.52	--	-.52
	PA	--	--	--
	PM	--	--	--
	MA	--	--	--
	OK	.50	--	.50
	PS	--	(.57) (.50)	.29
	VOCAB	--	--	--
	PARENTS' EDU	--	--	--

As for reading comprehension, Vocabulary, WRE, and Parents' Education Level impact directly upon comprehension in Grade 2 and 4. Alphanumeric RAN and PS did not directly influence comprehension in Grades 2 and 4. However, alphanumeric RAN owned indirect effect on comprehension through word reading fluency in both grades (β= -.12 in Grade 2; β= .14 in Grade 4). In addition, in Grade 2, MA (β= .16) and PA (β= .10) indirectly affected reading comprehension via Vocabulary although they did not have a direct contribution. Different from Grade 2, in addition to MA (β= .08) and PA (β= .13), Parents' Education Level had also indirect contribution to comprehension through Vocabulary (β= .07) in Grade 4. Table 20 and 21 report the sum of the direct and indirect influences of the variables included in the analyses.

Table 20. Total Effects of Variables on Comprehension in Grade 2

Outcome	Determinants	Direct Effect	Indirect Effect	Total Effect
COMP	RAN	--	(-.35) (.36)	-.12
	PS	--	(.26) (.59) (.36)	.05
	MA	--	(.49) (.33)	.16
	PA	--	(.32) (.33)	.10
	VOCAB	.33	--	.33
	PARENTS' EDU	.26	--	.26
	WRE	.36	--	.36

Table 21. Total Effects of Variables on Comprehension in Grade 4

Outcome	Determinants	Direct Effect	Indirect Effect	Total Effect
COMP	RAN	--	(-.52) (.26)	-.14
	PS	--	(.57) (.50) (.26)	.07
	MA	--	(.26) (.31)	.08
	PA	--	(.42) (.31)	.13
	VOCAB	.31	--	.31
	PARENTS' EDU	.38	(.25) (.31)	.38+.07=.45
	WRE	.26	--	.26

CHAPTER 6

DISCUSSION AND CONCLUSION

This current research study is primarily concerned with the relative roles of alphanumeric RAN, PA, PM, MA, OK, PS, vocabulary and parental education level for normally achieving children in Turkish word reading fluency and reading comprehension. Another central interest of this study was to explore the potential direct and indirect relationships among these variables. The answer to this question will also reveal the mediating effects of various independent variables on fluent word reading and comprehension in Turkish. 17 different tasks were administered to measure children's performances in alphanumeric RAN, PA, PM, MA, OK, PS, vocabulary, word reading fluency, and reading comprehension. The data was statistically analyzed via correlation and a series of multiple regression analyses. Furthermore, a model of reading was developed and tested by classical path analysis in which beta weights attained from regression analyses were used as path coefficients. Accordingly, this chapter discusses the results from the preceding result chapter on the basis of previous literature presented in Chapters 1 and 2. The discussion begins with the findings concerning word-level reading in Turkish. Following this, the results of reading comprehension in Turkish are discussed.

6.1 Word-level reading fluency in Turkish

Reading is a multi-componential process that encompasses a wide range of subskills (Adams, 1990; Fuchs et al., 2001; Hoover & Gough, 1990; Hoover & Tunmer, 1993; NRP, 2000). It is generally acknowledged that fluency is a fundamental constituent of skilled reading (Perfetti, 2007). Fluent word reading is, in turn, an essential prerequisite for comprehension (Ehri & McCormick, 1998; LaBerge & Samuels, 1974; Kirby et al., 2010; Nathan & Stanovich, 1991; Pikulski & Chard, 2005; Perfetti, 1985, 2007; Samuels & Flor, 1997; Schwanenflugel et al., 2004). Given the importance of reading in a child's academic as well as social life, it is important to identify the dynamics that foster fluent word reading, an indispensable ingredient in successful reading development.

The results of the independent samples t-test in the preliminary analyses indicated that the children in Grade 4 put in a better performance than the children in Grade 2 in overall word reading efficiency (i.e., WRE) and real word reading (i.e., SWE). Such a finding reveals the effect of grade level on the development of fluent real word reading. On the other hand, interestingly, the t-test results did not identify any significant differences in nonword reading performance of second and fourth graders. Accordingly, the following subsections discusses the influence of different variables on word reading fluency across grades along with the impact of grade level.

6.1.1 RAN and word reading fluency

In the present study, alphanumeric RAN, the ability to access familiar visual symbols from long-term memory and response those stimuli rapidly, was hypothesized to be a strong correlate of reading and make a unique and direct contribution to children's word-level reading fluency in Turkish. The findings of this research study confirmed this hypotheses and provided additional support for those of previous studies reporting that RAN is strongly associated with word-reading fluency (e.g., Abolafya, 2008; Albuquerque, 2017; Asadi et al., 2017; Babayiğit & Stainthorp, 2010; Babayiğit & Stainthorp, 2011; Bektaş, 2017; Bishop, 2003; Furnes & Samuelsson, 2011; Georgiou et al., 2008c; Georgiou et al., 2016; Kirby et al., 2003; Kirby et al., 2010; Manis et al., 1999; Manis et al., 2000; Moll et al., 2014; Papadopoulos et al., 2016; Sönmez, 2015; Vaessen et al., 2010). Congruent with the literature, RAN seems to have a steady influence on word reading fluency across grades levels in Turkish. That is, RAN was detected as a strong and consistent correlate of word reading fluency in both Grade 2 and Grade 4 in the current study (r= -.56; r= -.74 respectively). These correlational findings between RAN tasks and reading measures are compatible with those found by Georgiou et al. (2016) for fourth graders in Greek (r= -.57 for fluent word reading and r= -.59 for nonword reading). The in-depth regression analyses conducted for each grade level also demonstrated that RAN was one of the two variables that yielded a significant persistent contribution through Grades 2 and 4. That is, RAN was detected as a significant predictor of fluent word reading, explaining 23% and 47% of unique variability in fluent word reading in Grade 2 and Grade 4 respectively. Such findings are compatible with the results of Araújo and colleagues' (2015) meta-analysis study in which RAN-reading connections were found to change slightly across grade levels and are developmentally stable in transparent orthographies. The strong steady link between RAN and Turkish word reading fluency across grade levels found in the present study also supported the findings of Landerl and Wimmer (2008), who showed that in contrast to PA which lost its influence over time, RAN measured in Grade 1 was a consistent predictor of reading fluency up to Grade 8 in German, another orthographically transparent language. Likewise, in the current study, not just fourth graders but also second graders appeared to incorporate serial rapid naming into their word recognition skills competently, and utilized orthographic strategies predominantly in reading.

Further, when the results were reconsidered with an emphasis on grade-level differences, it was observed that the amount of the unique contribution made by alphanumeric RAN to word fluency increased through grade levels (from 23% to 47%) in the current study. Such a result is in line with the findings presented by Asadi and colleagues (2017) in Arabic. Asadi et al. (2017) showed that the contribution of RAN to word fluency reached its maximum level in the fourth grade (β= .34). Similarly, the path analyses demonstrated that the β weight of alphanumeric RAN rose substantially across grades (i.e., β= -.35 in Grade 2 and β= -.52 in Grade 4). Overall, alphanumeric RAN seemed to establish stronger connections with word reading fluency from second to fourth grades. This might be explained with the progress that the children made in RAN across grade levels. That is, the preliminary analyses showed that the children in the fourth grade achieved higher levels of rapid automatization than the children in the second grade. Parallel to this growth in automatization, the role of RAN in word reading fluency appeared to increase across grades.

In addition, Kail and Hall (1994) suggested that times to name stimuli such as digits, letters and colors are determined by a global mechanism that confines the speed with which cognitive tasks are completed. Likewise, Catts et al. (2002) claimed that the participants' performance on rapid naming of objects in relation to reading achievement may partly reflect a general deficit in speed of processing. In contrast to these studies, the findings in the present study propose that the relationship between alphanumeric RAN and word reading fluency might extend beyond the general processing speed. In line with Bowey et al. (2005), alphanumeric RAN still accounted for significant additional unique variance in word reading fluency once global PS effects were partialled out. These results are also compatible with the results of Cutting and Denckla (2001) who reported that alphanumeric RAN is one of the critical components that independently contributes to successful reading for normally developing beginning elementary readers. Apparently, the unique role of RAN in explaining word fluency imply that RAN is linked to reading fluency not because it serves as a mere index of general processing speed as proposed by some researchers (e.g., Kail & Hall, 1994), but because RAN itself possesses some other special processes (e.g., attentional, perceptual, conceptual memory, lexical and articulatory) that regulate the relationship between RAN and word-reading.

