PREDICTORS OF READING COMPREHENSION IN TURKISH: EVIDENCE FROM 4TH AND 5TH GRADERS

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PREDICTORS OF READING COMPREHENSION IN TURKISH: EVIDENCE FROM 4TH AND 5TH GRADERS

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Predictors of Reading Comprehension in Turkish:

Evidence from 4th and 5th Graders

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DECLARATION OF ORIGINALITY

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ABSTRACT

Predictors of Reading Comprehension in Turkish:

Evidence from 4th and 5th Graders

This present study investigated the relationship between linguistic and cognitive skills, such as text reading fluency (TRF), vocabulary knowledge (VK), morphological awareness (MA), rapid automatized naming (RAN), processing speed (PS), and memory capacity (ME), and reading comprehension skills in 4th and 5th grade native Turkish-speaking students. A total of 42 fourth-grade and 52 fifth-grade students participated in the study, and the relevant linguistic and cognitive skills were measured using various tests. The data were analyzed using Pearson correlation and multiple linear regression analyses. According to the correlation analysis, a statistically significant relationship was found between reading comprehension skills and all linguistic and cognitive skills in fourth-grade students. In fifth-grade students, a significant relationship was observed between reading comprehension skills and all variables except for rapid automatized naming (RAN) and processing speed (PS). The results of the multiple linear regression analysis showed that morphological awareness (MA) and text reading fluency (TRF) were significant predictors of reading comprehension skills for fourth-grade students. For fifth-grade students, morphological awareness (MA) and vocabulary knowledge (VK) were identified as significant predictors of reading comprehension skills. These findings highlight the importance of morphological awareness in Turkish reading comprehension.

ÖZET

Türkçe'de Okuduğunu Anlama Becerisinin Yordayıcıları: 4. ve 5. Sınıf Öğrencilerinden Elde Edilen Bulgular

Bu çalışmada, ana dili Türkçe olan 4. ve 5. sınıf öğrencilerinin metin okuma akıcılığı (MOA), sözcük bilgisi (SB), morfolojik farkındalık (MF), hızlı otomatik isimlendirme (HOTİ), işleme hızı (İH) ve bellek kapasitesi (BK) gibi dilbilimsel ve bilişsel becerilerinin okuduğunu anlama becerileri ile olan ilişkisi ve bu becerilerin okuduğunu anlamada belirleyici rolü incelenmiştir. Araştırmaya 42 dördüncü sınıf ve 52 beşinci sınıf öğrencisi katılmış, ilgili dilbilimsel ve bilişsel beceriler çeşitli testler ile ölçülmüştür. Veriler Pearson korelasyon analizi ve çoklu doğrusal regresyon analizleri ile değerlendirilmiştir. Korelasyon analizine göre, dördüncü sınıf öğrencilerinde tüm dilbilimsel ve bilişsel beceriler ile okuduğunu anlama becerisi arasında istatistiksel olarak anlamlı bir ilişki bulunmuştur. Beşinci sınıf öğrencilerinde ise hızlı otomatik isimlendirme (HOTİ) ve işleme hızı (İH) dışındaki tüm değişkenlerle okuduğunu anlama becerisi arasında anlamlı bir ilişki tespit edilmiştir. Çoklu doğrusal regresyon analizi sonuçlarına göre, dördüncü sınıf öğrencileri için morfolojik farkındalık (MF) ve metin okuma akıcılığı (MOA), okuduğunu anlama becerisinin anlamlı yordayıcıları olarak bulunmuştur. Beşinci sınıf öğrencileri için ise morfolojik farkındalık (MF) ve sözcük bilgisi (SB) okuduğunu anlama becerisi için anlamlı yordayıcılar olarak tespit edilmiştir. Bu bulgular, morfolojik farkındalık becerisinin Türkçe okuduğunu anlama üzerindeki önemini vurgulamaktadır.

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CHAPTER 1

INTRODUCTION

Reading is one of the most fundamental skills that enable students to be successful both in academic life and beyond (García-Madruga et al., 2014). Additionally, studies have shown that poor reading skills are associated with increased school dropouts in later years (Daniel et al., 2006). Proficiency in reading begins with the ability to grasp letter-sound correspondences and decode written text, but the ultimate goal is comprehension, the ability to grasp the intended message conveyed through writing (Woolley & Woolley, 2011). While the focus is on the ability to read in the early years of formal education, as this skill becomes automatic, the importance of "reading to learn" increases in the later years due to the growing academic demands. Therefore, a good ability to comprehend what one reads is necessary for effective learning in the later stages of education (Lei et al., 2010).

Reading comprehension is an interactive ability in which many complex processes occur in the reader's mind (Pearson, 2015). Many studies aiming to investigate which linguistic and cognitive processes occur in the minds of poor and competent readers and their interaction with each other could be found in the literature (Lee Swanson et al., 2006; Li et al., 2009; Psyridou 2021). In this way, more effective instruction models can be developed, and, thanks to early diagnosis, various interventional measures can be taken on this issue that affect academic and lifelong success (Catts et al., 2015; Justice, 2006; Vaughn et al., 2010).

One of the linguistic skills that accounts for reading comprehension is morphological awareness, which can be briefly described as the ability to manipulate the smallest meaningful unit of a word (Deacon et al., 2014). Studies conducted with

many different languages and age groups have shown that morphological awareness is a significant predictor of reading comprehension (Vaknin-Nusbaum & Saiegh-Haddad, 2020; Kotzer et al., 2021; Qiao et al., 2021; Oliveira et al., 2020). Some other studies indicate that another linguistic predictor of reading comprehension skills is vocabulary knowledge (Perfetti & Stafura, 2014; Protopapas et al, 2007; Swart et al., 2017). According to Verhoeven & Perfetti (2011, p. 2) "Words are the carriers of meaning and therefore closely tied to text comprehension and knowledge construction.". For this reason, the effects of quantity (breadth) and quality (depth) of vocabulary knowledge on reading comprehension has become the subject of the studies in the literature and showed some negligible effects on reading comprehension competency (Cain & Oakhill, 2014; Perfetti, 2007; Tannenbaum et al., 2006). Another linguistic skill that gains importance in comprehension after the word decoding skill becomes automatic is text-level reading fluency (TRF) which is "the ability to read a connected text quickly, accurately and with a natural intonation" (Veenendaal et al., 2015, p. 213). Many studies investigating the predictiveness of fluency on this subject have shown that it is an important component of reading comprehension skill in various languages (Álvarez-Cañizo et al., 2015; Başaran, 2013; Kim, 2015; Lai et al., 2014).

There are also a number of cognitive skills that account for reading comprehension. Rapid automatized naming (RAN) skill, which is defined by Kirby et al. (2010, p. 341) as "how quickly an individual can pronounce the names of a set of familiar stimuli" is one of them. Although the predictive power of RAN on comprehension has shown different results in different studies, the relationship between them has been supported by many studies (McWeeny et al., 2022; Swanson et al., 2003). Another cognitive skill that is examined in relation to reading

comprehension is memory capacity. Short-term and working memory capacity have been considered as individual cognitive differences influencing reading comprehension success in the literature (Haarmann et al., 2003; Seigneuric et al., 2005). Studies trying to explain the nature of reading comprehension have also addressed the cognitive skill of processing speed. According to Borella & Ribaupirerre (2014, p. 87) processing speed is "the speed at which information is processed (read, encoded and retrieved) in an individual's memory". It is seen in the literature that processing speed is also related to reading skills (Gerst et al, 2021). Although the studies in the literature explain most of the complex reading comprehension puzzle, some missing pieces still need to be investigated, for example, how the studies are similar or different from the Turkish reading comprehension skill due to the differences in language-specific features.

In addition, according to the PISA 2022 Turkey report published by the Ministry of National Education, Turkish students ranked 36th among 81 countries in reading skills in their native language and 30th among 37 OECD countries. The same report also reveals that 3 out of every 10 students in Turkey fall below the minimum proficiency level in reading skills, as defined by PISA. PISA describes the minimum proficiency level as the reading ability necessary for daily competencies at the age of 15. Additionally, students who perform at a high level are considered potential human capital that can contribute to the economic and social development of their countries. According to the PISA report published by the Ministry of National Education, only 1.9% of students in Turkey reached the high-performance level in 2022 (MoNE, 2023). In light of this information, a detailed examination of the cognitive and linguistic skills influencing Turkish students' reading comprehension

processes will significantly contribute to raising awareness about the development of these skills and generating solutions to the identified challenges.

For this reason, in order to understand the linguistic and cognitive components that affect reading comprehension in more detail, it is aimed to conduct this study with Turkish 4th and 5th-grade students, who are transitioning from primary to secondary school, in the light of the research questions stated below:

In 4th grade students:

- Is there a significant relationship between linguistic subskills (vocabulary knowledge, morphological awareness and text reading fluency), cognitive subskills (memory capacity, processing speed and rapid automatized naming) and reading comprehension?
- How much variance do cognitive and linguistic subskills account for in reading comprehension?

In 5th grade students:

- Is there a significant relationship between linguistic subskills (vocabulary knowledge, morphological awareness and text reading fluency), cognitive subskills (memory capacity, processing speed and rapid automatized naming) and reading comprehension?
- How much variance do cognitive and linguistic subskills account for in reading comprehension?

In this section, it is briefly mentioned that reading comprehension is a complex process with various linguistic and cognitive components as well as the purpose of the current study. The second chapter will provide a more comprehensive literature review on reading comprehension and its linguistic and cognitive components. In the 3rd chapter, the methodology of the study will be explained, and

then the analysis results will be shared in the 4th chapter. Finally, the 5th chapter will include discussion and conclusions about the study.

CHAPTER 2

LITERATURE REVIEW

This chapter is structured into three main sections. The first section provides a review of the theoretical background related to the reading skill and its developmental progression. Additionally, it introduces the theoretical frameworks that have been widely known in literature and have laid the groundwork for scientific research on reading comprehension. Following this, the second and third sections offer a review of research on the key linguistic and cognitive predictors of reading comprehension. The second section presents an overview of linguistic precursors, including text reading fluency (TRF), morphological awareness (MA), and vocabulary knowledge (V), along with their definitions and their relationship to reading comprehension. Additionally, the section explores how these linguistic precursors relate to other predictors, and incorporates studies conducted in various languages. Similarly, the third section addresses key cognitive predictors of reading comprehension, covering rapid automatized naming (RAN), processing speed (PS), and memory capacity (MC) in sequence.

2.1 Reading comprehension

Reading is a complex skill in which many different linguistic and cognitive sub-skills play compound roles. Unlike speaking, reading acquisition generally requires formal education. The process of reading acquisition begins with recognizing letter-sound relationships at an early age and continues with formal education in schools. Children's mastery in reading is closely related to their academic success and lifelong learning (Rabiner et al., 2016). Considering that reading success is so

important in students' lives, research that will help us understand this skill more deeply is also important in order to improve reading success and teaching methods (Hjetland et al., 2020).

In its broadest definition, reading is the ability and process of understanding the relationship between visual symbols and sounds to gain meaning (Ziegler & Goswami, 2006). Just recognizing the sound-letter match and being able to decode a text is not enough to define reading skills. Thus, it is crucial to explore the deeper dimensions of reading proficiency. Snow (2002, p. 11) also defines reading as "the process of simultaneously extracting and constructing meaning through interaction and involvement with written language". According to these definitions, the topmost goal of the reading process is not just decoding but comprehending the meaning of written language.

Given the definitions above, it is inadequate to discuss reading skills without considering comprehension. Many experts emphasize the importance of fluent word recognition and decoding for reading comprehension. According to LaBerge and Samuels' (1974) Automaticity Theory, humans have a limited cognitive processing capacity. When a complex skill requires multiple cognitive components to simultaneously engage attention within a limited time, successfully executing that skill becomes very challenging due to the limited attention capacity. In such a scenario, the automatization of lower-level components frees cognitive capacity, facilitating the execution of higher-level tasks. LaBerge and Samuels (1974) divided this process into two distinct stages: the initial stage, which requires conscious attention and is referred to as *accuracy*, and the subsequent stage of effortless and rapid execution, referred to as *automaticity*. Specifically, in the context of reading comprehension, as readers become automatic and effortless in lower-level skills such

as word recognition and decoding, they can recognize words quickly and effortlessly. This process frees cognitive resources for comprehension and higher-level processing. Initially, readers must consciously and laboriously decode each word, but through practice and exposure, their decoding skills become automatic. This reduction in cognitive load and mental effort can then be redirected toward understanding and interpreting the text.

Building on this understanding of reading processes, various models have been developed to explain reading acquisition, illustrating the sequential nature of skill development. Similar to the Automaticity Theory, models explaining reading acquisition generally propose that children achieve mastery in reading by initially recognizing letters, combining phonemes and sounds to form words, and progressing through various stages. Here, three of the most well-known models, Chall's (1983), Frith's (1985), and Ehri's (1999), will be introduced.

Jeanne Chall's (1983) model of reading development, outlined in her book "Stages of Reading Development," describes the sequential stages children typically progress through as they acquire reading skills from early childhood to adolescence. Chall's model of reading development outlines six stages. In Stage 0 (Pre-reading, birth to age 6), children are exposed to books and print, learning letter recognition, phonemic awareness, and basic print concepts. Stage 1 (Initial Reading or Decoding, ages 6-7) involves learning letter-sound correspondences to decode simple words. Stage 2 (Confirmation and Fluency, ages 7-8) sees children achieving greater reading fluency, accuracy, and expression. In Stage 3 (Reading for Learning the New, ages 9-14), the focus shifts from "learning to read" to reading for information, expanding vocabulary, and improving comprehension of complex texts. Stage 4 (Multiple Viewpoints, ages 14-18) involves critical analysis and synthesis of information from

diverse sources. Finally, Stage 5 (Construction and Reconstruction, ages 18+) involves advanced reading and critical thinking, where readers form their own understanding and viewpoints from texts. Chall's model emphasizes that reading development is a continuous, cumulative process where each stage builds on the previous one, highlighting the importance of a strong early literacy foundation and evolving from basic decoding to advanced comprehension and critical thinking, ultimately fostering lifelong learning. However, it should be noted that Chall is often criticized because her model suggests a linear progression through reading stages, whereas in reality, children may skip stages, regress, or progress at varying rates.

Expanding on this idea of stages, another model developed to explain children's reading development is Frith's (1985) stage-based framework, which outlines the progression from basic letter recognition to fluent reading. The model identifies three main stages: (i) the logographic stage, where children recognize words through visual cues without understanding letter-sound relationships; (ii) the alphabetic stage, where they begin decoding words by sounding out letters and developing phonological awareness; (iii) and the orthographic stage, where reading becomes more automatic as children recognize words through patterns and chunks of letters, leading to fluent reading and improved comprehension. Frith notes that while these stages are sequential, they can also overlap, with children often using characteristics from multiple stages simultaneously. For example, a child might primarily use alphabetic strategies but still rely on logographic recognition for some words. The model also suggests that children may temporarily struggle with previously known words when adopting new strategies, but typically show significant improvement once they integrate these strategies. Additionally, the model acknowledges that different strategies can develop separately and be used in specific

contexts, such as reading nonsense words. Frith's model implies that reading instruction should be adapted to the child's current stage of development, with an early focus on letter recognition and phonics, and later emphasis on word patterns and reading fluency. However, the model is also criticized since it oversimplifies reading development as a linear process and fails to account for individual differences, comprehension growth, and language variations.