The close association between alphanumeric RAN and word reading fluency identified in the current study appears to provide further evidence for the idea that both RAN and reading taps into shared cognitive and linguistic processes (Araújo et al., 2015; Manis et al., 1999; Norton & Wolf, 2012; Stringer et al., 2004; Wolf, 1991). In other words, RAN reflects a critical dimension of reading fluency with a significant and persistent influence over the course of reading development. One reason for this might be that both RAN and reading necessitates automaticity to serially process visually presented material (Georgiou et al., 2013; Gray, 2004; Norton & Wolf, 2012). Additionally, the strong and consistent link between RAN and word reading fluency may also stem from the characteristics of the orthography and the stages of reading development (Grade 2 and 4 in this study) studied in the current research. That is, in languages with transparent orthographies, such as Turkish, the progression of reading accuracy reaches its ceiling relatively fast, usually by the end of first grade (Babayiğit & Stainthorp, 2007; Öney & Durgunoğlu, 1997; Öney & Goldman, 1984; Seymour et al., 2003; Wimmer, 2006) because of the unambiguous letter-speech sound correspondences characteristic of transparent orthographies. Then, quick and efficient matching of visually presented orthographic information such as letters with the phonological one becomes a stronger and more consistent correlate and predictor of fluent reading (e.g., Cutting & Denkla, 2001; Vaessen & Blomert, 2010) from Grade 2 to Grade 4.

Additionally, the path analysis showed that alphanumeric RAN did not have additional indirect effects on word fluency through OK in either grade level. This finding, however, contrasts with some studies (e.g., Georgiou et al., 2008d; Loveall et al., 2013) which postulate a strong association between RAN and OK skills. On the other hand, in line with Cutting and Denckla (2001), instead of RAN, PS was found to make a significant contribution to OK in both Grade 2 and Grade 4, which will be discussed thoroughly in the PS section below.

6.1.2 PA and word reading fluency

The relationship between PA and word-reading fluency is of another interest in this study. Preliminary analyses showed that both groups had already mastered high levels of PA skills. As such, the second grade children did not significantly differ from the fourth graders in terms of their PA performances. This finding is parallel with the postulate that PA abilities reach ceiling levels at very early grades of literacy acquisition (by the end of first grade) in Turkish due to the transparent nature of the Turkish orthography (Babayiğit & Stainthorp, 2007; Öney & Durgunoğlu, 1997). In accordance with this finding, in the current study, PA failed to reach level of statistical significance in simultaneous regression analyses in spite of the high correlations between PA and word reading fluency (r= .53 for Grade 2; r= .61 for Grade 4). The regression analyses did not detect any unique contribution of PA to word reading fluency in any grade level. Such results confirmed the research hypothesis that PA would not affect children’s word-level reading speed directly and independently after the first grade as children in higher grades already gain more reading experience in a transparent orthography. In contrast to the studies that identified awareness of phonology as a significant variable in word reading in transparent orthographies (e.g., Cardoso-Martins, 1995; Cavalheiro et al., 2010; Güldenoğlu et al., 2016; Hoien et al., 1995; Widjaja & Winskel, 2004) and in opaque orthographies (e.g., Blaiklock, 2004; Bradley & Bryant, 1983; Demont & Gombert, 1996; Georgiou et al., 2008a), the findings in the present study can be interpreted that reading fluency in consistent orthographies such as Turkish may not impose any demands on PA, at least starting from Grade 2. Although such an interpretation does not concur with the results of some studies (e.g., Torgesen et al., 1997; Wagner et al., 1997) in which individual differences in PA were suggested to be important in explaining variability in the growth of early word reading skills at least through fourth grade in opaque orthographies, it is in accordance with de Jong and van der Leij (2002), Landerl and Wimmer (2008), and Mann and Wimmer (2002), who found no further impact of PA on the development of word reading after first grade in transparent orthographies**.** As previously mentioned**,** Öney and Durgunoğlu (1997) pointed that the Turkish children were at ceiling on both decoding and spelling by the end of first grade. As such, the researchers proposed that because decoding develops relatively quickly and efficiently, the facilitative effects of PA should be confined only to the very early stages of literacy development in Turkish**.** Likewise, Babayiğit and Stainthorp (2007) also noted that provided that children can map 29 letters of the alphabet onto their corresponding sounds, they can decode any word in Turkish. According to the researchers, it is this extreme transparency of the Turkish orthography that makes speech analysis skills redundant in reading accuracy by the end of Grade 1. Accordingly, it appears that the consistency of a writing system in a language mediates at which phase of reading development a particular cognitive ability is more effective. As Vaessen et al. (2010) proposes, in contrast to opaque languages in which the contribution of PA to reading fluency remains important for a longer period of time, PA loses its influence on word reading fluency as a function of reading expertise in orthographically consistent languages. This interpretation is also parallel with Vaessen and Blomert (2010), claiming that PA most strongly impacts on reading fluency in beginner readers who use phonological decoding strategies whereas RAN is more influential in reading fluency in experienced readers. Vaessen and Blomert (2010) found that PA and RAN contributed considerably to Dutch word reading fluency in all grades although the strength of the contribution gradually changed over six primary school grades of reading development. That is, the influence of PA on word reading fluency diminished gradually whereas RAN gained more importance for word fluency. This shift in the relative importance of the predictors of word reading fluency seems to take place rather quickly and abruptly in Turkish, probably immediately after Grade 1. Therefore, instead of a relative and gradual shift between PA and RAN observed in Dutch, individual differences in RAN levels exerted a significant influence over reading fluency in Grade 2 and 4 in Turkish. On the other hand, PA did not make any contribution at all to word reading fluency of children in the same grades. As Ziegler et al. (2010) postulated, the weight of the contribution of PA to reading performance systematically varied with the degree of orthographic transparency, being relatively robust in more opaque orthographies. It is also important to note that children's PA abilities were significantly correlated with their nonword reading performance in the current study ($r = .49$ for Grade 2 and $r = .63$ for Grade 4). It is possible that children tend to make use of sublexical, phonological approach when they encounter unfamiliar word forms.

Furthermore, the classical path analysis results indicated that although PA did not own any direct influences on word reading fluency, it does have an indirect effect through OK in Grade 2 (β= .33, see Table 18 and Figure 9). However, PA lost its indirect contribution to word fluency in Grade 4. Apparently, as suggested by Adams (1990), to a certain extent, the use of phonics to decode words appears to help children scrutinize the orders of the letters within words and build up orthographic codes for common letter patterns. This orthographic knowledge, then, boosts children's performance in word reading fluency, at least in early grades.

6.1.3 PM and word reading fluency

The current study also intended to gain insight into the relative role of PM to word-level fluency. It was presumed that the effect of PM on children's word reading speed would not be observed in Grade 2 and 4 as children in these grades should already practice grapheme-phoneme correspondence rules in Turkish, which has a highly consistent orthography. The high consistency between graphemes and phonemes was expected to ease the burden on phonological short-term memory during reading. The results confirmed this hypothesis. Although the correlational analyses revealed a moderate correlation between word reading fluency and PM (r= .44 for Grade 2; r= .52 for Grade 4), PM was not detected as a powerful precursor of word reading fluency in the regression analyses. Although these findings contradict with the extant research (e.g., Gathercole & Baddeley, 1990; Gathercole & Baddeley, 1993; Hansen & Bowey, 1994; Nithart et al., 2011; Passenger et al., 2000; Wagner & Torgesen, 1987), they are in line with the results of some other studies (e.g., Dufva et al., 2001; Georgiou, et al. 2008a; Høien-Tengesdal & Tønnessen, 2011; Näslund & Schneider, 1991; Parrila et al., 2004). As suggested by Parrila et al. (2004), the transparency of the Turkish language in the current study might have influenced the results. Furthermore, Wagner et al., (1997) suggested that efficient phonological coding of information in working memory helps beginning readers to keep an accurate representation of the phonemes that are related to target letters or parts of words while dedicating the maximum amount of cognitive resources to decoding and comprehension processes simultaneously. Likewise, according to Tunmer and Hoover (1993), PM facilitates the learning of grapheme-phoneme correspondence rules and blending operations for novice readers. In the present study, because the participant children in Grades 2 and 4 had already attained grapheme-phoneme correspondence rules and practiced blending operations during reading in an orthographically transparent language, PM did not appear to make any significant contribution to word reading fluency in these grades for normally developing readers. Even the exclusion of the variables such as alphanumeric RAN and OK which had significant correlation with PM did not improve the predictive power of PM in Turkish word reading fluency.

6.1.4 MA and word reading fluency

This study also explored the potential direct and indirect effect of MA on word reading fluency. Children's morphemic awareness was presumed to increase their performance in word reading speed since processing of larger units (i.e., morphemes rather than letters) provides readers with faster word recognition (Kirby et al., 2012). The results disconfirms this research hypothesis and contradicts with the previous research studies conducted in different languages (e.g., Asadi et al., 2017; Carlisle, 1995, 2000; Deacon & Kirby, 2004; Fowler & Liberman, 1995; Kirby et al., 2012; Kirby et al., 2012; Levesque et al., 2017; Mahony et al., 2000; Yeung et al., 2013). Although MA and word reading fluency were significantly correlated with each other in Grade 2 (r= .41), the variables did not yield any significant correlations in Grade 4. Parallel to this, MA did not explain any proportion of variance in word fluency when entered together with alphanumeric RAN, PA, OK, PS, PM, vocabulary, and parental education level. Further, the path analysis results did not display any indirect contribution of MA to word fluency through Vocabulary. These results contradicts with Deacon's study (2012) with first and third graders in English. In the study, the researcher found small but independent contribution of MA to real word and pseudoword reading accuracy controlling for OK, PA, and vocabulary. Such a difference might partly stem from the reading tasks applied in the studies. Unlike Deacon (2012), this current study used the reading tasks that measures fluency in real and pseudoword reading. Consistent with Bektaş (2017), in the present study, MA lacked predictive contribution to Turkish word reading fluency in Grade 2 and 4 when other variables (e.g., RAN, PA) were entered into the equation. This was partially be explained with the type of the reading measure included as a dependent variable as suggested by Bektaş (2017). That is, this current study showed that MA did not account for a significant amount of variance at word-level measures of reading ability in Turkish. Further, MA might have explained a significant amount of variance if the focus of the reading tasks had been accuracy rather than fluency. As Deacon (2012) suggested, such a result might also stem from the relatively large number of variables included in the regression equation, in particular with the unique presence of OK and alphanumeric RAN, both of which are the robust predictors of fluency in transparent orthographies.

6.1.5 PS and word reading fluency

This current study also attempted to investigate to what extent one's general quickness in processing visual information influences his/her word reading fluency performance. Previous studies provided substantial evidence for the close association between general PS and word reading skills (Babur, 2003; Bowey et al., 2005; Catts et al., 2002; Christopher et al., 2012; Cutting & Denckla, 2001; Kail & Hall, 1994; Plaza & Cohen, 2005). Accordingly, it was hypothesized that the participants with increased PS would read words more fluently in comparison with those who have slower speed of processing. High correlations were observed between PS and word fluency in Grade 2 (r= .54) and in Grade 4 (r= .66) in this study. The simultaneous regression analyses, on the other hand, demonstrated that PS did not have a direct and independent contribution to word reading fluency once it was taken into account with other variables (i.e., alphanumeric RAN, PA, PM, OK, PS, vocabulary and parents' education level) in both grades. However, PS was detected as a significant variable, accounting for a high amount of unique variance in word fluency (29% in Grade 2 and 44% in Grade 4) when other cognitive variables (i.e., OK and alphanumeric RAN) that had substantial amount of predictive power on word fluency were excluded from the analysis. Apparently, the overlaps between PS and OK as well as PS and alphanumeric RAN suppressed the unique effect of PS on word fluency. Additional regression analyses for the path model also confirmed this finding. That is, in both grade levels, PS made significant unique contributions to OK (11% in Grade 2 and 33% in Grade 4). Such an interrelation between PS and OK also illustrated the indirect influence of PS on word reading fluency via OK in the path model. In addition, this indirect contribution of PS increased across grades (β=

.15 for Grade 2 and β= .29). As such, it is proposed that how quickly children are able to process and respond to visual information is a significant independent precursor of word level reading fluency in Turkish. All these findings concur with the ones found by Denkla and Cutting (2001). The researchers did not find any direct contributions of PS on the word-level reading of first, second, and third graders in English. However, they identified an indirect effect of PS on word reading which was mediated by OK. Thus, consistent with Kail and Hall (1994), the researcher suggested that PS may stand as a global mechanism that could affect a variety of word reading predictors. In other words, Cutting and Denckla proposed that a certain level of PS is a *general entry or lower-level requirement* to be able to develop the quickness necessary for other cognitive abilities such orthographic knowledge, rapid naming, phonological awareness, and memory span and for word reading. This current study provided further evidence for this postulate.

6.1.6 OK and word reading fluency

This study also intended to examine the relationship between word level fluency and OK, the ability to form, store, and access permissible letter patterns. According to Ehri (2005), knowledge of letter chucks provides readers at consolidated phase with remembering how to read multisyllabic words, unfamiliar words, and pseudowords rapidly. For example, when the child knows the relevant chunks in long words such as *interesting*, he/she has to make fewer connections to retain the word in memory because the number of the connections is decreased from 10 grapheme-phonemes to four syllabic chunks. For another example, the reader in the consolidated stage stores a multiletter unit *–ent* as a chunk in memory after recurrently reading the words such as *went, sent*, and *bent*. As a result, when the consolidated alphabetic reader comes across the word *dent* for the first time, he/she needs to associate just the two units, *d* and *–ent.* Ehri (2005) pointed that this knowledge of orthographic patterns ultimately helps the development of efficient fluency in word recognition. Parallel to this view, OK has consistently been identified as a critical predictor, explaining considerable amount of unique variance in word reading (Asadi et al. 2017; Barker et al., 1992; Cunningham & Stanovich, 1991; Cutting & Denckla, 2001; Deacon, 2012; Georgiou et al., 2008c; Olson et al., 1989; Papadopoulos et al., 2016; Ricketts et al., 2007). In the current study, readers with better OK were expected to display better performances in word-level reading fluency. In line with the research hypothesis and the results reported in earlier studies, this study demonstrated that OK was the strongest correlate of word reading fluency in both grade levels (r= .71 in Grade 2; r= .72 for Grade 4). A series of simultaneous regression analyses also demonstrated that performance on the orthographic processing task uniquely predicted word reading fluency skill in both Grade 2 and Grade 4. In fact, it made the biggest independent direct contribution to word reading fluency in Grade 2 (explaining 45% of the variance) in comparison with other variables included in the study. Likewise, it was the second strongest predictor of word fluency in Grade 4, accounting for 45% of the variance. Such findings were remarkably higher than those of Barker et al. (1992) who found a significant 10% of variance attributable to OK for speed pronunciation of isolated words for third graders. The results were also convergent with those of Cunningham and Stanovich's study (1990) in which OK accounted for an additional 10.2% of the variance in word recognition ability of third and fourth graders in English when entered subsequent to age, nonverbal intelligence, memory and phonological skills. Overall, children's sensitivity to the regularities in written language appears to directly and substantially accelerate their speed at word even in early grade levels independent of parental education level, vocabulary, and other cognitive and linguistic variables such as alphanumeric RAN, PA, PM, MA, and PS. The direct contribution of OK to word fluency is also compatible with the results of Asadi et al. (2017) in Arabic. The study identified significant direct influence of OK on Arabic word reading fluency for children from first to sixth grades with β weights ranging from .27 to .51 across grades. The path analyses in the present study displayed higher β weights for word reading fluency in Grade 2 and 4 (β= .59 and β= .50 respectively). In sum, the substantially stronger relationship of orthographic ability to the measures of word reading fluency suggests that children's quick recognition of permissible letter patterns to identify individual words, or word parts, on the printed page and their fluent access to the orthographic representations of the target words play a distinct facilitative role in the progression of fluent reading in Turkish. Georgiou and colleagues (2008c) accounted for such a strong connection with the task demands. According to Georgiou et al. (2008c), the significant effect of orthographic processing on the reading fluency tasks reflects Greek-speaking children's reliance on large grain size units in timed condition. That is, depending on the demands of a particular reading task, children may adjust the grain size units that they apply during reading. When speed is not required, children rely upon phonological recoding; however, when a speeded response is needed, children utilize bigger grain size units in a transparent orthography. Likewise, the children might have used their orthographic strategies to achieve fluent word recognition (i.e., sight word reading) in Turkish under time pressure.