In contrast to Frith's more linear perspective, Ehri's (1999) model of reading development offers a more fluid approach, treating these phases as overlapping rather than discrete, meaning that progression to a subsequent phase does not require full mastery of the preceding one. According to this model, children typically progress through four stages as they learn to read: In *the pre-alphabetic stage*, children rely on visual cues and may recognize words based on their visual features, such as logos or shapes, without understanding the individual letters or sounds. In *the partial alphabetic stage*, they begin to grasp letter-sound relationships, often using initial and final letters to guess words, though they may not fully decode the entire word. In *the full alphabetic stage*, they can decode words by matching letters to sounds, developing a more comprehensive understanding of the alphabetic principle and blending sounds to form words. Finally, in *the consolidated alphabetic stage*, children recognize common letter patterns and read more efficiently, identifying words by recognizing familiar endings without needing to decode each letter individually. Ehri's model emphasizes the crucial role of orthographic knowledge, phonological awareness, and letter-sound understanding in developing reading fluency and efficient word recognition. However, criticism of Ehri's model includes concerns about the weak operational definitions of the phases, the lack of connection

to underlying cognitive structures, and the unclear transitions between phases (Beech, 2005).

As the field of reading comprehension continues to evolve, various frameworks have emerged, each contributing unique insights. Among these, the Simple View of Reading introduced by Gough and Tunmer (1986) is one of the most well-known. According to the Simple View of Reading, reading comprehension is formulated as decoding x linguistic comprehension = reading comprehension (D x LC = RC). In this formula, decoding describes the ability to understand letter-sound correspondence, which can also be called the mechanical part of reading, and to be able to turn written symbols into the spoken ones. Linguistic comprehension, on the other hand, refers to the part of reading that is mostly related to understanding. Accordingly, linguistic comprehension includes word and grammatical knowledge as well as inferring the general meaning expressed in the structure read by the reader. According to this formula, reading comprehension is explained by two important components, and any disruption or weakness in either of these components will result in a deficit in reading comprehension. Furthermore, difficulty in reading comprehension may occur for three reasons; It may be due to decoding, linguistic comprehension, or both. For example, individuals who do not have fast and fluent decoding skills may have difficulty understanding what they read, even if they have high linguistic comprehension, and vice versa. This framework makes a significant contribution to the development of better intervention methods by identifying in which areas students with reading comprehension difficulties struggle with.

Building upon the Simple View, the Component Model of Reading proposed by Joshi and Aaron (2000) further delineates the essential components of reading comprehension. In their 2000 study, Joshi and Aaron compared the multiplicative

model from the Simple View (R = D x C) with an additive model (R = D + C) among third-grade English-speaking children, suggesting that both were effective, but the multiplicative model had a slight advantage. They found that efficient word recognition, essential for reading comprehension, relies on rapid decoding. Moreover, their research demonstrated that incorporating processing speed significantly improved the model's ability to explain reading comprehension variance. The study showed that while decoding and listening comprehension together accounted for 48% of the variance in reading comprehension, adding letter-naming speed contributed an additional 10%. They then refined the Simple View of Reading by introducing processing speed (S) as a key component, resulting in their revised model (R = D x C + S). This model provides a nuanced understanding of reading development by emphasizing the interdependence of decoding, comprehension, and fluency. Consequently, the component model illustrates how a deficiency in any of these aspects can impede overall reading comprehension, making it essential to address all three in educational contexts.

Another framework that tries to explain reading comprehension is the Interactive Compensatory Model developed by Stanovich (1980). According to this model, reading comprehension is an active process in which multiple subskills and strategies play an interactive role. According to this model, cognitive components that play a role in reading comprehension are not isolated from each other. If the reader has difficulty mastering any of these reading components, the other skill can compensate. For example, a student with weak decoding skills can replace it with vocabulary or background knowledge. According to this model, readers have individual differences in their mastery levels in the subcomponents that affect reading comprehension, and if these skills are weaker than a certain critical point,

their comprehension levels are seriously affected. It is also added that in this model, the factors that affect reading comprehension are not only individual ones but also contextual factors such as familiarity with the text or the complexity of the text.

Construction-Integration Model (CIM) developed by Kintsch (1988) focuses on explaining reading comprehension from a different perspective. According to CIM, reading comprehension involves the active construction of meaning during reading as well as the integration of the reader's previous knowledge. Accordingly, bottom-up and top-down processes interact in the process of extracting meaning from what is read. That is, the reader first creates a mental representation of the message to be given by decoding the written text and extracting the meaning with the bottom-up process during the construction of meaning. This process includes sub-processes such as the recognition of words or grammatical and semantic parsing. Then, the newly created mental representation in the reader's mind is combined with the existing knowledge in long-term memory to create inferences and connections based on understanding. In this process, readers try to interpret the new information and close the gap by using top-down processes. In summary, according to CIM, reading comprehension is an active and dynamic process that aims to create consistent mental representations by constantly combining existing information in the reader's mind with the newly decoded information during reading.

The Reading Systems Framework, proposed by Perfetti and Stafura (2014), is a comprehensive model that elucidates the complex cognitive processes underlying reading comprehension by integrating multiple cognitive and linguistic components. Central to this framework is the interaction between the orthographic system, which involves visual word recognition and orthographic mapping, the phonological system, which encompasses phonological awareness and phonics, and the semantic

system, which includes vocabulary knowledge and lexical access (See Figure 1). Effective reading comprehension requires seamless coordination and bidirectional influence of these systems, along with support from additional factors such as working memory, background knowledge, and reading fluency. The framework highlights the crucial role of word knowledge—spanning linguistic, orthographic, and general knowledge—as a foundation for successful reading comprehension. It details how these knowledge sources interact with core reading processes, including decoding, word identification, and comprehension monitoring, within a cognitive system that manages limited resources to link perceptual input with long-term memory.

A pivotal aspect of the framework is the lexicon's role in bridging word identification and comprehension, where quality lexical representations significantly impact reading comprehension by facilitating word-to-text integration. This process, essential for constructing a coherent mental model of the text, is more efficiently executed by skilled readers. The framework also addresses developmental and individual differences in reading skills, suggesting practical applications for identifying reading difficulties and informing targeted instruction. Empirical evidence, such as studies utilizing eye-tracking and event-related potentials (ERPs), supports this model’s assertions, demonstrating that skilled readers effectively integrate word meanings and learn new words from the context. Overall, the Reading Systems Framework provides an integrative approach to understanding the cognitive underpinnings of reading comprehension, emphasizing the dynamic interplay between various components and offering insights for both research and practical applications in reading instruction.

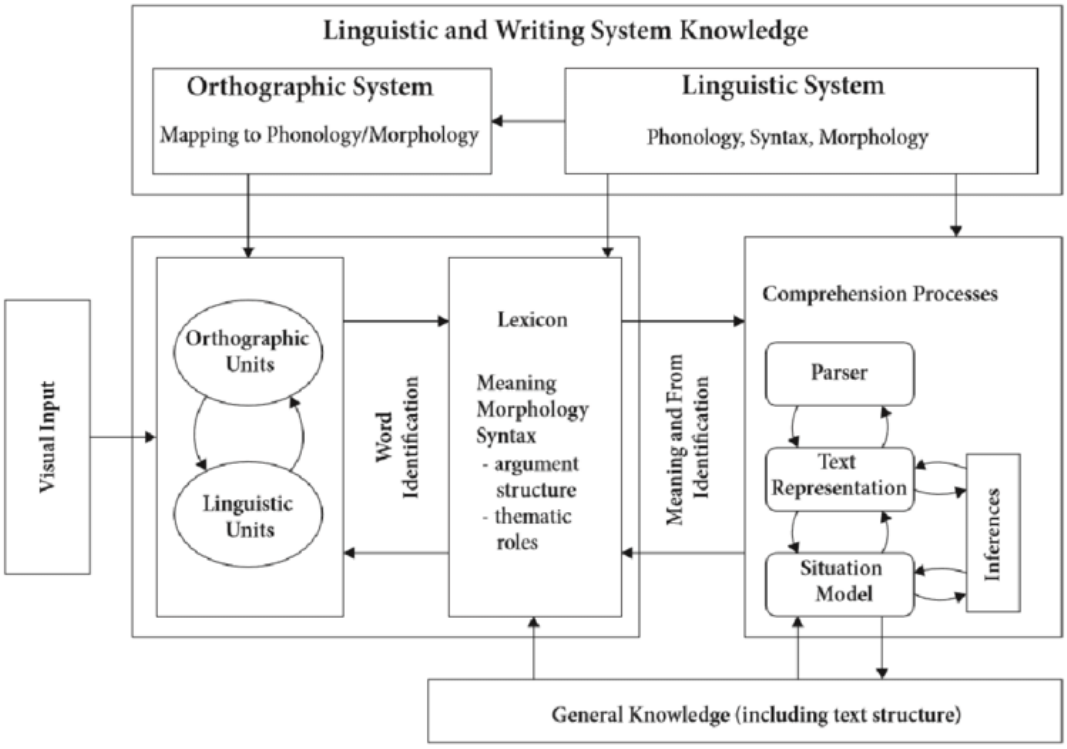


Figure 1. The Reading Systems Framework (Perfetti & Stafura, 2014).

> The components of reading within a 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).

In summary, these models and frameworks collectively provide a comprehensive understanding of the intricacies of reading acquisition and comprehension. Each model highlights essential components that contribute to the complex process of reading development, and the interconnections among them underscore the importance of a multifaceted approach to teaching and intervention. Furthermore, they indicate that reading development is not merely about recognizing

words but also encompasses deeper cognitive processes and linguistic skills that contribute to overall reading proficiency. In addressing reading difficulties, it becomes imperative to recognize the role of these interconnected components and to develop targeted strategies that foster the development of each aspect for improved reading comprehension. So that the next chapter focuses on linguistic and cognitive subcomponents that are common in the above-mentioned models and frameworks to understand the role they play in reading comprehension.

2.2 Linguistic predictors

In this section, the linguistic subskills that predict reading comprehension—namely fluency, morphological awareness, and vocabulary knowledge—will be defined and explored. Their relationships with reading comprehension will be examined through studies conducted in various languages, aiming to provide a detailed explanation of their nature.

2.2.1 Fluency and reading comprehension

Fluency has an important place when examining and explaining the nature of reading comprehension. It can be expressed in its most general definition as "reading accurately at a quick rate with appropriate prosody" (Hudson et al., 2008 p. 4). According to LeBerge and Samuels' (1974) Automaticity Theory, fluency is considered as a prerequisite for reading comprehension, since it enables readers to focus their attention on the meaning of the text instead of struggling with decoding individual words. Similarly, Perfetti's (1985) Verbal Efficiency Theory asserts that reading fluency improves comprehension because as word reading becomes automatic, it frees up cognitive resources, allowing the reader to focus more on the

demanding task of understanding the text. Fluency also helps the reader retain longer sentences more easily and successfully, thus helping to use cognitive resources more effectively. Considering these influential theories, it becomes clear that fluency is not merely a mechanical aspect of reading but a foundational skill that supports comprehension. This is why the relationship between fluency and reading comprehension has attracted considerable empirical attention and has been extensively researched over time.

Findings supporting the relationship between reading fluency and comprehension were obtained from different studies in which words were tested both in isolation (word-reading fluency) and in context (text-reading fluency). These studies have revealed that text-reading fluency is a separate construct, although it is interconnected with word-reading fluency (Veenendaal et al., 2015). Thus, fluency in reading encompasses more than just the speed of word recognition; it also involves understanding how words fit into the larger structure of the text. Accordingly, the reading fluency construct can be divided into two categories as: (a) word-reading fluency, which indicates the ability to decode isolated words or words in lists automatically, and (b) text reading fluency, which means the capability of successfully decoding and grouping the words into meaningful grammatical chunks to derive the meaning (Kim, 2015). While both forms of fluency are crucial, text-reading fluency seems to play a more direct role in how efficiently readers can extract meaning from written material. Words in context are read faster than isolated words, because a word read as a stimulus causes neighboring words to be activated in the brain, lowering the activation threshold of these words and increasing the retrieval speed. This semantic activation process is automatic, so it does not require

conscious attention. However, reading isolated words is a conscious and slow word identification process that requires attention.

In Klauda and Guthrie's (2008) study, which measured reading fluency at three levels (individual word, syntactic unit, and whole passage) with 285 5th grade students, it was determined that each level was uniquely related to reading comprehension. This emphasizes the importance of contextual reading fluency in predicting reading comprehension. Similarly, to examine the effect of context-free and context-reading skills on reading comprehension, Jenkins et al. (2003) investigated how context-free and context-reading skills contribute to reading comprehension. They made 113 4th grade students read a folktale and separately listed words from the same folktale. As a result of the analysis, context fluency was found to be a stronger predictor of reading comprehension than list fluency. These findings underscore the nuanced role that context plays in enhancing fluency and comprehension, highlighting that reading words in isolation may not provide a full picture of a reader's abilities.

The directionality of the relationship between text reading fluency and reading comprehension has also been a subject of research in literature since the exact relationship between text reading fluency and reading comprehension remains unclear (Kim et al., 2021). It has been debated whether text reading fluency predicts comprehension, or it results from comprehension. Kim (2015) argued that text reading fluency involves automatic, low-level comprehension processes related to vocabulary and grammar, rather than higher-order skills like making inferences. In a recent study, Kim et al. (2021) examined the text reading fluency, word reading, listening comprehension, and reading comprehension data of students from grade 1 to grade 3 longitudinally and tried to explain the direction of the relationship using

two structural equation models (text-reading fluency as a predictor/mediator model, and text-reading fluency as an outcome model). The results of this study supported the first model showing that text reading fluency is a complex, multidimensional construct that predicts and improves reading comprehension. This suggests that building fluency, particularly at early stages of reading, can have long-term benefits for comprehension.

There are also some studies showing a developmental relationship between reading comprehension and fluency (Kim, 2015). The relationship appears to evolve as children progress through different stages of reading development. Both word-reading and text-reading fluency contribute to reading comprehension performance of readers with varying degrees at different stages. However, in the early stages of reading acquisition, especially for elementary school children, word reading efficiency (context-free fluency) is more strongly associated with reading comprehension (Álvarez Cañizo et al., 2020). Since decoding is the primary focus at the beginning of reading acquisition, text reading fluency was not seen as an independent contributor in some studies, but in the later phases, text reading fluency was found to have a relationship above reading comprehension and word reading fluency (Kim, 2015). Lopez et al. (2011)'s study also indicates that as students become more automatic in decoding words, the context in which words appear becomes more influential in reading performance. Similarly, according to Fuchs et al. (2001), reading fluency improves as students progress through elementary years, indicating that its impact on reading competence, which also means comprehension, becomes more influential in upper grades. This developmental trajectory suggests that fluency, especially at the text level, becomes increasingly important for older students as they engage with more complex texts.