6.1.7 Vocabulary and word reading fluency

A growing body of research has examined the relative role of vocabulary in various word reading skills (e.g., word reading accuracy, exception word reading, and nonword reading) (Joshi, 2003; Nation & Snowling, 2004; Ouellette, 2006; Ricketts et al., 2007; Verhoeven et al., 2011). These studies, in general, have shown that vocabulary is important for word reading. In the current study, vocabulary knowledge was explored in relation to word reading fluency. The correlational results revealed an increasing association between vocabulary knowledge and word fluency across grade levels (r= .49 for Grade 2; r= .64 for Grade 4). In spite of such strong correlations between vocabulary and fluent word reading, simultaneous regression analyses did not identify any direct influence of vocabulary knowledge on word level fluency in any grades. These results were similar to Ricketts et al., (2007) in which vocabulary did not account for any variance in nonword reading fluency. On the other hand, the findings of the current study did not exhibit any parallelism with the studies (e.g., Nation & Snowling, 2004) which explored vocabulary knowledge with reference to the word and/or exception word reading accuracy. It appears that the relative contribution of word knowledge changes depending on the reading measure used at word level. On the other hand, in a longitudinal study with Dutch-speaking primary school children, Verhoeven and colleagues (2011) found an influence of early vocabulary on children’s later word decoding fluency. However, the researchers reported that the influence of early vocabulary in word decoding fluency was weaker compared to its influence on comprehension. As such, the researchers explained that high transparency of Dutch orthography mediates the relationship between fluent word decoding ability and vocabulary. Likewise, it is highly probable that because Turkish orthography is transparent, vocabulary knowledge did not occupy any decisive role for the development of fluent word reading in comparison with its role in reading comprehension which will be thoroughly discussed in this chapter. Herein, it is emphasized that children could achieve fluent reading irrespective of their level of vocabulary knowledge. Apparently, vocabulary did not have an influential role in word reading fluency when considered together with more powerful predictors of reading, namely alphanumeric RAN and OK in Turkish.

6.1.7 Parents' education level and word reading fluency

In addition to the cognitive and linguistic variables, this study questioned the influence of parental education level as a component of SES on word fluency. SES is usually defined by the educational level, the occupational status, and the income of the parents and has been acknowledged as a potent predictor that may create individual differences in overall reading success (Aikens & Barbarin, 2008; Bowey, 1995; Cornwall, 1992; Jehangir et al., 2015; Whitehurst & Lonigan, 1998). Different from these studies, this study particularly explored whether children's parental education level was significantly associated with their word reading fluency performances. Correlational results displayed significant moderate correlations between parents' education level and word reading fluency in second and fourth grades (r= .34 for Mother Education and r= .47 for Father Education in Grade 2; r= .52 for Mother Education; r= .40 for Father Education in Grade 4). On the other hand, parents' education level did not directly predict word fluency in any grades when it was entered into the equation together with alphanumeric RAN, PA, PM, MA, OK, PS, and vocabulary. Further, SES had no indirect influence on word fluency through vocabulary. Based on these results, it can tentatively be concluded that discrepancies in parental education level does not cause any differences in the lower level reading skills such as word fluency in Grade 2 and 4 in Turkish. Such a disconnection can also be explained by the role of schools in providing equal experiences during the reading acquisition process. In other words, the primary schools in Turkey use the same curriculum and the method (i.e., SBSIM) in teaching how to read. The SBSIM was claimed to boost children's fluency (Baştuğ & Erkuş, 2016; MEB, 2005). Accordingly, the children with lower parental education level in this study might have compensated the gap by means of the instruction that they had received for early reading acquisition at school and thus read as fluently as the children with higher parental education level.

6.2 Reading comprehension in Turkish

Reading comprehension plays a significant role in personal growth and success in academic and social life. It has been acknowledged as a critical skill and an ultimate goal of the reading activity (Oakhill & Cain, 2006; Stanovich, 2000; Stevens et al., 1991). It is multidimensional and entails the use of various types of knowledge (e.g., linguistic knowledge, orthographic knowledge, and general knowledge about text forms and prior world knowledge) and many subskills such as visual processing of target words, making use of syntactic rules and linking the words to understand the underlying meaning of the sentence, relating sentences within the text and constructing inferences, and utilizing background knowledge (Oakhill & Cain, 2006; Perfetti & Stafura, 2014). This current study sought to explore the role of word reading fluency, alphanumeric RAN, PS, MA, vocabulary, and parents' education level in reading comprehension. The relation of reading comprehension with each of these variables will be discussed in the upcoming subsections one by one.

6.2.1 Word reading fluency and reading comprehension

Studies in various languages with different sample groups have underscored the critical role of fluent word recognition and perceived it as a keystone for the development of successful comprehension (Bell & Perfetti, 1994; de Jong & van der Leij, 2002; Fernandes, Querido, Verhaeghe, Marques, Araujo, 2017; Fuchs et al., 2001; Klauda & Guthrie, 2008; Nathan & Stanovich, 1991; Perfetti, 2007; Protopapas et al., 2007; Schwanenflugel et al., 2004; Therrien, 2004; Wise et al., 2010). Accordingly, it was assumed that word-reading fluency would be a powerful predictor of reading comprehension in both grades in Turkish. Parallel to the research studies and the hypothesis, the correlational analyses in the present study indicated that comprehension was strongly linked to word reading fluency (r= .66 in both grade levels). The multiple regression analyses supported this result, displaying that word reading fluency explained 21% of the unique variance in reading comprehension in Grade 2 once it was entered into the regression with vocabulary and parental education level. In Grade 4, word fluency had a diminishing but significant contribution to comprehension (10%) when considered with other variables. The present findings lend support to LaBerge and Samuels's (1974) *Automaticity Theory*, which holds that fast and accurate word recognition frees cognitive resources for reading comprehension. In other words, provided that readers achieve automatic, instant word recognition, they can gradually shift attention and cognitive resources to understanding what they are reading. The close relationship between fluent word reading and reading comprehension also provides empirical evidence for Hoover and Gough's (1990) *Simple View of Reading*, which asserts that aside from linguistic comprehension, the development of reading comprehension is partially dependent upon rapid word decoding. The results of this current study are also harmonious with *Verbal Efficiency Theory* (Perfetti, 1985) and *Lexical Quality Hypothesis* (Perfetti & Halt, 2002), in which, basically, automatic, resource-cheap word-level processes are presumed to preserve processing resources for higher level comprehension and thus support it. The relation of word reading fluency to reading comprehension found in this study also concurs with several studies conducted in different languages (e.g., Fernandes et al., 2017; Kim et al., 2010; Kirby et al., 2010; Klauda & Guthrie, 2008; Norton & Wolf, 2012; Parrila et al., 2004; Shankweiler, 1989; Stanovich, 1993; Wise et al., 2010) which regarded fluent word reading as an indispensable prerequisite for a successful comprehension in different grade levels. Furthermore, de Jong and van der Leij (2002) observed a substantial influence of word reading speed on reading comprehension along with vocabulary and listening comprehension from first to third grade in Dutch. The researchers also reported that RAN was the main contributor of word reading fluency. As such, the researchers concluded that the development of fluent word reading and reading comprehension is grounded on partly different cognitive and linguistic determinants. This present study provided further evidence for this assumption by revealing similar findings in Turkish.