The prosody component, defined as appropriate expression or intonation combined with phrasing that preserves meaning, is one of the three elements of reading fluency and supports reading comprehension by helping to maintain auditory sequences in working memory and facilitating semantic analysis (Kuhn et al., 2010). In Miller and Schwanenflugel's (2006) study examining the oral reading data of third-grade students and adults, it was found that students with high reading fluency skills tended to pause similarly to adults. These students also showed more significant pitch drops at the end of regular statements and more noticeable pitch rises at the end of yes-no questions. It was also determined that students whose expressive reading skills were more similar to adults had better reading comprehension skills. In their study aimed at examining how text characteristics, rather than reader characteristics, affect reading speed and comprehension, Álvarez Cañizo et al. (2020) used narrative and expository texts to investigate fluent reading and comprehension in middle school students. They found that readers relied more on prosodic cues to understand complex informational texts and demonstrated that prosody, a component of fluency, plays a significant role in ongoing reading development in middle school.

One of the reasons that negatively affects the generalizability of the impacts of reading fluency on reading comprehension is that previous studies in the literature have mostly focused on English, which is an opaque language. However, whether the language is opaque or transparent is a factor that affects reading fluency. Studies conducted in transparent languages show that children gain fluency at an earlier age than in opaque languages. It is speculated that text reading fluency may play a more important role in predicting reading comprehension because reading fluency is gained faster in transparent languages (Kim et al, 2014). In one of the limited studies

conducted on Turkish, a language with transparent orthography, Başaran examined the relationship between reading speed and comprehension skills of 4th-grade students. The findings of the study indicated that fluent reading, particularly prosody, predicted deeper comprehension better than other reading skills, while accuracy in reading predicted surface-level comprehension This raises important considerations for cross-linguistic research and the need to investigate fluency's role in languages beyond English.

As we explore the complexities of reading comprehension further, it is essential to consider the role of other linguistic skills that contribute to this process. In the next section, we will turn our attention to morphological awareness, another crucial predictor of reading comprehension.

2.2.2 Morphological awareness and reading comprehension

Morphological awareness can be defined in the broadest sense as "children's awareness of and ability to manipulate the morphemic structure of words" (Carlisle, 1995, p.190). This skill, which involves decoding, understanding, and using morphemes—the smallest meaningful units of language—plays a significant role in aiding readers across several critical dimensions. Specifically, morphological awareness facilitates (a) decoding/word recognition efficiency, (b) vocabulary growth, (c) syntactic and grammatical understanding, and (d) inference making.

For example, Green (2009) illustrates the practical utility of this skill through the word "sleeplessness," which may initially seem long and complex. However, once children are able to decompose it into familiar morphemes—"sleep," "less," and "ness"—it becomes easier to decode. Green further highlights that morphological awareness not only aids in decoding but also in understanding the

meanings of unfamiliar words by leveraging familiar roots and affixes. An instance of this is the word "owlet," whose meaning children may infer by recognizing the parallel with "piglet," associating the suffix "-let" with a younger version of an animal. This ability to infer meanings enhances vocabulary growth, a key component of literacy development.

The relationship between morphological awareness and reading comprehension, as well as other literacy skills, has been examined in a variety of studies utilizing different methodologies and measurement tools. These numerous studies conducted with a wide age range in many languages have shown a crucial relationship between morphological awareness and reading comprehension (Lee et al., 2022). For instance, in one of the foundational studies in this area, Carlisle (1995) conducted a longitudinal investigation into the connection between morphological awareness, pseudoword reading, and reading comprehension in children from kindergarten through second grade. To assess morphological awareness, Carlisle employed two tasks: morphological production and morphological judgment. The morphological production task requires children to complete a given word with the appropriate morpheme to form a grammatically correct sentence. “(e.g. Farm. My uncle is a_____. The expected answer is farmer.)” In the morphological judgment test, students are asked to judge the correctness of orally presented sentences 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 study found that while morphological awareness (MA) was not related to reading skills for kindergarten students up to first grade, the performance in morphological production was more strongly related to reading comprehension in first grade. Carlisle concluded that MA is a crucial factor

in reading development for young children and potentially more critical for older students in understanding derived words (Carlisle, 1995).

In another study, Kirby et al. (2012) examined the relationship between morphological awareness and five different reading measures, including reading comprehension, by longitudinally analyzing the data of 103 students from first to third grade. In the study, morphological awareness was measured using a word analogy task, which required participants to complete missing words according to a given pattern. "(e.g., *run: ran:: walk:* (*walked*))". The study included both inflectional and derivational items. The results showed that morphological awareness, particularly in grade 3, was a significant predictor for all reading measures, including reading comprehension. The analysis also revealed significant correlations in MA scores across grades, with the highest correlation ($r = .66$) between grades 2 and 3. Kirby et al. (2012) interpreted the increasing importance of morphological awareness over the years as aligning with the advantage of recognizing morphemes in reading and the growing need for reading comprehension as students make progress over time.

Levesque et al. (2017) offers additional insights into the underlying mechanisms that link morphological awareness with reading comprehension. Their study, which involved 221 English-speaking third graders, utilized a multivariate path analysis to explore how various factors, including morphological awareness, contribute to reading comprehension. Through tasks that measured word reading, vocabulary, and morphological decoding, they demonstrated that morphological awareness indirectly impacts word reading and morphological analysis, but also has a direct effect on reading comprehension. Their findings suggest that morphological

awareness is a significant, independent predictor of comprehension, above and beyond other reading-related skills.

In order to examine the importance of morphological awareness in terms of higher-level reading skills for different age groups, James et al. (2021) conducted a study involving a total of 401 English speaking students in the 6-8, 9-11 and 12-13 age groups. The result of the study, which measured the awareness of compounding, inflections and derivations (morphological subcategories) with both judgment and production tests, shows that morphological awareness together with vocabulary has an essential contribution to reading comprehension of readers at all levels.

Rispens et al. (2008) investigated the impact of three types of morphological awareness on word reading among Dutch-speaking children. The study measured the inflectional, derivational, and compounding morphological awareness performances of 104 first graders and 112 sixth graders. The study found that noun inflection uniquely influenced word recognition in first graders, while derivational morphology independently contributed to word reading in sixth graders. It also showed that in spite of controlling age and other factors, the study did not find an increasing contribution of morphological awareness to reading ability over time, contrasting with previous research. As noted by the researchers, the results may have shown contrasts due to the limitations and differences in the measurement tools used in the study.

Morphological awareness also involves recognizing grammatical markers (e.g., tense, number), which helps understanding sentence structure and meaning. In their study examining the contribution of morphological awareness to reading comprehension, Nagy et al. (2006) used various tests that required students to understand the meaning indicated by the added morpheme and to complete sentences

grammatically with the appropriate morpheme. When analyzing the relationship between success in these tests and reading comprehension, the researchers found that morphological awareness significantly contributed to reading comprehension.

Additionally, the semantic meanings carried by morphemes help readers with comprehension and inference making. For example, Deacon et al. (2014) conducted a study with 3rd and 5th-grade English-speaking students to examine the relationship between morphological decoding and morphological analysis skills and reading comprehension. In this study, morphological analysis was measured by the students' ability to correctly judge the semantic meaning of a morpheme presented in a word. When analyzing the relationship between students' reading comprehension skills and morphological analysis abilities, it was found that morphological analysis uniquely contributed to comprehension.

Güldenoğlu et al. (2016) conducted a longitudinal study in Turkey to investigate the effects of early morphological skills on later reading abilities. In this study, they assessed 85 monolingual Turkish kindergarten students, tracking their reading speed and comprehension performance into the first grade. The researchers collected data using morphological awareness tasks such as word structure analysis and production tasks, along with standardized reading assessments. The findings revealed that students with strong morphological knowledge in kindergarten demonstrated superior reading speed and comprehension in first grade, highlighting the long-term benefits of morphological skills. This study further illustrates the predictive power of morphological awareness in languages with transparent orthographies like Turkish.

Özata & Haznedar (2018) examined various cognitive and linguistic factors (rapid automatized naming, phonological awareness, phonological memory,

morphological awareness, orthographic knowledge, processing speed, and vocabulary) related to Turkish monolingual second graders' rapid word reading and reading comprehension skills. According to the research findings, fluent word reading, vocabulary, and parental education level were the most significant predictors of reading comprehension, while it was observed that morphological awareness affects reading comprehension through vocabulary.

Manolitsis et al. (2017) examined the relationship between inflectional, derivational, and compounding morphological awareness and word reading fluency and reading comprehension in a longitudinal study with 215 students whose native language is Greek, a morphologically rich language, from preschool to the second grade. The results indicated that inflectional and derivational morphological awareness in kindergarten, as well as all forms of MA in the first grade, contributed to 2-5% of the unique variance in reading comprehension, implying that morphological awareness skills play an important role in reading comprehension of Greek students even at the kindergarten level. However, unlike previous studies, Simpson et al. (2020) found that in their study with 4th-grade monolingual Spanish-speaking students, whose language background has transparent orthography, syntactic knowledge was a significant predictor of reading comprehension, even after controlling for various factors, while morphological knowledge did not significantly explain additional variance. Simpson et al. (2020) highlighted that these conflicting results suggest that understanding the relationship between morphological awareness and reading comprehension requires further research in different languages.

The role of morphological awareness in comprehension is further supported by Liu et al.'s (2024) meta-analysis, which reviewed 44 studies on the subject. Their findings revealed a robust correlation ($r = 0.565$) between morphological awareness

and reading comprehension across diverse age groups and languages, further establishing the universal significance of morphological skills in literacy development.

In light of these findings, it is evident that morphological awareness is a key component in the development of reading comprehension. However, the variability in results across languages and age groups suggests that further research, especially with Turkish-speaking students, is necessary to fully understand the role of morphological awareness in reading comprehension at different stages of literacy development.

The next chapter will delve into the relationship between vocabulary knowledge and reading comprehension, highlighting how vocabulary serves as another critical pillar in understanding and interpreting text.

2.2.3 Vocabulary knowledge and reading comprehension

Another linguistic component that has an important role in understanding reading comprehension is vocabulary knowledge. Although vocabulary knowledge may seem simple, it is a multifaceted and complex construct in terms of defining and explaining it. The mental lexicon is a complex and interconnected network of words with numerous intricate links, making it challenging for researchers to explain and study how words and their relationships are stored and structured (Schmitt, 2014). Cronbach (1942)’s early definition takes vocabulary knowledge as a multifaceted construct that includes understanding a word's meaning in various contexts, its application, range of meanings, nuances, and ease of recall. As research in this area has increased, other aspects that define vocabulary knowledge have also been incorporated into literature. For example, National Reading Pannel (NRP) (2000)

divides vocabulary knowledge into two categories: (a) receptive, and (b) productive vocabulary. Receptive vocabulary basically refers to the words that people can understand when they hear or read. Productive vocabulary, on the other hand, refers to the words that people use when they speak or write. Receptive vocabulary knowledge is believed to be larger than productive one since people can recognize more and rarer words than they actively use. When defining vocabulary knowledge, two other concepts that should be mentioned are vocabulary depth and breadth. According to Li & Kirby (2015, p. 612), "breadth of vocabulary refers to how many words a person knows, whereas depth of vocabulary refers to how well a person knows these words." There are various studies showing that receptive and expressive vocabulary sizes as well as depth and breadth of vocabulary knowledge are related to reading comprehension. For example, Ouelette (2006) conducted a study examining the relationship between receptive and expressive vocabulary, as well as breadth and depth, decoding, visual word recognition, and reading comprehension. Typically developing 60 fourth-grade students participated in the study. The results of the study revealed that each vocabulary measure was related to reading skills differently. Receptive vocabulary breadth is found to be predictive of decoding; however, visual word recognition was predicted by expressive vocabulary breadth. In addition, reading comprehension was predicted by the depth of the vocabulary knowledge.

The Lexical Quality Hypothesis (LQH) proposed by Perfetti and Hart (2002) is a well-known theoretical framework that accounts for the relationship between vocabulary knowledge and reading comprehension. According to LQH, the quality of lexical representations, that is, the precision and accessibility of information about words stored in memory, directly impacts reading comprehension. In more detailed terms, high-quality lexical representations are precise, easily accessible, and

effectively integrated into context. So that they facilitate fluent reading and comprehension. In contrast, low-quality representations lack detail, are harder to retrieve, and hinder integration, all of which leading to difficulties in word recognition and understanding complex texts (Perfetti and Hart, 2002). For example, Braze et al. (2007) examined the relationship between orally assessed vocabulary and reading comprehension in the context of the lexical quality hypothesis with young adolescents aged 16 to 21. In order to investigate whether the Simple View of Reading captures all variations in reading comprehension and whether orally assessed vocabulary knowledge contributes additional variance as predicted by the Lexical Quality Hypothesis, they measured a broad range of cognitive and educational skills including decoding, vocabulary knowledge, listening comprehension, phonological awareness and reading comprehension. Findings indicate that while the decoding ability is crucial and the Simple View of Reading reasonably fits the data, it does not account for all variances. Vocabulary knowledge, on the other hand, contributes uniquely to reading comprehension, supporting the idea of the Lexical Quality Hypothesis.

Some of the evidence revealing the relationship between reading comprehension and vocabulary knowledge comes from students with poor reading comprehension skills. For example, Spencer et al. (2019) focused on understanding why some children with strong decoding skills still exhibit poor reading comprehension in order to determine the role of vocabulary knowledge in this discrepancy. Decoding, vocabulary and reading comprehension skills were assessed through various tests. Then the scores of children who were identified as having poor reading comprehension despite being proficient in decoding were compared with a control group of children who had both strong decoding and good reading

comprehension. By using a regression-based matching approach, the researchers demonstrated that children with poor reading comprehension, despite adequate decoding skills, generally had lower vocabulary knowledge compared to children with both strong decoding and comprehension skills, suggesting that vocabulary knowledge is a crucial component of reading comprehension and that weaknesses in vocabulary can hinder understanding, even when decoding skills are strong. Similarly, there are studies showing that poor vocabulary knowledge in early stages leads to an increasing gap between poor and successful comprehenders in the long term. Stanovich (2009) describes this situation as the "Matthew Effect" (rich-get-richer and poor-get-poorer), where competent early readers continue to develop and benefit more from their reading experiences, while struggling readers fall further behind, exacerbating the initial inequalities. Duff et al. (2015) evaluated written word reading skills in 4th grade and oral vocabulary from preschool to 10th grade in a sample of 485 children to examine how early reading skills affect vocabulary development over time. The results showed that children who were better readers in 4th grade experienced significantly faster vocabulary growth compared to their peers, even after controlling for initial vocabulary levels. Supporting the Matthew Effect, over time, these differences in growth rates led to significant disparities in vocabulary size.

Robust vocabulary is crucial for reading comprehension in any language (Verhoeven & Perfetti, 2022). However, the orthographic structure of languages, phoneme-grapheme regularity, causes readers to be more or less affected by vocabulary knowledge in the word recognition process (Venezky, 1995). This suggests that the effects of vocabulary on the reading comprehension process might differ between languages according to orthographic structure. Verhoeven et al.

(2011) investigated the longitudinal associations between vocabulary acquisition and reading skills in a study with 2,790 Dutch elementary school students. Data was collected from participants on basic vocabulary, advanced vocabulary, word decoding, and reading comprehension from 1st to 6th grade. Key findings reveal that children showed consistent improvement in vocabulary and reading skills, with strong initial vocabulary positively influencing word decoding and comprehension. Notably, a reciprocal relationship between advanced vocabulary and reading comprehension was established, suggesting that reading skills also contribute to vocabulary growth. Researcher further concluded that early vocabulary development predicts both word decoding and reading comprehension, with a stronger impact on reading comprehension, especially in Dutch, where the high transparency of orthography makes early vocabulary less critical for word decoding but more influential for reading comprehension. Additioanally, Babayiğit & Stainthorp (2014) conducted a study on 56 Turkish Cypriot children longitudinally from to grade 2 to investigate the influence of listening comprehension, vocabulary, grammatical skills, and verbal short-term memory (VSTM) on early reading comprehension. According to the results**, l**istening comprehension **i**dentified as a significant predictor of early reading comprehension, playing a more substantial role than word-reading skills. Vocabulary, grammar, and VSTM were found to partly mediate the relationship between listening comprehension and early reading comprehension, indicating that these skills support the development of comprehension abilities. The mediating role of vocabulary is explained by researchers as it "may impact upon reading comprehension directly through its effect on the semantic processing of text as well as indirectly through its facilitating effect on word recognition skills". This finding contrasted with studies in English, where word-reading skills often play a more

dominant role in early reading comprehension. The differing results suggest that the transparency of Turkish orthography facilitate rapid word-reading development. Studies have shown that vocabulary may have different effects on the development of reading and reading comprehension depending on the orthographic structure of languages. This indicates that studies conducted with Turkish-speaking students in the later stages of the reading process will provide important insights.

Protopapas et al. (2007) conducted a study investigating the relationship between vocabulary and reading comprehension in the relatively transparent orthography of Greek, providing important insights. The researchers aimed to investigate how word reading skills contribute to reading comprehension and how developmental changes in this relationship occur over time. They measured word reading skills (word and pseudoword reading accuracy, pseudoword and sight word efficiency, spelling, rapid automatized naming), nonverbal intelligence, receptive and expressive vocabulary knowledge, and reading comprehension skills in 534 Greek students from second to fourth grade. The study revealed that the connections between reading skills (like word and pseudoword accuracy and fluency) and language skills (like vocabulary and comprehension) were strong and either stayed the same or got stronger as the children moved to higher grades. However, word reading had less impact on comprehension once vocabulary was accounted for, showing that decoding helps comprehension through vocabulary knowledge. The findings underscore the importance of lexical mediation in the relationship between word reading and reading comprehension, showing that as children grow older, their vocabulary and lexical knowledge become increasingly important for understanding text.

There are also some studies showing that morphological awareness (MA) and vocabulary are interconnected, with MA accounting for a distinct portion of the variance in vocabulary development (McBride-Chang, 2005; Spencer et al. 2015). Morphological awareness aids vocabulary knowledge by enabling individuals to form new words through understanding roots, prefixes, and suffixes, recognizing word families, and inferring meanings of unfamiliar words, thereby enhancing vocabulary breadth and depth, and improving reading comprehension (Green, 2009). McBride-Chang et al. (2008) examines the relationships between morphological awareness and vocabulary knowledge in 624 preschool children across three languages: Cantonese, Mandarin, and Korean. The morphological awareness was measured by compound production, morpheme identification, and morpheme decomposition tasks and vocabulary knowledge was tested by expressive and receptive vocabulary tasks. After controlling for other cognitive abilities, such as phonological awareness and nonverbal IQ, the study found that morphological awareness makes unique contribution to vocabulary knowledge in all three languages, underscoring the universal importance of morphological awareness in vocabulary acquisition. Additionally, older children and those with higher initial vocabulary scores performed better on both vocabulary and morphological awareness tasks. The study also demonstrated a bidirectional association between morphological awareness and vocabulary knowledge.

This chapter reviewed key linguistic predictors of reading comprehension, including text reading fluency, morphological awareness, and vocabulary knowledge, all of which contribute to efficient word recognition and understanding. The next chapter will focus on cognitive predictors, beginning with rapid automatized naming (RAN), a key factor in reading speed and accuracy.

2.3 Cognitive predictors

2.3.1 Rapid automatized naming and reading comprehension

Rapid automatized naming (RAN), also known as naming speed, is a cognitive process that involves quickly naming a sequence of familiar items such as letters, numbers, colors, or objects (Kirby et al., 2010). It reflects how accurately and quickly an individual articulates the items presented as stimuli. RAN performance reflects efficiency in various cognitive processes, including visual recognition, lexical access, articulatory processes, attention, and processing speed (Siddaiah & Padakannaya, 2015). Considering the history of rapid automatized naming (RAN), Geschwind and Fusillo (1966) first proposed that rapid color naming and reading involve similar neurocognitive processes, based on data from a patient who had both reading difficulties and an inability to name colors. Denckla & Rudel (1976) later kept investigating rapid automatized naming performances of children with reading difficulties and developed a test battery that required individuals to name familiar objects as quickly and accurately as possible and measured the total time. RAN tests have been explored in many studies as predictors of reading success and difficulties (Norton & Wolf, 2012). When considering these studies in the literature, two formats of RAN tasks emerge. The first is the *continuous* or *serial naming format*, which requires individuals to read items printed on a page sequentially. The second is the *isolated* or *discrete naming* format, which requires individuals to name one item correctly and quickly at a time on a computer screen. According to Denckla and Cutting (1999), proponents of the continuous format argue that this format better reflects essential reading processes (such as scanning and sequencing) and places greater demands on executive functioning, making them more accurate predictors of reading abilities than discrete format. In a study of 107 Greek children from grades 2

and 6, Protopapas et al. (2013) assessed the ability to name digits, objects, and words in both discrete and serial formats. The study revealed that the younger children had a high correlation between discrete and serial naming tasks, while the older children had a moderate correlation, indicating that cognitive processes in reading and RAN evolved with age, shifting from individual word naming to simultaneous processing of multiple words. Additionally, in some studies, it has been shown that non-alphanumeric stimuli such as color and object naming are predictors of reading performance in early stages (Catts et al., 2015; Landerl & Wimmer 2008), but alphanumeric stimuli such as numbers and letters are a better predictor in the later period (de Jong, 2011; Misra et al., 2004). For example, Memisevic et al. (2022) in his study with 168 third-grade students from Bosnia and Herzegovina measured both the students' letter and object naming speeds and stated that letter naming speed was a unique significant predictor of reading speed, but object naming did not have a significant correlation with reading-related measures.

Due to the complex nature of RAN and its intricate relationship with reading, particularly its various subcomponents, the construct has been widely researched in the literature, resulting in inconsistent evidence and differing viewpoints. The divergence in views revolves around whether RAN should be considered a separate subskill or examined in relation to other subskills. For example, Wagner et al. (1997) categorized RAN within the phonological processing domain, together with phonological awareness (PA) and phonological memory (PM), as phonological naming (PN), describing it as "the efficiency with which children retrieve phonological codes." (p. 469). Additionally, Schatschneider et al. (2002) found a positive correlation between phonological awareness and RAN. They highlighted the potential statistical issues that arise when children are grouped based on their

performance in these two related areas. Since these variables are interconnected, a deficit in one could affect the assessment and perceived impact of a deficit in the other.

However, there is also another line of research suggesting that RAN is an independent predictor of reading ability, separate from phonological processing. According to the Double Deficit Hypothesis proposed by Wolf and Bowers (1999), phonological awareness and naming speed are two distinct skills both of which contribute to reading ability. This hypothesis suggests that reading disabilities can stem from two independent sources: deficits in phonological awareness and deficits in naming speed, with the combination of both leading to more severe reading difficulties. In order to investigate the hypothesized separateness of RAN, Wolf et al. (2002) examined how phonological awareness and naming-speed affect reading performance of 144 2nd and 3rd grade severely impaired readers. Results showed that phonological awareness was more important for decoding words, while naming-speed was crucial for recognizing them. 19% of the participants were found to have only phonological deficits, 15% only naming-speed deficits, 60% having both, and 6% unclassified. Consistently, Norton and Wolf (2012) state that rapid automatized naming (RAN) and phonological awareness (PA) should be assessed separately due to their moderate correlation, their distinct contributions to reading ability as indicated by regression and structural equation models, and the findings from genetic and brain imaging studies that show different biological bases for RAN and PA.

Another debate in the literature is about the relationship between rapid automatized naming (RAN) and orthographic processing (OP). Both RAN and OP are crucial for reading fluency and spelling, as they involve recognizing written words and patterns (Georgiou et al., 2016). Bowers and colleagues (e.g., Bowers &

Wolf, 1993; Sunseth & Bowers, 2002) propose that RAN is connected to reading as it is mediated by orthographic processing., which is supported by some studies in the literature (e.g., Lervåg et al., 2009; Papadopoulos et al., 2016). Conversely, other studies suggest that RAN's relationship with orthographic processing is not strong, and it remains a distinct predictor of reading ability even when accounting for orthographic processing (e.g. Cutting & Denckla, 2001; Moll et al, 2009).

Kirby et al. (2010) attribute inconsistencies in the literature to the diversity of reading measures and control variables used, as well as the range of languages and orthographies studied. Georgiou et al. (2008) examined the reading acquisition processes of children whose native languages were Greek (orthographically consistent) and English (orthographically inconsistent). In Grade 1, they measured phonological awareness (PA), phonological memory (PM), rapid automatized naming (RAN), orthographic processing (OP), word decoding, and reading fluency. In Grade 2, they reassessed word decoding and reading fluency and analyzed the data using structural equation modeling. The results showed that phonological and orthographic processing uniquely influenced reading ability in both grades 1 and 2, with the effects differing between English and Greek. RAN-digits strongly predicted grade 1 reading performance for Greek-speaking children but had a weaker effect for English-speaking children. By grade 2, it continued to impact Greek children's reading indirectly through grade 1 performance, while it directly influenced reading outcomes for English children in both grades. The authors emphasized the need to consider language-specific factors in evaluating reading predictors, noting that RAN-digits' impact varied with orthographic consistency.

Besides, despite orthographic and language-specific differences, RAN seems to be a universal predictor of reading, as shown by studies in different languages

(Landerl et al., 2022). Samuelsson (2011) examined the relationship between phonological awareness and rapid automatized naming and their effects on reading and spelling in Norwegian/Swedish and English-speaking children. The study found that RAN's predictive power for reading was consistent across languages with different orthographic systems, suggesting that early literacy development models are broadly applicable across languages. In a recent study, Candan et al. (2020) investigated the effects of phonological encoding (PE) and rapid automatized naming (RAN) on word reading and spelling in Turkish, a highly consistent language, based on data from third and fourth-grade students. The results indicated that while both RAN and PE significantly predicted word reading and spelling, RAN's influence increased, and PE's influence decreased as students progressed to higher grades.

Additionally, in their analysis investigating whether RAN is associated with a specific domain of reading, Araújo et al. (2015) showed that the rapid naming skill is related to various domains, including not only word-level reading but also non-word reading, text reading and comprehension. In one of the limited studies examining the relationship between RAN and reading comprehension, Kirby et al. (2003) aimed to understand how phonological awareness and RAN influence reading development from kindergarten to grade 5. The study found that phonological awareness and naming speed in kindergarten independently predict reading success, with phonological awareness being more important in early grades and naming speed becoming more influential in later grades. Children with low skills in these areas tended to progress more slowly in reading and are more likely to have reading difficulties by grade 5. Karadag et al. (2019)'s study with 177 Turkish native second grade students also showed that RAN is a direct predictor of reading skills and, in turn, a predictor of reading comprehension skills. As a result of the study, the

mediatory role of RAN on comprehension was emphasized. However, the limited number of studies on the relationship between RAN and reading comprehension, especially in shallow orthographies, requires further investigation.

As discussed so far, previous studies have highlighted the link between rapid automatized naming (RAN) and various reading skills across different languages and orthographies, as well as at different stages of literacy development. Since RAN is a key cognitive skill in reading acquisition, it is important to explore how it influences the development of reading and comprehension abilities in a language like Turkish, which has a consistent orthographic system. Building on this, the next chapter will explore processing speed, another cognitive factor that influences the efficiency of reading and comprehension.

2.3.2 Processing speed and reading comprehension

Christopher et al. (2012, p. 472) defines the term processing speed as "how quickly a person is able to complete a cognitive task, such as matching up visual stimuli". There are studies examining the relationship between processing speed and reading comprehension in many different contexts, such as individuals with ADHD (Brown et al., 2011) or learning disabilities (Wang et al., 2022) or individuals from different age groups. For example, Christopher et al. (2012) studied the relationship of various executive control and speed measures with word reading and reading comprehension. The study involved 483 participants aged 8 to 16 and investigated the impact of individual cognitive differences. The findings revealed that the relationship between word reading and reading comprehension remained consistent across different ages. Additionally, although general processing speed was important for word reading, it emerged as a unique predictor for both word reading and comprehension.

Various studies have shown that there is a difference between the information processing speeds of skilled and poor readers. For example, Urso (2008) examined the relationship between processing speed and poor reading skills with the participation of 44 first and third-grade students aged between six and ten. Various processing speed tasks were used in the study and a strong correlation was found between word reading ($r = .794$) and poor word reading ($r = .811$) and processing speed. Poor readers also received lower scores on processing speed tasks.

The relationship between processing speed and comprehension can be understood as facilitating the ability to quickly connect previously read information with upcoming text, thereby enhancing overall understanding (Borella & de Ribaupierre, 2014). In their study examining whether the development in naming speed was age-related or a global change in processing speed, Kail & Hall (1994) measured the global processing speed, naming time and various reading skills of 144 students aged between eight and thirteen. The results of the path analysis showed that processing speed is a predictor of naming time and that it is related to reading recognition and hence comprehension. Additionally, Gerst et al. (2021) applied 16 different processing speed tests to 844 students from third to fifth grades. The results demonstrated that both simple and complex processing speed predicted word reading speed, but complex processing speed also predicted single word reading and reading comprehension. In summary, studies have shown that there is a negligible relationship between processing speed and various domains of reading, especially reading comprehension. The studies also revealed the need for further research.

As we explore further cognitive factors, memory capacity becomes another essential component, playing a significant role in retaining and manipulating

information during reading, thus directly influencing comprehension performance. The next chapter will explore the role of memory capacity in reading comprehension.

2.3.3 Memory capacity and reading comprehension

Since reading comprehension is an ability that involves complex processes in the mind such as extracting and constructing meaning, working memory capacity has also an important role in reading processes (García-Madruga et al., 2013). Working memory helps process and store information necessary to understand a text. (Seigneuric & Ehrlich, 2005). To this end, much work has focused on working memory which shows that it is a predictive factor in reading comprehension in adults and children. For example, Nouwens et al. (2020) examined the relationship between 113 students' executive functions, including working memory, inhibition, and planning, in the 4th grade and their reading comprehension in the 5th grade. As a result of the study, they found that working memory and planning had a unique direct effect on reading comprehension, while working memory and inhibition also had an indirect effect on decoding. Also, Cain et al. (2004) applied sentence span and digit working memory tests to children aged 8, 9 and 11 years in their longitudinal study and examined their relationship with reading comprehension skills. As a result of the study, working memory predicted the unique variation of reading comprehension at each time point. Additionally, Peng et al. (2018) conducted a meta-analysis on 197 studies examining the relationship between working memory and reading. As a result of the analysis, it was determined that there was a significant and moderate relationship between all working memory and reading measures. While this relationship was domain general in the early stages of reading, it appeared to be more effective in later stages as domain specific, such as verbal working memory.