6.2.2 Vocabulary and reading comprehension

In a broad-scope framework of reading comprehension, Perfetti and Stafura (2014) put knowledge of written words and meanings at the heart of reading and defines it as a *pressure point* for reading comprehension, viz. “a prime candidate for a cause of reading comprehension difficulty” (p. 26). A great deal of research has also underlined that vocabulary knowledge is a prerequisite for understanding the reading text (Babayiğit & Stainthorp, 2013; Cunningham & Stanovich, 1997; Jenkins et al., 1984; Joshi, 2005; Nation & Snowling, 1998; Manis et al., 2000; Nation et al., 2004; Oakhill & Cain, 2006, Ouellette, 2006; Ricketts et al., 2007; Verhoeven et al., 2011). Consistent with these studies, vocabulary was significantly correlated with reading comprehension in both grade levels (r= .49 for Grade 2; r= .64 for Grade 4) in the current study. Furthermore, it concurrently accounted for additional variance in reading comprehension beyond word reading fluency and other predictors of reading such as alphanumeric RAN, MA, PS, and parental education level. That is, vocabulary explained 16% and 13% of the variance in reading comprehension in Grade 2 and Grade 4 respectively. These results are also compatible with those found in some studies which investigated the role of vocabulary in concurrent reading comprehension for primary school children (e.g., 17.8% in Ricketts et al., 2007; 25.2% in Nation & Snowling, 2004). The results also confirm the research hypothesis which predicts that children's expressive vocabulary knowledge will facilitate their reading comprehension in Turkish.

6.2.3 Parents' education level and reading comprehension

Literature pertinent to SES components (parental income, education level, and occupation) reported a significant link between children's socioeconomic background and measures of academic achievement (White, 1982). Research studies also showed that the types of the extended reading, writing and talking activities as well as the characteristics of academic language in the home environment that the children are exposed to differ depending on the parental income and education level (Adams, 1990; Aarts et al., 2011; Heath, 1989). More specifically, this present study took parental education level into consideration as a family background indicator along with word reading fluency, vocabulary, alphanumeric RAN, and PS at the same point in time to determine the relative importance of each variable in children's reading comprehension. It was presumed that the children with high parental education would surpass the children with low parental education in reading comprehension scores. Studies in the research literature revealed that children's socio-economic backgrounds were strongly related to overall reading achievement (e.g., Aikens & Barbarin, 2008; Jehangir et al., 2015) A growing body of research has showed that learners from a high socioeconomic background performed significantly better than those from a low socioeconomic background in reading comprehension (e.g., Cheng & Wu, 2017). In the current study, the correlational results indicated a significant association between parents' educational attainment and reading comprehension (r= .39 for Mother Education Level and r= .63 for Father Education Level in Grade 2; r= .68 for Mother Education Level and r= .42 for Father Education Level in Grade 4). Simultaneous regression analyses also showed that the role of parents' educational attainment in accounting for concurrent variance in reading comprehension increased across grades. That is, whereas second graders' parental educational level explained 11% of the variance in their reading comprehension performance, fourth graders' parental educational level made 22% of contribution. This growing influence of parents' education level on comprehension can partially be explained by Chall's developmental model of reading. According to this model, students at Stage 3 (Grades 4-8) use reading as an instrument for learning as texts involves new words and ideas, becoming more varied, complex and challenging linguistically and cognitively. Accordingly, in the previously reported study, Chall and Jacobs (2003) explored the dynamics influencing the critical transition from Stage 2 to 3 in which children pass from *learning to read* to *reading to learn*. The researchers followed low-income children from grades 2, 4 and 6 for two years and measured their vocabulary knowledge (word meaning), word recognition, word analysis, oral reading, reading comprehension and spelling. Concerning reading comprehension, the study reported that the children in low-income group lagged behind the normative group in Grades 6 and 7. The researchers pointed that the deceleration on word meaning scores which started in Grade 4 ultimately influenced reading comprehension of low-income children in Grades 6 and 7. Different from Chall and Jacobs (2003), the current study found the traces of parents' education level effect even in second graders' comprehension performances. The influence of parental education background doubled in Grade 4 where the children, according to Chall's stages of reading development, began to be exposed to linguistically and cognitively more complex reading materials. Furthermore, in line with Chall and Jacobs (2003), the increasing influence of parental education level found in the current study can be explained by the mediating role of vocabulary in reading comprehension. In other words, the path analysis results revealed that in addition to its direct influence, parental education affected reading comprehension indirectly through vocabulary in Grade 4. However, such an indirect influence of parental education level was not observed in Grade 2, in which children were exposed to more concrete, and cognitively and linguistically less challenging words. That is, parental education level was not a significant predictor of vocabulary in Grade 2 although it predicted 9% of the variance in Grade 4.

6.2.4 MA and reading comprehension

An increasing body of research provided evidence that MA was significantly related to reading comprehension across different grade levels and languages (Carlisle, 1995, 2000; Cheng, et al., 2016; Deacon et al. 2014; Deacon & Kirby, 2004; Gafoor

& Remia, 2013; Green, 2009; Kirby et al., 2012; Levesque et al., 2017; Yeung et al., 2013). Considering the rich and complex morphology of the Turkish language, it was hypothesized that children with high MA would present better performances in reading comprehension as high MA helps children build meaning from the reading passage and make more accurate and efficient decisions on the meanings and syntactic functions of unfamiliar or derived words within the reading text (Carlisle, 1995; Deacon & Kirby, 2004). In line with the results of the previous studies and the research hypothesis, the correlational findings yielded a significant connection between MA and reading comprehension in Grade 2 (r= .55) and Grade 4 (r= .43). On the other hand, unlike the results of the previous studies and the research hypothesis, interestingly, MA did not exert any significant direct influence on reading comprehension in either grade level when it was entered into the regression together with alphanumeric RAN, PS, vocabulary, parental education level, and word reading fluency. It appears that once the strong predictive power of vocabulary, parental education level, and word reading fluency are taken into account, MA does not uniquely explain any variance in Turkish reading comprehension. However, MA had an indirect contribution to comprehension via vocabulary in both grade levels (β= .16 in Grade 2; β= .08 in Grade 4, see also Figure 11 and Figure 12). These findings suggest that awareness in parts of words such as inflections and derivations helps children expand their vocabulary knowledge, which in turn contribute to an increase in their reading comprehension.

6.2.5 Alphanumeric RAN and reading comprehension

Some studies underlined the predictive strength of RAN in reading comprehension, especially for inadequate readers (Abolafya, 2008; Manis et al., 1999; Manis et al., 2000; Plaza & Cohen, 2003). Further, based on a study with adequate readers, Joshi and Aaron (2000) suggested the inclusion of naming speed in a model of reading. The researchers found that speed of letter naming explained additional 10% of variance in reading comprehension, while decoding and listening comprehension explained 48% of the variance. Thus, the researchers revised the classical Simple View of Reading proposed by Gough and Tunmer. They proposed *Component Model of Reading* in which they added speed to the formula, $R = D \times C + S$. This current study explored the role of alphanumeric RAN in reading comprehension for adequate readers by taking different cognitive and linguistic variables into consideration. It was presupposed that alphanumeric RAN made an indirect contribution to reading comprehension rather than a direct one. The path analysis results confirmed this hypothesis. That is, different from Joshi and Aaron (2000), alphanumeric RAN did not have a direct influence on comprehension in Grade 2 and Grade 4 once it was entered together with PS, MA, vocabulary, parents' education level, and word reading fluency. Still, one can argue that the inclusion of speed of naming might improve predictive capacity of a reading model because the reduced path model in the current study showed that alphanumeric RAN made an indirect contribution to reading comprehension through word reading fluency in both Grade 2 (β= .12) and Grade 4 (β= .14). Such results show that word reading fluency mediates the relationship between alphanumeric RAN and reading comprehension. Apparently, when children achieve automatic rapid naming at word level reading, they are able to spare their limited cognitive resources for comprehension. This assumption is congruent with the relevant literature. For instance, Kirby et al. (2003) underlined the mediating role of reading fluency for the close RAN-comprehension connection. That is, the researchers found that RAN was a significant precursor of fluent word reading and fluent word reading was mandatory for successful comprehension. Likewise, Wolf and Katzir-Cohen (2001) emphasized that a certain level of reading speed has a pivotal role in sufficient comprehension.

6.2.6 PS and reading comprehension

Previous studies have emphasized that PS indirectly influences reading comprehension via rapid naming and word reading fluency (e.g., Catts et al., 2002; Christopher et al., 2012; Kail & Hall, 1994). That is, to the extent that children achieve rapid and efficient recognition of letters and words, they can read more text and integrate the text and meaning more rapidly. Furthermore, Christopher and colleagues (2012) explained the low contribution of PS to comprehension via contextual clues helping readers for word recognition in extended text reading. In the current study, it was hypothesized that PS would make an indirect contribution to reading comprehension through word reading fluency. The path analysis results based on a set of simultaneous regression analyses disconfirmed this hypothesis and indicated that PS had neither direct nor indirect effect (through fluent word reading) on reading comprehension in Grades 2 and 4 once it was entered into the regression equation with alphanumeric RAN and OK. However, as previously discussed, PS was strongly predictive of fluent word reading once OK and alphanumeric RAN were dropped from the regression equation in both grade levels. This finding suggests that the interplay between PS and OK, and PS and alphanumeric RAN might inhibit the direct effect of PS on word fluency and that PS might exert an indirect contribution to reading comprehension via word reading fluency. Furthermore, the analyses showed that PS also exerted its indirect influence on reading comprehension through the three-path mediating effect of OK and word fluency in both grade levels (β= .05 in Grade 2 and β= .07 in Grade 4). In other words, PS affected OK, which made a significant contribution to word reading fluency, which, in turn, backed up reading comprehension. Once again, this indirect influence displays the importance of speed for lower and higher order skills of reading.

6.3 The interplay among variables and reading achievement

This research study is primarily concerned with the role of multiple cognitive, linguistic, and familial background dynamics in fluent word recognition and reading comprehension. In addition to the relation of the core reading skills with different predictor variables (i.e., alphanumeric RAN, PA, PM, MA, OK, PS, vocabulary, and parents' level of education), an in-depth examination of the significant interconnections among these variables might give more insight about the attainment of critical reading skills.

With respect to RAN, some researchers placed RAN under phonological processing skills along with PA and PM (e.g., Schatschneider et al., 2002; Torgesen et al., 1997; Wagner & Torgesen, 1987). In contrast to this perspective, the findings in the current study found significant but low correlations of alphanumeric RAN with PA (*r* = -.40 in both grades) and PM (*r* = -.36 in Grade 2; *r* = -.30 in Grade 4). The correlation coefficients found in this study between alphanumeric RAN and PA are similar to that in Swanson and colleagues' comprehensive meta-analysis (mean *r* = .38). Likewise, Babür (2003) found no significant correlation between RAN components and PM for second graders. She explained that second graders might have become so automatized in naming digit, letters and objects that STM did not exert any effects on these variables. The current study provided additional evidence for this assumption. Moreover, the results of the regression analyses in the current study showed that alphanumeric RAN accounted for a large proportion of unique variance in fluent word reading even when other phonological processing skills such as PA and PM were partialled out from the regression equation (R^2= .23 in Grade 2; R^2= .47 in Grade 4). These regression results provided further evidence that alphanumeric RAN and phonological processing skills are probably discrete constructs and underlying different cognitive processes as suggested in different research studies (e.g., Denckla & Cutting, 2001; de Jong & van der Leij, 1999; Norton & Wolf, 2012; Parrila et al., 2004; Wolf & Bowers, 1999). This study suggested that rather than phonological processing skills, alphanumeric RAN is a robust predictor of fluent word recognition.

Alternatively, in a series of research studies, Bowers and colleagues (Bowers et al., 1994; Bowers & Wolf, 1993; Sunseth & Bowers, 2002) emphasized the association between rapid naming and OK development to explain RAN-reading connection. They speculated that an impaired rapid naming mechanism (i.e., slow naming of visual stimuli such as letters) may negatively affect the sensitivity to commonly occurring orthographic patterns and inhibit the quick build-up of orthographic codes for common patterns, which ultimately impede efficient word reading. Accordingly, this present study particularly investigated the mediating role of OK in Turkish word reading fluency. The results presented that unlike Loveall et al. (2013) and Manis et al., (2000) rather than RAN, PS and PA were unique predictors of OK when entered into the regression equation together in the current study. These results are also compatible with Cutting and Denckla (2001), who reported that when PS was taken into account, RAN did not have any predictive strength on OK. According to Cutting and Denckla (2001), having a close link with

IQ, a certain level of PS is vital for the development of speed necessary for variables such as OK. That is, it seems that general speed of visual activation enables linking of letters and orthographic structures into words. Further, the role of PA in OK in Grade 2 reflects the children's reliance on phonological representations acquired through the spoken language at this grade level. That is, due to the conflict that exists between conventional spellings and everyday pronunciations, the children might not establish the correct letter patterns for certain words (e.g., *plan* vs *pilan* [plan], *bitti* vs *bitdi* [finished], *kaplumbağa* vs *kaplumba* [turtle], *serbest* vs *serbes* [free]) at early grade levels. Ultimately, such a discrepancy between the spoken form of a word and its conventional spelling might cause fluency problems in reading. Thus, explicit teaching of such variations in early school years might help children build sound knowledge of orthography and prevent the difficulties in fluency that might appear in reading. Such a training might also discard the emergence of spelling errors in Turkish as proposed by Sönmez (2015). In addition, as previously discussed, alphanumeric RAN and OK had independent and unique influence on word fluency in both grade levels. Such results are in line with some other studies which found no evidence for RAN-OK link, but reported the unique contribution of RAN beyond the effects of OK (e.g., Denckla & Cutting, 2001; Li et al., 2012; Rothe et al., 2014). It appears that boosting children's PA and PS abilities will probably help them construct more robust OK, which, in turn, enhance their word reading fluency in Turkish.

Concerning the relation of PA with PM, significant and high correlations were observed in the current study (r= .59 in Grade 2; r= .46 in Grade 4). In line with the literature, these correlational findings suggest that PA tasks such as phoneme blending and phoneme segmentation require retention of a series of sounds simultaneously and so place strong demands on PM (Alloway et al., 2004; Asadi et al., 2017; Brady 1986; Cutting & Denckla, 2001; Hansen & Bowey, 1994; Näslund & Schneider, 1991; Nithart et al., 2011; Wagner et al., 1994). Alternatively, verbal phonological short-term memory tasks such as digit span and nonword repetition mandate phonological processing in order to temporally store verbal material into a phonological code (Gathercole et al., 2006).

Regarding the relation of MA to other precursors of reading, studies highlighted the unique contribution of MA to vocabulary (e.g., Green, 2009; McBride-Chang et al., 2005; McBride-Chang et al., 2007). Consistent with the research literature, significant and high correlations were observed between MA and vocabulary (r= .67 in Grade 2; r= .45 in Grade 4). As such, based on the previous studies and the correlational results, vocabulary was presumed to be a mediator, influencing the relation between MA and reading. The regression results confirmed this hypothesis. That is, MA was found to be a powerful predictor of vocabulary in both Grade 2 and Grade 4 (explaining 27% and 11% of the unique variance respectively). Thus, it can tentatively be concluded that children take the advantage of their existing morphological knowledge to attain the meanings of new words. As Green (2009) proposed, children use meanings of familiar base words and suffixes to deduce meanings of unfamiliar derivatives (e.g., using the meaning of *let* in *piglet* to estimate the meaning of unfamiliar word, *owlet*). This, in turn, enhance children's reading comprehension skills.

Furthermore, Cutting and Denckla (2001) noted that the general speed of processing could affect a variety of word reading predictors. The significant association between PS and alphanumeric RAN found in the current study (r= -.54 for Grade 2; r= -.56 for Grade 4) supports this finding and is in line with other research studies in which RAN was found to be a powerful predictor of reading fluency partially because speed is an integral part of RAN performance (Kail & Hall, 1994; Papadopoulos et al., 2016). It appears that to some extent the connection between children's quickness in general processing and rapid naming might regulate their performance in core reading skills.

Finally, the connection between vocabulary and parental education level worths mentioning. Hart and Rinsley (1995) identified qualitative and quantitative differences in the words that children from lower vs. higher SES families encounter. Chall and Jacobs (2003) found that vocabulary knowledge was the first variable in which children from low-income familial background lagged behind the children from the normative group in the fourth grade. Parallel to these studies, this current study found that parental education level accounted for a significant unique variance in vocabulary knowledge (9% in Grade 4). Such results show that parents' education level might influence vocabulary growth, at least quantitatively, which, in turn, affect children's comprehension skills.

6.4 Conclusion

In the present thesis study, an attempt is made to shed further light upon the concurrent predictors of word reading fluency and reading comprehension in children learning to read in Turkish, an orthographically consistent language. The results suggested that fluent word reading and reading comprehension are related to each other; however, different variables underlie the development of these two reading skills.