In summary, working memory plays a critical role in reading comprehension, aiding in the processing and retention of information needed to construct meaning from text. Numerous studies have consistently shown that working memory is a significant predictor of reading comprehension in both children and adults, with its influence becoming more domain-specific as reading skills develop. These findings underscore the importance of cognitive skills, like working memory, in the complex process of understanding written language.

In previous chapters, we explored the multifaceted nature of reading comprehension, examining both linguistic and cognitive predictors that contribute to its development. Linguistic factors, such as text reading fluency, morphological awareness, and vocabulary knowledge, play a central role in decoding and understanding text, while cognitive elements like rapid automatized naming, processing speed, and working memory further enhance comprehension abilities. With these foundational insights into reading processes, the next chapter will focus on literacy education in Turkey, offering a broader context for understanding how these skills are nurtured and developed within a specific educational system.

2.4 Literacy instruction in Turkey

The Turkish education system has undergone significant transformations over the past few decades, particularly regarding literacy instruction in primary and secondary schools. With the introduction of the 4 + 4 + 4 education system in the 2012-2013 academic year, compulsory education in Turkey now spans 12 years, encompassing primary education (Grades 1-4), secondary education (Grades 5-8), and high school (Grades 9-12) (MEB, 2012). This structural change aimed to address the

developmental needs of children at different educational stages and has implications for literacy education.

Historically, the Sentence Method (SM) was the dominant approach in teaching reading in Turkish primary schools, focusing initially on presenting full sentences before breaking them down into smaller units like words and phonemes. This method, however, received criticism for delaying the introduction of letter-sound relationships until later in the academic year (Baydık & Bahap-Kudret, 2012). In response to these critiques, the Sound Based Sentence Instruction Method (SBSIM) was implemented in the 2005-2006 academic year. This method prioritizes sounds as the foundation of literacy instruction, allowing students to progress from simple to complex phonetic structures (MEB, 2005). It emphasizes a synthesis approach, where reading and writing are taught concurrently, thus enhancing students' abilities to form sentences and comprehend texts (MEB, 2005).

SBSIM's approach aligns with the unique phonetic structure of the Turkish language, characterized by a strong correspondence between sounds and letters. As students engage with various syllables, words, and sentences, they develop a deeper understanding of the relationship between spoken and written language, promoting both fluency and comprehension (MEB, 2005). Furthermore, the method encourages creativity by providing a wide array of examples rather than relying on rote memorization of fixed sentences (Akyol & Temur, 2008).

Research has yielded mixed reviews regarding the effectiveness of SBSIM in fostering reading skills. While many teachers reported positive outcomes—such as enhanced student participation and creativity—some expressed concerns about students' difficulties with reading comprehension, particularly with longer texts (Akyol & Temur, 2008; Kayıkçı, 2008). A survey by Yurduseven (2007) found that

teachers appreciated the resources used in SBSIM, but they also noted that students often struggled to grasp the holistic meaning of texts.

The advantages of SBSIM include its focus on group work and interactive learning, which aligns with modern pedagogical approaches advocating for collaboration and critical thinking (Kayıkçı, 2008). Nevertheless, some studies indicated that children learning through SBSIM faced challenges in reading fluency and comprehension when compared to those taught using SM. For instance, Akyol and Temur (2008) found no significant differences in reading comprehension or speed between the two methods, though they noted that students using SM made more types of reading errors, which could be attributed to their developmental stage.

A meta-analysis conducted by Baştuğ and Erkuş (2016) reviewed 35 studies related to SBSIM and found that while students generally began reading more quickly with this method, many struggled with fluency and comprehension. The authors highlighted that the method, while effective for initial reading acquisition, may not adequately support sustained reading proficiency, particularly in comprehending complex texts (Baştuğ & Erkuş, 2016).

In conclusion, literacy instruction in Turkey has evolved significantly, reflecting broader educational reforms and the need for effective teaching methods that address students' diverse learning needs. While SBSIM shows promise in facilitating early literacy skills, ongoing evaluation of its impact on long-term reading comprehension and fluency is essential. Continued professional development for teachers and enhancements in instructional materials will be vital to optimizing literacy education outcomes in Turkish primary and secondary schools.

Regarding the reading comprehension, in 4th and 5th grades, instructions are conducted within the framework of the Turkish language curriculum set by the

Ministry of National Education. At these levels, students are introduced to various text types, including informative, narrative, explanatory, descriptive, and argumentative texts. In addition to literary genres, students engage with everyday texts, news articles, letters, poems, and fables, among others. These texts are designed to develop critical thinking, text analysis, identifying main ideas, making inferences, and understanding cause-and-effect relationships. The themes typically revolve around topics such as nature, family, society, science, technology, and history, aiming to enhance students' general knowledge and capture their interest. This approach seeks to improve both reading skills and critical thinking abilities through interaction with diverse texts (MoNE, 2019).

This section provides information on the historical development of literacy education in Turkey, the instructional methods used, teacher perspectives, and student outcomes. Additionally, it discusses the instructional practices implemented in 4th and 5th grades with regard to reading comprehension. The following section will present detailed information about the methodology of the study.

CHAPTER 3

METHODOLOGY

3.1 Research design

The present study has a cross-sectional research design where vocabulary knowledge, morphological awareness, text reading fluency, memory capacity, processing speed, rapid automatized naming and reading comprehension performances of 4th and 5th grade Turkish-speaking children were measured and analyzed quantitatively. With the help of this research design the researcher had the opportunity to examine multiple variables between different samples. In this context, it is intended to find answers to following research questions:

In 4th grade students:

- Is there a significant relationship between linguistic subskills (vocabulary knowledge, morphological awareness and text reading fluency), cognitive subskills (memory capacity, processing speed and rapid automatized naming) and reading comprehension?
- How much variance do cognitive and linguistic subskills account for in reading comprehension?

In 5th grade students:

- Is there a significant relationship between linguistic subskills (vocabulary knowledge, morphological awareness and text reading fluency), cognitive subskills (memory capacity, processing speed and rapid automatized naming) and reading comprehension?
- How much variance do cognitive and linguistic subskills account for in reading comprehension?

3.3 Participants

This study was conducted in a primary school and a secondary school in the Sarıyer district of Istanbul. A total of 94 Turkish-speaking students, 42 primary school 4th grade students and 52 secondary school 5th grade students, participated in the study. The students who participated in the study were selected from those who were not diagnosed with any reading or learning difficulties. This information was obtained from the school principals and teachers. However, since it was found that two students, one from the 4th grade and the other from the 5th grade, were univariate outliers, their data were excluded from the study and the analysis was conducted with 92 students. Additionally, given the purposes of this study, those students who could speak a language other than Turkish at a native level were not included in the study. There was no documented sensory deficit in any of the students who participated in the study. Following Etikan et al. (2016), convenience sampling was used in this study as it provides practicality to the study in terms of easy accessibility, availability of participants, affordability, or geographical proximity.

Based on information obtained from school administrators, regular classroom teachers, and school counselors, the students participating in the study generally came from families with lower-middle economic status. The educational level of the parents was predominantly high school or below, indicating that the students can be considered socioeconomically disadvantaged.

3.4 Instruments

3.4.1 Test of reading comprehension

A reading comprehension test prepared by Candan (2021) was used to measure the comprehension levels of the participants of current study. This test, which is suitable

for the ages and levels of the students, includes a total of nine paragraphs, three narrative and six expository. Participants are expected to silently read the paragraphs and then answer the open-ended questions by writing. There are a total of 40 questions in the test. Questions are prepared in two main categories: (a) literal and (b) inferential. The answer to literal questions can be directly found from the text. On the other hand, the answers to inferential questions require the reader to make inferences based on the text. Literal questions are also prepared in three different categories: reference, paraphrase, and ordering questions. The answers to reference questions can be easily found by referring directly to the text. In paraphrase questions, the information from the text is slightly altered and presented in the question. In ordering questions, the test taker is expected to order and organize the information mentioned in the text to give the answer. Inferential questions are also divided into three categories which are textually implicit, scripturally implicit, and synthesis questions. Textually implicit questions can be inferred based on the information mentioned in the text. To answer scripturally implicit questions, the reader needs to make an inference by also adding their own background knowledge to the original text. Finally, in synthesis questions, the reader is expected to adapt the information from the text to new and novel situations. A rubric, also prepared by Candan (2021), was used for the evaluation of the test, and scores ranging from 0 to 1 were given for each question based on the quality of the answers, e.g., 0.25, 0.50, 0.75. The maximum score that can be obtained if all questions are answered correctly is 40. Participants did not lose points due to errors in their writing.

3.4.2 Test of text reading fluency

In this study, text reading fluency was measured by asking test takers to read the first two texts of reading comprehension test out loud. The researcher kept time with a stopwatch while the test taker read the first and second texts without pausing in between. Test takers were instructed as quickly and accurately as possible. They were also asked to comply with the prosody (necessary expression). The total reading time of the two texts was recorded as a single score. Students performed this test individually.

3.4.3 Test of morphological awareness

Sentence-based morphology test was applied to measure students' morphology knowledge. In this test, 30 Turkish sentences were given mixed according to whether they were grammatically correct or incorrect. Sentences that are grammatically incorrect do not comply with the morphological rules of Turkish. This test is administered to the test taker individually. At the beginning of the test, with the guidance of the experimenter, students were expected to read two sample items out loud and determine whether the sentences were grammatically correct. Then, the students read the four exercise items out loud and decided whether they were correct or incorrect without any interference. After the experimenter made sure that the student understood the task correctly, the students were expected to read and answer 30 test items silently. Students were instructed to answer the items as quickly and accurately as possible.

3.4.4 Test of vocabulary knowledge

The test measuring students' vocabulary knowledge consists of three sections. In the first section, participants are expected to read the words shown to them aloud and then say their synonyms. In the second section, again in the same way, participants read the words and then say their antonyms. In the third section, participants read a pair of words that have a conceptual relationship between them and then are expected to complete another pair of words given to them in a manner suitable for this relationship. In this part, participants are expected to give the most meaningful association (e.g. ice is cold; fire is … The participant is expected to say the word "hot"). Before each section, students practice sample words that explain the task to them with the researcher. In the test, there are 29 words in each of the synonym, antonym, and association sections, making a total of 87 words. Students receive one point for each correct answer and zero points for an incorrect or missing answer. Answers are checked with the answer key included in the test. Some problematic answers provided by students that are not found in the answer key are consulted with the thesis advisor to determine whether they should be accepted as correct or not.

3.4.5 Test of rapid automatized naming

Turkish Test of Rapid Automatized Naming (RAN) (HOTI: Hızlı Otomatik İsimlendirme Testi, Bakır & Babür, 2009, 2018) is a tool that has four subsets (letter, picture, number, color recognition) and measures the speed and accuracy of visual symbol recognition. In this study, number subset was used since its appropriateness for the 4th and 5th grade students. This test is administered individually, and the test taker is expected to read aloud a total of 50 digits given in five lines as accurately and quickly as possible. In each line, 10 numbers (2, 4, 6, 7, and 9) are given mixed.

Before starting the test, 10 numbers were shown for practice, and it was made sure that the test taker could recognize all the numbers. During the test, how long it took the test taker to read the numbers was measured using a stopwatch, and the total time was recorded as a score. For this test, reading in less time is considered as a higher score.

3.4.6 Test of processing speed

In this test, taken from the Woodcock-Jhonson III test battery (Woodcock et al., 2001) , participants are expected to find and mark two similar or conceptually associated objects among seven familiar objects given in the same line. Before starting the test, participants practice by solving five sample test items. Then they are given three minutes to solve the test, which consists of a total of 40 rows. During this time, participants are expected to find as many matching pairs as possible. One point can be obtained for each correctly marked pair in each row, resulting in a total of 40 points. Participants can skip a row they do not know or change an answer they believe to be incorrect within the given time. Since the test does not contain verbal or cultural elements, the original version of the test was used in this study.

3.4.7 Test of working memory

To measure students' memory capacities, the digit span test from the Turkish adapted battery of WISC-R was applied. This test consists of two parts. At first, in the forward span task participants are expected to listen to numbers ranging from 2 to 9 digits and repeat them in the order they hear. The number of digits increases gradually, and there are two different trials for each digit count. If a participant fails in both trials for a particular digit count, the test is terminated. In the second part,

called the backward span task, participants are required to recall the digits they heard in reverse order, from the end to the beginning, unlike in the first part. One point is given for each correctly answered item in the test, while no points is given for incorrectly repeated items. From this test, students can obtain a maximum of 32 points, 16 from the first part and 16 from the second part.

3.5 Data collection

Data collection for the study occurred in two stages: (a) obtaining necessary permissions, and (b) the data collection process itself. In the first stage, ethical approval was obtained by submitting a detailed research proposal explaining all tests and processes related to the study to The Ethics Committee for Master's and PhD Theses in Social Sciences and Humanities at Boğaziçi University. Subsequently, schools where the study would be conducted were determined based on convenience, and meetings with school principals were held to obtain their support and permission to conduct the study. Following this, online procedures were initiated to get permission from the Ministry of National Education (MoNE). The permission process was conducted inter-organizationally between Boğaziçi University and the District Directorate of National Education. After receiving official approval from the MoNE, parents of the students were contacted through the school principals, and teachers, and it was expected that both the parents and students would fill out a consent form, as the participants were under 18 years old. Only students with parental consent participated in the study, and participation was based on the voluntary consent of both. The process of obtaining all approvals took more than three months.

After obtaining permissions, RAN and V tests were initially administered individually to fourth-grade students. Subsequently, TRF, MR, and ME tests were administered to students individually in a second session in order to prevent test fatigue. Since the duration of the tests in both rounds was approximately equal, they were combined in this manner. Individual data for 4th grade students were collected over a period of approximately two weeks. After collecting data from 4th grade students, the same process was repeated with fifth-grade students. Due to the larger number of 5th grade students, the data collection process took approximately three weeks. After completing the administration of individual tests, RC and PS tests were administered collectively to each class during class hours. The collective tests lasted approximately 55-60 minutes. Since there were two classes in fourth grade and three classes in fifth grade, the administration of these tests took about five class hours on the same day. All tests were conducted by the researcher herself in classrooms allocated separately for her by the school administration in primary and middle school buildings.

3.6 Data analysis

The data of the research were analyzed with a Statistical Package for Social Sciences (SPSS) program. 42 students from the 4th grade and 52 students from the 5th grade participated in the data collection process. The distributions of the data were examined with boxplot simple, and it was understood that one participant from the 4th grade and one participant from the 5th grade constituted an outlier. In this context, those participants' data were deleted from both data sets. Analyzes were carried on 41 students in the 4th grade and 51 students in the 5th grade. After assigning the mean value to the missing data, the averages of both the dependent and

independent variables of the study were taken separately. In the analysis of the data, normality criteria were tested with Kolmogorov Smirnov test and decided by examining the skewness and the kurtosis coefficients, which is expected to range between -2 and +2 (Bachman, 2004). Additionally, analyzes were conducted using descriptive statistics, Pearson correlation, and standard multiple regression analysis (enter method was used). Data analysis was carried out by verifying the assumptions required for the application of standard multiple regression analysis (whether there is a multicollinearity problem, examining Standard Residual values and Cook's Distance values, examining the Durbin-Watson value and histogram graph).