Concerning word fluency, the findings indicated systematic influences of alphanumeric RAN on fluent word recognition across grade levels. A possible explanation may be that the students at Grade 2 and 4 were efficiently making use of sight word reading strategies measured by letter and number serial naming. Such findings concur with the previous studies that identified RAN as a persistent predictor of word reading fluency in orthographically transparent languages. Additionally, the influence of alphanumeric RAN increased across grade levels as children gained more experience and automatization in reading. In addition, the present study emphasized the independent and consistent contribution of OK to word reading fluency from Grade 2 to 4. Once again, the findings provided evidence that the children in Turkish master orthographic processing skills and use these skills even in early grade levels, which provide them with higher levels of achievement in sight word reading. In other words, children draw on their knowledge of permissible letter chunks to a greater extent so as to increase their speed in reading, particularly under time pressure. Parallel to these findings, PA was not found to be predictive of second and fourth graders' fluent word reading in Turkish. That is, having reached orthographic stage in reading, phonological decoding strategies became redundant for the children in Grade 2 and 4 in fluent word recognition. It is highly probable that PA loses its predictive power on word reading fluency due to the transparent nature of the Turkish orthography. That is, because children in transparent orthographies reach the ceiling on decoding rapidly, the facilitative role of speech analysis skills disappears as a function of reading expertise (Babayiğit & Stainthorp, 2007; de Jong & van der Leij, 2002; Landerl & Wimmer, 2008; Mann & Wimmer, 2002; Öney & Durgunoğlu, 1997). Another finding of the present study is that PM did not exert any influence on Turkish children's fluent word reading. Apparently, because second and fourth graders had already attained grapheme-phoneme correspondence rules and practiced blending operations during reading in a phonetically regular language, word reading fluency may not have imposed a heavy burden on children's cognitive processes such as PM. The contribution of MA to word reading fluency was also nonsignificant. This might be due in part to the focus of the reading task used at word level. In the current study, fluency was aimed at word level reading. MA might have accounted for a significant quantity of variance if the focus of the reading task had been accuracy. As Deacon (2012) suggested, such a result might also stem from the relatively large number of variables included in the regression equation, in particular with the unique presence of OK and alphanumeric RAN, both of which are the robust predictors of fluency in transparent orthographies. Likewise, the influence of PS on fluent word reading was suppressed due to the interconnection of PS with OK and alphanumeric RAN. PS made a sizeable amount of direct contribution to word fluency once these variables were excluded from the regression equation. Furthermore, PS had a substantial amount of indirect influence on word reading fluency which was mediated by OK. This finding offers glimmerings of evidence for the idea that a certain level of PS is a *general entry or lower-level requirement* for the development of other precursors of reading and of word reading, as proposed in the research literature. In addition, expressive vocabulary knowledge did not seem to play a significant role in word reading fluency probably because the transparent orthography of Turkish does not necessitate the use of word knowledge in fluent word reading. In addition to cognitive and linguistic variables, this study also examined the predictive power of parental educational attainment as a SES component on word fluency. It was found that parental education level was not a significant predictor of word fluency performance in second and fourth grades. It is possible that the type of the reading task might mediate the relationship between parental education level and reading. That is, the discrepancies in parental education level might not cause any differences in lower level reading skills such as fluent word recognition. Alternatively, the reading programs applied in primary schools might equip children from all SES backgrounds with the equal experiences necessary for fluent word reading.

With regard to reading comprehension, consistent with the pertinent literature, word reading fluency was found to be one of the strongest and consistent predictors of reading comprehension. In other words, the more fluent the readers were the more successful they were in comprehension. This finding provided substantial empirical evidence for various reading models such as *Automaticity Theory*, *Simple View of Reading*, *Verbal Efficiency Theory*, and *Lexical Quality Hypothesis*, which regard automatic and efficient word recognition as one of the preconditions of successful reading comprehension. Furthermore, children's vocabulary knowledge at both grade levels explained a significant amount of variability in their concurrent comprehension performances. This *pressure point*, as defined by Perfetti and Stafura (2014), seems to enhance children's capacity in higher order reading skills although it does not explain any variance in word-level fluency skill. Likewise, it was found that parental educational level was a reliable correlate and predictor of reading comprehension in both grade levels. The growing nature of this predictive power across grade levels is noteworthy. Apparently, as children are exposed to linguistically and cognitively more complex text materials, the influence of parental education level on comprehension increases as well. An additional support for this claim also comes from the mediating role of vocabulary in parental education and comprehension association. That is, parental education affected reading comprehension indirectly through vocabulary in Grade 4. However, such an indirect influence of parental education level was not observed in Grade 2 presumably because second graders were exposed to cognitively and linguistically less challenging words in reading. Interestingly, MA did not yield any significant direct influence on reading comprehension in any grade levels when it was entered into the regression together with alphanumeric RAN, PS, vocabulary, parental education level, and word reading fluency. On the other hand, the indirect influence of MA on reading through vocabulary shows that awareness in morphological structures of a language provides children with expanding their word knowledge, which eventually eases the process of reading comprehension. Similar to MA, alphanumeric RAN made an indirect contribution to children's comprehension through word reading fluency. This result presents further evidence for the assumption that certain level of automatization in word reading is critical for successful reading comprehension. As in alphanumeric RAN, it was found that the contribution of PS to comprehension was indirect (via the three-path mediating effect of OK and word fluency in both grade levels). This finding again suggests that a certain level of speed at lower order reading skills is a prerequisite for more complex reading skills such as comprehension.

Furthermore, the findings in the present study revealed that in order to achieve a more comprehensive framework for reading development, the interplay among the predictors of reading should also be taken into account. To be more specific, the independence of alphanumeric RAN from other phonological processing skills might imply that alphanumeric RAN is a separate construct and deficiency in rapid naming might cause another type of reading difficulty. The interconnection between PA in OK in Grade 2 might indicate that the children at this grade level rely heavily on their phonological representations acquired through the spoken language in their orthographic choice. That is, when a conflict exists between conventional spellings and everyday pronunciations, the children might utilize their spoken language skills and thus do not establish the correct letter patterns for certain words. This might eventually decelerate their speed in word reading. The interrelation between MA and vocabulary knowledge suggests that higher level of MA might boost the attainment of new words, which, in turn, significantly influence reading comprehension. The connection between PS and OK as well as PS and alphanumeric RAN also gives further insights about the importance of speed in the development of reading-related cognitive and linguistic skills. The findings in the current study also revealed that vocabulary knowledge, which is a significant predictor of reading comprehension was interrelated with parental education level. In addition, it was observed that children with higher PA performed better on vocabulary task. Finally, parental education level was found to be correlated with other variables such as alphanumeric RAN, PA, PM, PS, MA, and OK, suggesting that discrepancies in SES components might result in individual differences in these cognitive and linguistic variables, which eventually cause a gap in children's reading achievement. Thus, all these interrelations should be taken into consideration for establishing a sound model of reading.

6.5 Pedagogical implications of the study

Reading is a complex and multifaceted ability that requires the integration of several different cognitive, linguistic and perceptual processes. It might also be exposed to the influences of children's socioeconomic level directly or indirectly. The results of the data presented in the current study suggest that different predictor variables make significant and unique contributions to the subskills of reading, namely fluent word recognition and comprehension. That is, while children make use of serial rapid naming and orthographic awareness in word reading fluency, fluent word recognition, word knowledge, and parents' education level boost their comprehension ability in Turkish. Therefore, educators could use activities that help children improve their rapid naming and orthographic knowledge to increase children's fluency in word reading. The development of these skills facilitates efficient word reading, which, ultimately, backs up children's comprehension capacity. The emphasis on vocabulary attainment in the classroom environment could also lead to an improvement in children's comprehension ability. In addition, the instructional support that children have in these linguistic and cognitive skills might diminish the gap that appears in reading skills due to parental education level. Predictors of reading might also interact with each other over the course of reading development. Educators should keep in mind that such interplays give rise to the mediating influences of certain variables on reading skills. To illustrate, it was found that children's PA skills influenced their OK performances in Grade 2, which ultimately influenced children's fluent word recognition performances. Although Turkish has a transparent orthography, there might be a mismatch between spoken forms of words and their conventional spellings (e.g., *plan* vs *pilan* [plan]). The degree of this mismatch might also change depending on the regional dialect used in children's hometown (e.g., *gelmicem* instead of *gelmeyeceğim* in Ordu [I will not come]). The findings of the present study proposed that students might transfer their phonological representations of words into their orthography and make incorrect judgements about the conventional spelling of certain words. This, in turn, implies that an emphasis on such inconsistencies between pronunciations and spelling as well as explicit teaching of conventional spelling rules for certain words in Turkish will inhibit the formation of inaccurate orthographic patterns.