CHAPTER 4

RESULTS

4.1 Findings of 4th graders

Descriprve statistics for 4th graders:

Table 1 Descriptive Statistics of 4th Graders

Variables	N	Mean	SD	Min.	Max.	Max Pos.
RAN		26,1	4,5	17,9	35,0	-
V		24,0	7,7	11,0	43,0	87
MA		24,4	2,8	19,0	29,0	30
PS	41	25,5	6,0	4,0	35,0	40
MC		11,0	2,2	7,00	16,0	32
TRF		89,8	15,6	63,0	130,0	-
RC		23,9	6,4	7,25	34,0	40

Note: RAN= Rapid Automatized Naming, V= Vocabulary, MA= Morphological Awareness, PS= Processing Speed, MC= Memory Capacity, TRF= Text Reading Fluency

Table 1 presents the descriptive statistics for the 4th-grade students, serving as preliminary findings. In the rapid automatized naming (RAN) test, which measures students' speed in reading numbers, the fastest recorded time was 17.9 seconds, and the slowest was 35 seconds, with a mean of 26.1 seconds. This test does not have a predetermined maximum value. In the vocabulary test (V) , where the maximum possible score is 87, students scored between 11 and 43, with an average score of 24. The morphological awareness (MA) test, which has a maximum score of 30, showed student scores ranging from 19 to 29, with an average of 24.4. In the

processing speed test (PS), where the highest achievable score is 40, students' scores ranged from 4 to 35, with a mean of 24.4. Memory capacity (MC), calculated using the forward and backward digit span tests, had a maximum possible score of 32. Students' scores varied from 7 to 16, with an average of 11. Text reading fluency (TRF), measured in seconds, does not have maximum value. In this test, the fastest reading time was 63 seconds, the slowest was 130 seconds, and the average was 89.8 seconds. Finally, in the reading comprehension test (RC), where the maximum score is 40, students scored between 7.25 and 34 points, with an average score of 23.9.

Test of normal distribution:

In the following section, first the normality tests were conducted on the data set of 4th grade students. Then the Pearson correlation test was applied. Then, standard multiple linear regression assumptions were tested, and the regression results were examined.

Table 2. Normality Test of 4th Graders' Variables

Variables	*N*	Kolmogorov-Smirnov		Skewness		Kurtosis	
		Statistic	p	Statistic	SE	Statistic	SE
RAN	41	,086	,200*	,035	,369	-,824	,724
V		,143	,035	,373		-,551	
MA		,168	,005	-,400		-,778	
PS		,147	,025	-1,331		2,938	
MC		,155	,015	,558		-,125	
TRF		,155	,015	,408		,006	
RC		,101	,200*	-,811		,383	

Note: RAN= Rapid Automatized Naming, V= Vocabulary, MA=Morphological Awareness, PS=Processing Speed, MC=Memory Capacity, TRF= Text Reading Fluency

According to Table 2, when the normality distribution of the dataset of 4th graders is examined, it is understood that the variables RAN and RC demonstrates a normal distribution in terms of significance values ($p>.005$), but it is understood that other variables do not demonstrate a normal distribution ($p<.005$). When the skewness and kurtosis values of the variables are examined, almost all values (except for PS kurtosis) are distributed between -2 and +2. According to George and Mallery (2018), having kurtosis and skewness values within the range of -2 to +2 indicates that the data exhibits a normal distribution. According to this The Pearson Product-Moment Correlation Coefficient (r), which is a parametric type of correlation, has been used to determine the relationships between variables.

Research question 1:

"Is there a significant relationship between linguistic subskills (vocabulary knowledge, morphological awareness and text reading fluency), cognitive subskills (memory capacity, processing speed and rapid automatized naming) and reading comprehension?"

In Table 3 below, the Pearson correlation analysis results of variables belonging to 4th grade students are presented.

Table 3. Average Scores and Pearson Correlation Results of Variables for 4th Grade Students

N	Variables	$\bar{x}$	SD	Ran	V	MR	PS	MC	TRF	RC
41	RAN	26,19	4,51	1	-,26	-,20	-,11	-,33*	,30*	-,33*
	V	24,09	7,76		1	,53*	,32*	,46*	-,46*	,74*
	MA	24,41	2,80			1	,30	,57*	-,42*	,63*
	PS	25,53	6,02				1	,18	-,39*	,32*
	MC	11,02	2,27					1	-,42*	,46*
	TRF	89,85	15,63						1	-,62*
	RC	23,90	6,40							1

**<.005*

Note: RAN= Rapid Automatized Naming, V= Vocabulary, MA= Morphological Awareness, PS= Processing Speed, MC=Memory Capacity, TRF= Text Reading Fluency, RC=Reading Comprehension

Table 3 presents the average scores of 4th grade students, which range from 11.02 to 89.85 across the measured variables. Of the seven variables, five exhibit statistically insignificant relationships, while sixteen show significant correlations among each other. As the RAN scores of students increase, their TRF scores rise significantly (r = .30), whereas MC scores show a significant decrease (r = -.33). In contrast, increases in V scores are significantly correlated with increases in MA (r = .53), PS (r = .32), and MC (r = .46), on the other hand as V scores increase TRF scores decrease significantly (r = -.46). Similarly, higher MA scores are significantly associated with an increase in MC (r = .57) but a decrease in TRF (r = -.42). Moreover, as PS scores increase, TRF scores significantly decrease (r = -.39).

Finally, an increase in MC scores is significantly linked to a decrease in TRF scores (r = -.42).

In line with the research question, results from the Pearson correlation test reveal that RC scores have significant correlations with all the measured variables. Specifically, increases in MA (r = .63), V (r = .74), PS (r = .32), and MC (r = .46) are significantly associated with higher RC scores. However, higher RAN scores are significantly correlated with lower RC scores (r = -.33), as are higher TRF scores (r = -.62).

Examination of multiple regression assumptions of 4th graders:

Standard multiple linear regression analysis was applied to examine the predictive level of variables (RAN, V, MR, PS, ME, and TRF) used in the investigation of 4th grade students' RC levels. In order to conduct this analysis, certain assumptions need to be met. The reference intervals of assumptions were calculated considering the reference intervals of Field (2009), Green and Salkind (2005), and Hair, Anderson, Tatham, and Black (1998). Firstly, all correlation values among the variables range from -0.55 to 0.77. These values being less than 0.80 indicate that there is no multi-collinearity issue. Standard residual values range from -2.2 to 1.4, and it is expected that these values are not greater or smaller than 3.29. Therefore, they fall within the reference range. Cook's Distance values range from 0.00 to 0.27, and it is expected that these values are not greater than 1. The Durbin-Watson value is determined to be 2.570, indicating that it satisfies the assumption by being between 1 and 3. Below, the histogram distribution graph is also presented in Figure 2.

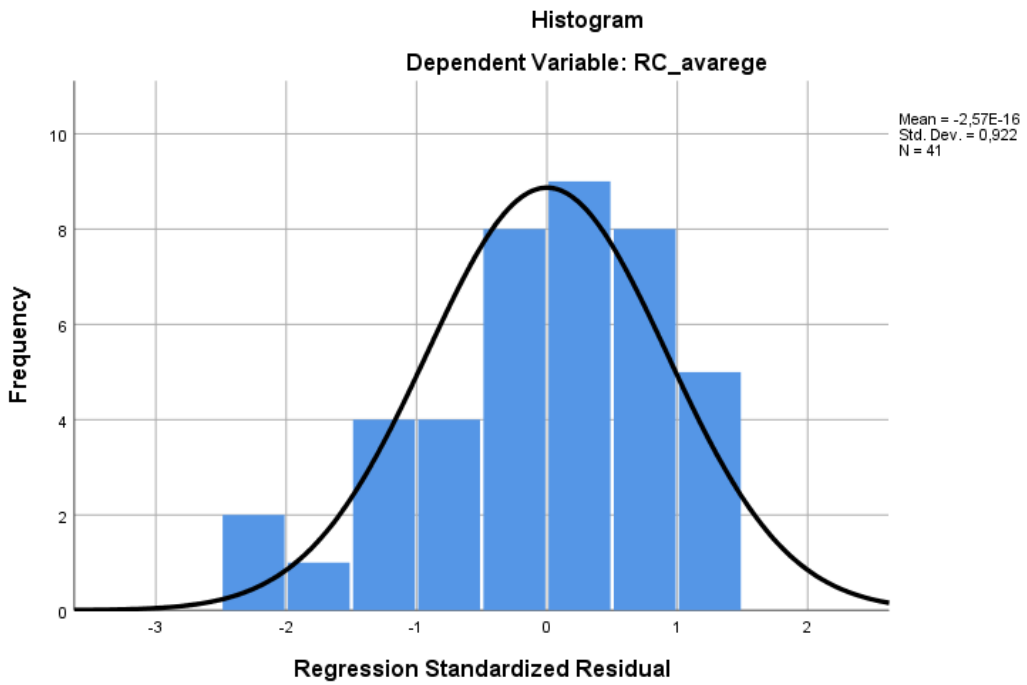


Figure 2. Histogram graph of standard multiple regression distribution.

According to Figure 2, it is understood that the distribution is normal based on the multiple linear regression analysis conducted. All these values indicate that there is no problem in applying standard multiple regression between the independent variables and the dependent variable RC.

Research question 2:

"How much variance do cognitive and linguistic subskills account for in reading comprehension?"

Standard multiple regression analysis results are presented in Table 4 below.

Table 4. Regression Analyses of Cognitive and Linguistic Subskills with RC as Criterion Measures

RC							
Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
RAN	-,110	,143	-,077	-,767	,448	-,401	,181
V	,288	,099	,349	2,905	,006*	,087	,489
MR	1,037	,275	,453	3,771	,001*	,478	1,595
PS	,165	,109	,156	1,512	,140	-,057	,388
MC	-,287	,339	-,102	-,847	,403	-,977	,402
TRF	-,067	,048	-,165	-1,409	,168	-,165	,030
R/Adjustment R^2	.837/.648/ (F= 13.281 p<0,01)						

*Bootstrapped results are based on 1,000 samples.*P < 0.05,*

Note: RAN= Rapid Automatized Naming, V= Vocabulary, MR= Morphological Awareness, PS= Processing Speed, MC= Memory Capacity, TRF= Text Reading Fluency, RC= Reading Comprehension

The F value obtained from the regression analysis is significant at the 0.01 level, indicating that the regression model is appropriate and at least one of the independent variables has a significant effect on the dependent variable. When examining the R2 value, it is found that the independent variables in the model explain 64% of the 4th grade students' RC levels. According to the results of the standard multiple regression analysis given in Table 4, the independent variables V and MR have a significant effect on the 4th grade students' RC levels ($p < 0.01$).

Considering the squares of the standardized regression coefficients (β2) for the 4th grade students' RC, a one-unit change in the independent variable V results in a positive change of 0.349 in the dependent variable RC. Similarly, a one-unit change in MR also results in a positive change of 0.453 in RC.

4.2 Findings of 5th graders

Descriptive statistics for 5th graders:

In this section, the dataset belonging to 5th grade students was first subjected to normality tests. Subsequently, a correlation test was applied. Following that, the assumptions of multiple linear regression were tested, and the regression results were examined.

Table 5. Descriptive Statistics of 5th Graders

Variables	*N*	Mean	SD	Min.	Max.	Max Pos.
RAN		24,2	4,3	17,1	34,7	-
V		24,1	7,6	9,0	41,0	87
MR		25,1	2,7	15,0	29,0	30
PS	50	28,4	4,9	18,0	40,0	40
MC		12,0	2,7	4,0	18,0	32
TRF		91,9	16,9	59,0	136,0	-
RC		24,0	6,8	5,8	35,8	40

RAN= Rapid Automatized Naming, V= Vocabulary, MR= Morphological Awareness, PS= Processing Speed, MC= Memory Capacity, TRF= Text Reading Fluency

Table 5 presents the descriptive statistics for 5th grade students as part of the preliminary findings. In the RAN test, which measured students' ability to read numbers as quickly as possible, the fastest recorded time was 17.1 seconds, while the slowest was 34.7 seconds, with an average time of 24.2 seconds. This test does not have a maximum possible value. In the vocabulary test, where the maximum achievable score is 87, students scored between 9 and 41, with an average score of 24.1 points. For the morphological awareness test, which has a maximum score of 30, student scores ranged from a low of 15 to a high of 29, with an average of 25.1. In the processing speed test, where the maximum possible score is 40, the highest student score was 40, while the lowest was 18, with an average score of 28.4. Memory capacity was assessed through the forward and backward digit span tests, with a maximum score of 32. Scores ranged from 4 to 18, with an average of 12 points. Text reading fluency was measured by timing students as they read a paragraph, and since this test is time-based, it does not have a maximum score. The fastest reading time was 59 seconds, and the slowest was 136 seconds, with an average of 91.9 seconds. Lastly, in the reading comprehension test, where the maximum score is 40, students scored between 5.8 and 35.8 points, with an average score of 24 points.

Testing for Normality Distributions:

Table 6. Normality Test of 5th Graders' Variables

Variables	N	Kolmogorov-Smirnov		Skewness		Kurtosis	
		Statistic	p	Statistic	SE	Statistic	SE
Ran	50	,081	,200*	,369	,337	-,473	,662
V		,097	,200*	,066		-,600	
MR		,203	,000	-1,528		3,305	
PS		,115	,094	-,211		,051	
MC		,100	,200*	-,357		,500	
TRF		,082	,200*	,473		,034	
RC		,111	,168	-,523		-,235	

Note: RAN= Rapid Automatized Naming, V= Vocabulary, MR= Morphological Awareness, PS= Processing Speed, ME= Memory Capacity, TRF= Text Reading Fluency

According to Table 6, when the normality distribution of the dataset belonging to 5th grades is examined in terms of significance values, it is understood that the variables RAN, V, MC, and TRF exhibit a normal distribution ($p > .005$), but the other variables do not exhibit a normal distribution ($p < .005$). When the skewness and kurtosis values of the variables are examined, almost all values (except for MR kurtosis) are distributed between -2 and +2. According to George and Mallery (2010), the values of kurtosis and skewness being within the -2 to +2 range indicate that the data exhibit a normal distribution. Pearson's product-moment correlation coefficient (r), a parametric type of correlation, was used to determine the relationships between the variables.

Research question 3:

"Is there a significant relationship between linguistic subskills (vocabulary knowledge, morphological awareness and text reading fluency), cognitive subskills (memory capacity, processing speed and rapid automatized naming) and reading comprehension?"

Table 7. Average Scores and Pearson Correlation Results of Variables for 5th Grade Students

N	Variables	$\bar{x}$	SD	RAN	V	MR	PS	MC	TRF	RC
50	RAN	24,29	4,37	1	-,27	-,09	-,11	-,32*	,38*	-,25
	V	24,14	7,64		1	,38*	,19	,47*	-,39*	,39*
	MR	25,12	2,79			1	,10	,38*	-,32*	,47*
	PS	28,44	4,91				1	,11	-,23	,12
	MC	12,00	2,79					1	-,29*	,40*
	TRF	91,92	16,94						1	-,50*
	RC	24,08	6,85							1

**<.005*

Note: RAN= Rapid Automatized Naming, V= Vocabulary, MR= Morphological Awareness, PS= Processing Speed, MC= Memory Capacity, TRF= Text Reading Fluency, RC= Reading Comprehension

In Table 7 above, the Pearson correlation analysis results of the variables for 5th grade students are presented. As the RAN levels of 5th grade students increase, TRF levels (r=.38) also increase significantly, while MC (r=-.32) levels decrease significantly. Increases in vocabulary score is significantly associated with increases in MR (r = .38), MC (r = .47), and RC (r = .39); however, TRF scores significantly

decrease (r = -.39) as vocabulary increase. Similarly, as MR levels increase, MC (r=.38) and RC (r=.47) levels also increase significantly; however, TRF (r=-.32) levels decrease significantly. As MC levels increase, RC (r=.40) levels also increase significantly, but TRF (r=-.29) levels decrease significantly. Finally, as TRF levels increase, RC (r=-.50) levels decrease significantly.

In line with the research question, the Pearson correlation test results show that RC scores are significantly correlated with V, MR, ME, and TRF scores. Specifically, increases in V (r = .39), MR (r = .47), and MC (r = .40) are significantly associated with higher RC scores. Conversely, as TRF levels increase, RC scores significantly decrease (r = -.50).

Examination of multiple regression assumptions:

Standard multiple linear regression analysis was conducted to examine the predictive level of variables (RAN, V, MR, PS, ME, and TRF) used in the investigation of 5th grade students' RC levels. In order to conduct this analysis, certain assumptions need to be met.

As with 4th graders' data analysis, here the reference intervals of assumptions were also calculated, taking into account the reference intervals of Field (2009), Green and Salkind (2005), and Hair, Anderson, Tatham, and Black (1998). Firstly, all correlation values among the variables range from -0.50 to 0.47. These values being less than 0.80 indicate that there is no multicollinearity issue. Standard residual values range from -2.09 to 1.65, and it is expected that these values are not greater or smaller than 3.29. Therefore, they fall within the reference range. Cook's Distance values also range from 0.00 to 0.29, and it is expected that these values are not greater than 1. The Durbin-Watson value is determined to be 1.639, indicating that it satisfies the assumption by being between 1 and 3. Below, the histogram distribution graph is also presented in Figure 3.

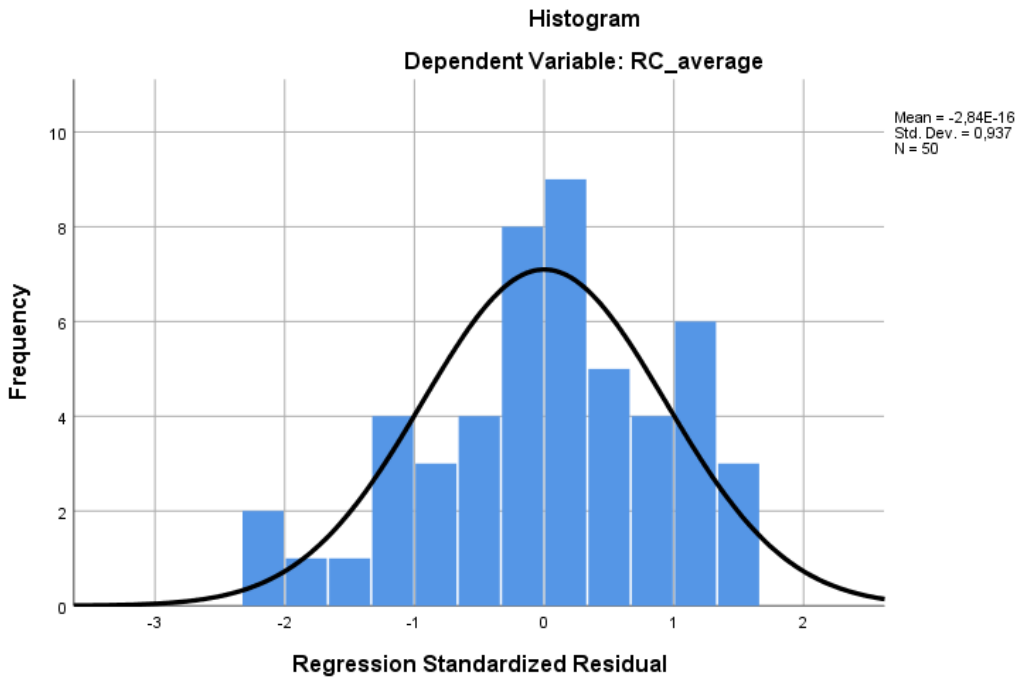


Figure 3. Histogram graph of standard multiple regression distribution

According to Figure 3, it can be understood that the distribution is normal through the standard multiple linear regression analysis generated. All these values

indicate that there is no issue in applying standard multiple regression between the independent variables and the dependent variable RC.

Research question 4:

How much variance do cognitive and linguistic subskills account for in Reading Comprehension?

Table 8. Regression Analyses of Cognitive and Linguistic Subskills with RC as Criterion Measures

RC							
Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
	B	Std. Error	Beta β			Lower Bound	Upper Bound
Ran	-,053	,209	-,034	-,254	,801	-,476	,369
V	,078	,130	,087	,602	,550	-,184	,340
MA	,669	,332	,273	2,014	,050*	-,001	1,339
PS	-,030	,171	-,021	-,174	,863	-,375	,315
MC	,372	,351	,151	1,059	,296	-,336	1,080
TRF	-,133	,057	-,328	-,320	,025*	-,248	-,017
R/Adjustment R^2	.630/.312/ (F= 4.704 p<0,01)						

Bootstrapped results are based on 1,000 samples.
**P<0.05,*
Note: RAN= Rapid Automatized Naming, V= Vocabulary, MA= Morphological Awareness, PS= Processing Speed, MC= Memory Capacity, TRF= Text Reading Fluency, RC= Reading Comprehension

Standard multiple regression analysis results for 5th graders are presented in Table 8 above. The F value obtained from the regression analysis is significant at the

0.01 level, indicating that the regression model is appropriate and at least one of the independent variables has a significant effect on the dependent variable. When examining the R2 value, it is found that the independent variables in the model explain 31% of the 5th grade students' reading comprehension. According to the results of the standard multiple regression analysis given in Table 8, the independent variables MA and TRF have a significant effect on the fifth-grade students' RC ($p < 0.01$). Considering the squares of the standardized regression coefficients ($\beta 2$) for the 5th grade students' RC, a one-unit change in the independent variable MA results in a positive change of 0.273 in the dependent variable RC. Similarly, a one-unit change in TRF results in a negative change of -0.328 in RC.

CHAPTER 5

DISCUSSION AND CONCLUSION

The purpose of this study is to examine the relationship between reading comprehension skills and its linguistic and cognitive subskills such as fluency (F), morphological awareness (MA), vocabulary knowledge (V), rapid automatized naming (RAN), processing speed (PS), and memory capacity (MC) in 4th and 5th-grade students in Turkish—a language that is orthographically highly transparent, and morphologically rich. To achieve this aim, students were administered a total of seven tests, covering six subskills and reading comprehension skills. The collected data were analyzed using correlation and regression analyses. In this section, the results of the analysis will be discussed in light of the literature on reading comprehension. First, the relationship between variables and reading comprehension for 4th and 5th grades will be discussed separately based on the correlation analysis. Subsequently, the discussion will address the regression results for both grades. Finally, the implications that could contribute to literacy instruction in Turkish will be presented, followed by a discussion of the study's limitations and suggestions for further research.

5.1 Relationship between reading comprehension and other variables

Research on reading comprehension indicates that this skill is a multifaceted and complex process, influenced by various subcomponents. Their effect varies depending on individual factors, developmental stages, and the structural characteristics of the language (Kendeou et al., 2016). The literature identifies F, MA, V, RAN, PS, and MC as being related to reading comprehension in varying

ways. This study investigates the correlation between these subskills and reading comprehension in 4th and 5th-grade students who are native Turkish speakers, a language characterized by high phoneme-grapheme correspondence, during their transition from learning to read to reading to learn. Pearson correlation analysis of the present study revealed that all measured variables in 4th grade (F, MA, V, RAN, PS, MC) significantly correlate with reading comprehension (RC), consistent with the findings reported in the literature.

In 4th grade, vocabulary knowledge showed the strongest correlation with reading comprehension ($r = .74$, $p < .01$), while in 5th grade, although the correlation was weaker ($r = .39$, $p < .01$), it remained significant. As highlighted by various reading comprehension models (e.g., Gough & Tunmer, 1986; Joshi & Aaron, 2000; Perfetti & Hart, 2002; Perfetti & Staffura, 2014), vocabulary knowledge is essential in the meaning-making process. Extensive research confirms the strong link between vocabulary and reading comprehension (Verhoeven & Perfetti, 2022), with studies across languages demonstrating that a larger vocabulary enhances reading comprehension. A broad vocabulary helps recognize words in texts, while deeper word knowledge supports understanding complex ideas (Ouellette, 2006).

Consistent with previous research (Carlisle, 1995; Deacon et al., 2015; Kirby et al., 2012; Rispens et al., 2008), morphological awareness was significantly correlated with reading comprehension in both 4th and 5th grades ($r = .63$, $p < .01$ and $r = .47$, $p < .01$, respectively). Given Turkish's agglutinative nature and rich morphological structure, the ability to recognize and manipulate morphemes—such as prefixes, suffixes, and roots—is essential for understanding complex word formations and enhancing reading comprehension. In languages with complex morphology, understanding how morphemes convey grammatical aspects like tense

and case is crucial for accurate sentence interpretation (Liu et al., 2024; Manolitsis et al., 2017).

The analysis of the current study reveals that text reading fluency (TRF) is strongly correlated with reading comprehension (RC) in both 4th ($r = -.62$, $p < .01$) and 5th grades ($r = -.50$, $p < .01$). Fluency, the ability to read text smoothly, quickly, and with appropriate expression, is considered as an important prerequisite for comprehension in reading research (Hudson et al, 2008). Similarly, the findings of this study also show that for Turkish-speaking 4th and 5th graders, who have relatively developed reading automaticity, text reading fluency is negatively correlated with reading comprehension, which means that as the students read faster, their comprehension increases. Similar to the findings of the current study, Klauda and Guthrie (2008) and Jenkins et al. (2003) both found that reading fluency within context is a strong correlate and predictor of reading comprehension.

As for the relationship between RAN and RC, RAN was found to be significantly and negatively correlated with RC in the 4th grade; however, the relationship was not significant for 5th graders. Joshi and Aaron (2000) expanded the Simple View of Reading to include naming speed in their Component Model of Reading, suggesting that letter naming speed (RAN) accounted for an additional 10% of variance in reading comprehension, while decoding and listening comprehension explained 48% for 3th grade students. It was hypothesized that RAN's effect increases with grade and in the 4th grade RAN was expected to have a greater predictive value for RC. When evaluating this hypothesis in terms of the RAN-RC correlation, it is partially confirmed for Turkish. While RAN is significantly correlated with RC in the 4th grade, the correlation loses its significance in the 5th grade. Studies suggested that word reading fluency mediates the relationship between

alphanumeric RAN and reading comprehension, indicating that efficient rapid naming allows readers to allocate cognitive resources to comprehension. RAN's relationship with RC seems to be mediated by reading fluency for upper grades in Turkish (Özata, 2018). The significant correlation between TRF and RAN found in this study's analysis ($r = .30$, $p < .01$ for the 4th grade; $r = .38$, $p < .01$ for the 5th grade) also supports previous research in this area.

Processing speed is a domain-general factor that can be explained as the rate at which an individual perceives, interprets, and responds to information, determining how quickly they can recognize words, understand meanings, and integrate them into coherent ideas during reading. The analysis of data indicates that the PS of 4th grade students has a statistically significant, however weak, positive correlation ($r = .32$, $p < .01$) with reading comprehension (RC), indicating that PS is somewhat associated with better RC (Christopher et al., 2012). Although the relationship between PS and lower-level skills such as decoding and fluency is consistently supported in the literature (Candan, Babür, Haznedar, and Erçetin, 2020), there is limited evidence regarding its direct link to RC. In this study, while a weak but significant correlation was found between PS and RC in 4th graders, PS showed a weak, non-significant correlation with RC in 5th graders ($r = .12$, $p < .01$). Similarly, Borella and Ribaupierre (2014) found that the relationship between PS and RC is mediated by working memory (WM). These findings suggest that the direct correlation between PS and comprehension, a higher-order reading skill, is weak and is likely to be mediated by other components.

Another variable examined in this study in relation to reading comprehension (RC) is Memory capacity (MC). A significant moderate positive correlation was found between Memory and RC in both 4th and 5th graders ($r = .46$, $p < .01$ and $r =$

.40, $p < .01$, respectively). This significant correlation emphasizes the role of working memory in holding and manipulating information while reading, which is crucial for understanding and integrating text. La berge & Samuels' (1974) Automaticy Theory suggests that in order to execute higher-level comprehension tasks better, readers need more free working memory. As the students have higher capacity, they can spare more memory to retain and integrate information in order to make inferences and handle complex sentences.

In addition to the correlation between RC and other components, significant high correlations were found among some predictor variables themselves. For example, vocabulary knowledge was found to be significantly correlated with morphological awareness in both grade levels ($r = .53$, $p < .01$ for the 4th grade; $r = .38$, $p < .01$ for the 5th grade). Morphological awareness helps readers understand unfamiliar words by analyzing their morphemes, aiding in inferring meanings and expanding vocabulary. This knowledge of word structure also facilitates the acquisition of new words. For instance, understanding common prefixes and suffixes enables readers to decipher and learn new words more efficiently.

A significant and strong correlation was found between morphological awareness (MA) and memory capacity (MC) in the 4th grade students ($r = .57$, $p < .01$). The correlation between morphological awareness and working memory can be explained by the essential role that working memory plays in processing, manipulating, and integrating morphemic information. Morphological analysis can impose a significant cognitive load, especially when dealing with unfamiliar or complex words. A strong working memory capacity could help manage this load by temporarily storing and manipulating morphemic information, making it easier to

decode and understand words on the fly, which is critical for understanding complex words, especially in morphologically rich languages.

5.2 Predictors of reading comprehension

The 4th grade students' standard multiple regression analysis results reveal that vocabulary knowledge (V), and morphological awareness (MA) are both significant precursors of reading comprehension. However, MA has a stronger impact on reading comprehension than V, as indicated by its higher standardized coefficient (β = 0.453 for MA vs. β = 0.349 for V). Other variables, including RAN, PS, MC, and TRF, do not show statistically significant relationships with reading comprehension in this model. Additionally, approximately 83.7% of the variance in reading comprehension is explained by the model, indicating a strong overall fit for the 4th grade students.

Morphological awareness helps students decode unfamiliar words and understand their meanings in context, which is essential for deep comprehension (Liu et al., 2024). The importance of MA for reading comprehension has been shown in many studies in the literature (Deacon et al., 2015; Güldenoğlu et al., 2016; James et al., 2021; Levesque et al., 2017; Liu et al., 2024; Manolitsis et al., 2017; Nagy et al.; 2006). The standardized coefficient value of the 4th graders (β = 0.453) in this study represents a strong positive relationship, indicating that morphological awareness is the most significant predictor in the model, suggesting that variations in morphological awareness can lead to significant differences in the reading comprehension performance of the students. Similarly, the standardized coefficient of the 5th graders (β = 0.273) shows that morphological awareness has a statistically significant, moderate, positive effect on reading comprehension. In morphologically

rich languages, where word meaning and grammatical structures are closely tied to morphology, morphological awareness is fundamental to reading comprehension. It allows readers to decode words, infer meanings, understand syntactic relationships, and process complex texts more effectively, making it a key component of literacy in these linguistic contexts. This means that students who have a good grasp of word morphology are much better equipped to comprehend complex texts. Some previous studies also support the findings of this research. For example, in a study conducted with poor comprehenders in Turkish, Kargın et al. (2022) also reported that morphological awareness is an important precursor to reading comprehension.