6.6 Limitations of the study

This study has some limitations worth mentioning. First, the current study explored the role of multiple variables based on the data gathered through a cross-sectional research design. A longitudinal study would give rise to further insight about the longer-term effects of these variables in reading fluency and comprehension in Turkish. Second, the current study only made use of the parents' education level as a SES component. Due to constraints of time and procedural difficulties, the researcher could not reach other indicators of SES such as parental income, home resources, and neighborhood characteristics, which would provide a deeper understanding about the role of SES in reading achievement. Third, the scope of some measures such as MA administered in the present study was limited to certain morphological structures. That is, the test measured children's MA capacity in certain inflectional and derivational morphemes. Considering the rich morphology in Turkish, a more comprehensive MA task might have assessed children's overall MA performance more meticulously. Furthermore, because the study included several variables, the researcher endeavored to illustrate the possible path lines among the study variables that could influence the results in a proposed path model. Meanwhile, in line with the previous studies, the researcher intended to develop a model of reading that appeared lucid and coherent. However, this developed model might not have reflected all the possible relations among the variables. The inclusion of additional path lines might have given more insights about the complexity of the reading activity. Another limitation of the study was that the sample size included in the study might have limited the power of the study and diminished the opportunity for extrapolating the statistical analysis results to the overall population. In addition, information about standardized scaling of test scores was not available for Turkish children, which made it difficult to report whether the children participants performed at, above, or below the norm for their age group. Last but not least, the participant children were selected among normally developing children based on teachers' judgements. IQ tests could have been applied to all the participants to increase reliability and control the level of IQ.

6.7 Recommendations for further research

The current study explored the concurrent relations of critical reading skills with linguistic, cognitive, and SES variables at Grade 2 and 4. Further research can focus on the data collected from kindergarten to fourth grade to address the developmental differences across various grade levels more thoroughly. In addition, this study was based on the concurrent assessment of each variable. Assessing children's performances in each variable longitudinally will provide future research with more insights about the developmental patterns of reading attainment in Turkish. Also, future studies should include a larger sample size, which will provide more generalizability and stronger statistical analyses such as Structural Equation Modelling. Besides, it is highly suggested to include various SES components simultaneously so as to define the relative contribution of SES to reading acquisition in Turkish more precisely. Finally, teachers are indispensable part of literacy instruction. Further studies can focus on the role of teachers in reading acquisition. In other words, more research is needed to gain insight about how teachers act and what they do to help children overcome the reading difficulties.

APPENDIX A

CONSENT FORM FOR SCHOOL ADMINISTRATION

ORDU İL MİLLİ EĞİTİM MÜDÜRLÜĞÜ'NE

Boğaziçi Üniversitesi Uygulamalı Dilbilim alanında, çocukların akademik başarısında çok önemli bir yere sahip olan *okuma edinimi* üzerine doktora tez çalışması yapıyorum. Bu çalışma Boğaziçi Üniversitesi Eğitim Fakültesi öğretim üyeleri Prof. Dr. Belma Haznedar, Yrd. Doç. Nalan Babur ve Prof. Dr. Gülcan Erçetin danışmanlığında yürütülmektedir. Çalışma, çocuklarının *Türkçede okuma edinimleri* ile bilişsel, dil bilgisel ve sosyo-ekonomik değişkenler (hızlı otomatik adlandırma, *fonolojik farkındalığı, sessel hafıza, morfem farkındalığı, ortografik farkındalık, genel işlemleme hızı, sözcük bilgisi)* ile *sözcük okuma akıcılığı* ve *okuduğunu anlama* arasındaki ilişkiyi ölçmektedir. Farklı değişkenleri inceleyen bu çalışmanın sonuçları çocuklarımızın hem akademik hem günlük yaşamlarında çok önemli bir paya sahip okuma becerisinin hangi faktörlerden etkilendiğini saptamada önemli ipuçları sağlayacaktır.

Çalışma kapsamında ikinci, üçüncü ve dördüncü sınıflardaki çocuklara sözcük okuma hızı, ses farkındalığı, kısa süreli hafıza, hızlı otomatik adlandırma, okuduğunu anlama, yazım bilgisi ölçen Boğaziçi Üniversitesi tarafından geliştirilmiş standart testler uygulanacaktır. Çalışmaya katılacak öğrenciler; uygulamaların yapılacağı 25 Mart 2016- 17 Haziran 2016 tarihleri arasında testlerin uygulanacağı okul yönetimi ve öğretmenler ile işbirliği halinde belirlenecektir. Çalışma öğrencilerin derslerinden geri kalmalarına sebep olmayacak ve eğitim müfredatını olumsuz etkilemeyecektir. Türkiye'de okuma edinimi alanında iyi bir literatürün oluşabilmesi ve daha iyi bir eğitim kalitesine ulaşabilmek için bu tür çalışmaları yapmak gerektiği inancındayım. Bu çalışmayı Ordu ili ………… ve ………… İlkokulunda gerçekleştirmek için gereğinin yapılmasını arz ederim.

Hatice ÖZATA

Boğaziçi Üniversitesi
Doktora Öğrencisi

APPENDIX B

SAMPLE TEST ITEMS

KOBIT (Kelime Okuma Bilgisi Testi)

Sight Word Reading (Anlamlı Sözcük Okuma)

bir
ama
bardak
baktık
midem

Phonemic Decoding Efficiency (Anlamsız Sözcük Okuama)

ge
heştün
çakur
misi
lerte

TURKISH COMPREHENSION TEST (Türkçe Okuduğunu Anlama Testi)

Soru: Kuş ne yapyor?
Cevap: Uçuyor

RAN (Hızlı Otomatik İsimlendirme)

RAN Letters

k	s	m	b	t
s	k	m	b	t

RAN Numbers

2	6	9	4	7
6	2	9	7	4

PHONOLOGICAL AWARENESS SUBTESTS (Fonolojik Farkındalık Testi)

Phoneme Blending (FFTT) (Ses Birleştirme)
t-o-p → top
m-a-s-a → masa
ç-i-v-i → çivi

Rhyme Production (FFTT) (Uyak Üretme)
boş → hoş
tel → sel
yara → tara

Phoneme Segmentation-Real Words (FFTT) (Ses Ayırma-Anlamlı Sözcükler)
et → e-t
düş → d-ü-ş
bak → b-a-k

Phoneme Segmentation- Nonwords (FFTT) (Ses Ayırma-Anlamsız Sözcükler)
rin → r-i-n
şurt → ş-u-r-t
lark → l-a-r-k

Syllable Deletion (FFTT) (Hece Eksiltme)
hızlı → hız
fincan → can
püskül → kül

Phoneme Deletion (FFTT) (Ses Eksiltme)
çek → ek
sayı → ayı
toka → tok

PHONOLOGICAL MEMORY SUBTESTS (Sessel Hafıza Testleri)

Memory for digits (WISC-R Turkish) (Sayı Tekrarı)
1-5
9-7-4
6-1-5-8

Nonword Repetition (KFFT) (Anlamsız Sözcük Tekrarı)
kun
cum
şildekmaska

TEST OF VOCABULARY KNOWLEDGE (WISC-R Turkish)
(Sözcük Dağarcığı Testi)

Tavşan ne demek?
Top ne demek?
Kalem ne demek?

TEST OF PROCESSING SPEED- CODING (WISC-R Turkish)
(İşleme Hızı-Kodlama)

TEST OF MORPHOLOGICAL AWARENESS
(Morfem Farkındalığı Testi)

<u>Inflectional Morphemes</u> (Çekim Eki Farkındalığı)
Kuş uçuyor. vs *Kuşta uçuyor.*
Yavru kuşlara iyi bakmak gerekir. vs *Yavru kuşların iyi bakmak gerekir.*

<u>Derivational Morphemes</u> (Yapım Eki Farkındalığı)
1) Bir kız mof yapıyorsa, ona ne denir?
a) **Mofçu** b) Mofluk
2) Çaya dipek atıyorsam, çayım nasıl olur?
a) Dipeksiz **b) Dipekli**

TEST OF ORTHOGRAPHIC KNOWLEDGE
(Ortografi Bilgisi)

tapak → tabak
yamur → yağmur
deyil → değil

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