Vocabulary knowledge helps readers understand the meaning of the words they encounter, which directly contributes to their overall understanding of the text (NRP, 2000). Numerous studies in the literature show that vocabulary knowledge is a strong predictor of reading comprehension (Babayiğit & Stainthorp, 2014; Braze et al., 2007; Duff et al., 2015; Protopapas et al., 2007; Spencer et al., 2019; Verhoeven et al., 2011). Compatible with previous studies, standardized coefficient ($\beta = 0.349$) of the 4th grade students in the current study indicates a significant moderate positive relationship between vocabulary and reading comprehension, making vocabulary one of the stronger predictors, suggesting that students who have a more extensive vocabulary are better able to comprehend what they read. This finding supports The Lexical Quality Hypothesis (Perfetti & Hart, 2002) which posits that reading comprehension depends on the precision, coherence, and accessibility of mental representations of words, with high-quality lexical representations facilitating more efficient and accurate reading.

The standard multiple linear regression analysis of the 5th grade students revealed that morphological awareness and text reading fluency are significant

predictors of reading comprehension. Other variables such as vocabulary, processing speed, and memory capacity do not significantly contribute to predicting reading comprehension in this model. The model explains a moderate amount (31.2%) of the variance in reading comprehension, indicating that while these skills are important, other factors also contribute to reading comprehension that are not captured by this analysis.

In reading comprehension research there is ample evidence that fluency predicts reading comprehension because it enables readers to recognize words automatically, freeing up cognitive resources for understanding the text (Fuchs et al., 2001; Gough & Tunmer, 1986; Joshi & Aaron, 2000; Klauda & Guthrie, 2008; Kim et al., 2021; Perfetti, 1985). Additionally, fluent reading supports comprehension through accurate decoding, appropriate pacing, and expressive prosody, all of which contribute to grasping meaning more effectively (Hudson et al., 2008). According to the Simple View of Reading (SVR) model, reading comprehension is the product of decoding (word recognition) and linguistic comprehension. Fluency plays a crucial role in this model by bridging the gap between decoding and comprehension, ensuring that automatic decoding does not hinder understanding. In line with the existing literature, the standardized coefficient of the 5th grade Turkish native students ($\beta = 0.349$) shows a moderate effect size. The negative beta means that higher TRF scores (which indicate slower reading) are associated with lower reading comprehension. This interpretation aligns with the general expectation that fluency aids comprehension: faster readers who can maintain accuracy are likely better at understanding what they read, reflecting the positive impact of TRF on RC.

5.3 Conclusion

This study aims to examine the relationship between reading comprehension and subskills such as fluency (F), morphological awareness (MA), vocabulary knowledge (V), rapid automatized naming (RAN), processing speed (PS), and memory capacity (MC) in 4th and 5th grade students who speak Turkish, a language that is orthographically transparent and morphologically rich.

Correlation analyses of the obtained data reveal that, for 4th grade students, all subskills are significantly correlated with reading comprehension to varying degrees. The findings indicate that vocabulary knowledge is the most strongly correlated skill with reading comprehension in both grades, although its impact slightly decreases in the 5th grade. Morphological awareness, essential in a morphologically rich language like Turkish, is also significantly correlated with comprehension. Text reading fluency shows a negative correlation with reading comprehension, suggesting that faster reading enhances understanding. RAN is significantly correlated with comprehension in the 4th grade but loses significance in the 5th grade, implying that its influence may diminish as students become more proficient readers. Processing speed shows a weak positive correlation with comprehension in the 4th grade and no significant correlation in the 5th grade, while memory capacity demonstrates a moderate positive relationship across both grades. Additionally, strong correlations were found among some predictor variables, such as vocabulary knowledge and morphological awareness, highlighting their interconnected roles in supporting reading comprehension.

To identify the cognitive and linguistic subskills that predict reading comprehension, a standard multiple regression analysis was conducted in this study. The results reveal that for the 4th grade students, both morphological awareness

(MA) and vocabulary (V) significantly predict reading comprehension, with MA having a stronger impact. This model explains 83.7% of the variance in comprehension, underscoring their critical role. For the 5th graders, MA remains a significant predictor, though its influence decreases, while text reading fluency (TRF) also emerges as a key factor. TRF's negative correlation suggests that faster reading supports better comprehension. Vocabulary, processing speed, and memory capacity do not significantly predict reading comprehension in the 5th grade. The model explains 31.2% of the variance for the 5th graders, indicating the importance of additional factors. These findings are consistent with existing research, highlighting the central role of morphological awareness, vocabulary, and fluency in reading comprehension, particularly in morphologically rich languages like Turkish.

5.4 Pedagogical implications of the study

Reading comprehension is not only a skill that affects academic success but also has lifelong implications. Therefore, strategies that enhance reading comprehension are crucial. Based on this study, various pedagogical implications can be proposed for sub-skills that are found to influence reading ability. For example, vocabulary knowledge was found to be central to the comprehension process. Children are thought to benefit from effective vocabulary instruction, which includes explicit teaching of high-utility words, promoting contextual learning, introducing word-learning strategies, ensuring repeated exposure through varied activities, and fostering a language-rich environment for meaningful engagement with words. In order to improve vocabulary knowledge of Turkish students, a variety of exercises can be used, focusing on both meaning and usage of words. For example, guess-the-word activities could reinforce vocabulary by having students infer a word based on

a description, or word maps would help students explore word meanings and associations by creating a visual diagram of related words, such as synonyms, categories, and usages, centered around a target word. Also, picture description activities could develop vocabulary by having students describe a visual scene in detail, encouraging them to use specific vocabulary words related to the image.

Morphological awareness has also been identified in this study as a significant precursor of reading comprehension. Therefore, focusing on teaching morphemes, engaging students in word analysis, addressing both derivational and inflectional morphology, and integrating morphology with vocabulary development would directly enhance students' reading comprehension abilities. Furthermore, to improve Turkish students' morphological awareness, several exercises can be used in the classrooms. Affix identification and matching activities involves students pairing root words with suffixes to form new words and explaining how the affix alters the meaning, helping them recognize and understand common affixes in Turkish. Word building games would make morphology practice fun by having students form valid words by combining root words with suffix cards, with the goal of creating the most correct words to win the game. Error correction tasks would help students develop morphological analysis skills by identifying and correcting morpheme errors in sentences, followed by discussions on why the incorrect forms are inappropriate for the context. Furthermore, fill-in-the-blank activities with morphological clues would strengthen students' understanding of word structure by having them fill in missing words derived from a given root, based on sentence context.

Finally, text reading fluency was found to be another significant predictor of reading comprehension in this study. Fluency instruction should include modeling fluent reading, guided oral practice with feedback, and repeated readings for

improved accuracy. To improve text reading fluency of Turkish students, exercises can focus on speed, accuracy, and expression while reading. Choral reading practices could build fluency by having students read aloud simultaneously with the teacher, helping hesitant readers gain confidence and learn the rhythm and pacing of fluent reading. Chunking practice would improve reading fluency by having students break sentences into smaller, logical chunks, allowing them to read more smoothly and understand the structure better. Additionally, reader's theater type of activities enhance fluency by having students perform scripted readings with assigned roles, focusing on expression, intonation, rhythm, and clarity to improve their oral reading skills.

5.5 Limitations of the study

41 students from the 4th grade and 51 students from the 5th grade participated in this research to examine the linguistic and cognitive components that affect reading comprehension. The number of participants was limited because it took a long time as the tests were administered and the data were collected individually by only one researcher. Additionally, in the study, text reading fluency was determined by measuring the speed of students' reading paragraphs as fast as possible, but prosody was not added as a criterion. Also, adding other cognitive skills, such as inhibition, to further research would be better to examine the factors affecting reading comprehension of students beyond primary school.

5.6 Recommendations for further research

In subsequent studies, increasing the sample size of the study and collecting data from more participants will positively affect the generalizability of the data. In the

study, the answers to reading comprehension and vocabulary questions were evaluated quantitatively, but qualitative evaluation of these tests may allow more detailed inferences. In addition, teachers' practices in reading comprehension and their effects on students can be another research topic for future studies.

APPENDIX A

SAMPLE TEST ITEMS

TEST OF READING COMPREHENSION

Cuma günü son ders beden eğitimiydi. Can, arkadaşlarıyla basketbol oynadıktan sonra evin yolunu tuttu. Omuzlarında bir hafiflik hissediyordu. Birden durdu. Çantasını okulda unutmuştu! Koşarak geri döndü. Merdivenleri çıkarken öğretmenini gördü. Ona, çantasını unuttuğunu söyledi. Sınıfa girdiğinde Hasan Bey yerleri süpürüyordu. Can, sırasına baktı ama çantasını göremedi. Hasan Bey gülümseyerek ona doğru yaklaştı ve "Çantanı arıyorsan, az evvel kayıp eşya dolabına bıraktım." dedi. Can teşekkür etti ve dolaptan çantasını aldı.

(The last class on Friday was physical education. Can headed home after playing basketball with his friends. His shoulders felt so light. Suddenly he stopped. He had left his bag at school! He went to school running back. He saw his teacher as he climbed the stairs. He told him he had left his bag. Hasan Bey was sweeping the floor when he entered the classroom. Can looked at his desk, but could not see his bag. Hasan Bey approached him with a smile and said, "If you're looking for your bag, I just left it in the lost and found locker." Can thanked him and took his bag from the locker.)

SORULAR (QUESTIONS)

1. Can beden eğitimi dersinde ne yaptı?

(What did Can do during the physical education class?)

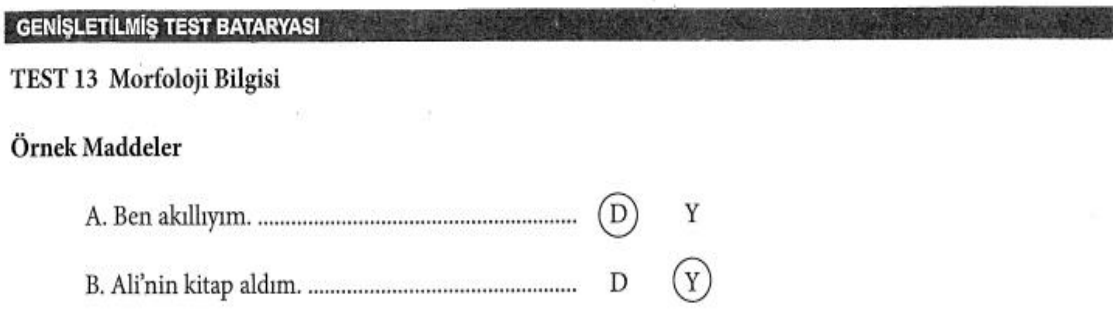
……

2. Hasan Bey kim olabilir?

(Who could Hasan Bey be?)

……..

TEST OF MORPHOLOGICAL AWARENESS



GENİŞLETİLMİŞ TEST BATARYASI

TEST 13 Morfoloji Bilgisi

Örnek Maddeler

A. Ben akıllıyım. ..... (D) Y

B. Ali'nin kitap aldım. ..... D (Y)

TEST OF VOCABULARY KNOWLEDGE

a) Knowledge of Synonyms (Eş Anlamlılar)

1 _____ *ad* - isim
2 _____ *hekim*-doktor
3 _____ *talebe*-öğrenci
4 _____ *pabuç*-ayakkabı
5 _____ *kırmızı*-al
6 _____ *imtihan*-sınav, yazılı

b) Knowledge of Antonyms (Zıt Anlamlılar)

1 _____ *iyi*-kötü
2 _____ *ilk*-son
3 _____ *çalışkan* - tembel
4 _____ *ihtiyar*-genç
5 _____ *üvey* - öz
6 _____ *tutsak*-özgür

c) Knowledge of Word Analogy (Benzetim)

buz... soğuk ateş...

çimen... yeşil gökyüzü...

kız... kadın oğlan...

gece... ay gündüz...

takvim... gün saat...

dört... kare beş...

1 _____ sıcak
2 _____ mavi
3 _____ erkek, adam
4 _____ güneş
5 _____ zaman, dakika, saniye
6 _____ beşgen

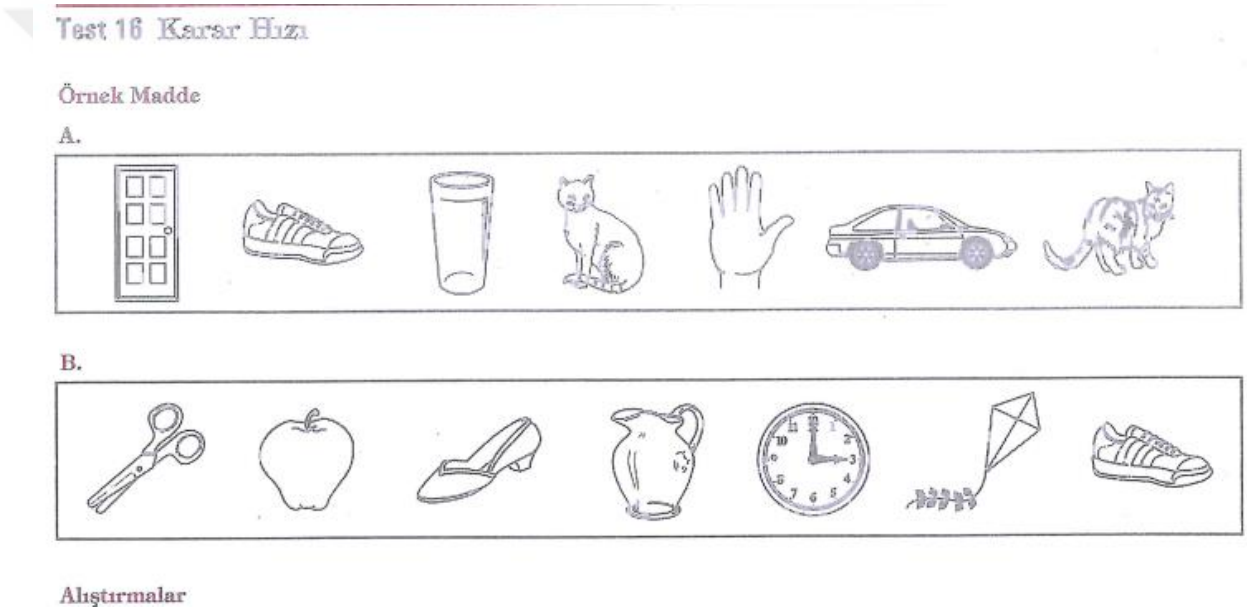
TEST OF RAPID AUTOMATIZED NAMING

(RAN DIGITS)

2 6 9 4 7

6 2 9 7 4

TEST OF PROCESSING SPEED


Test 16 Karar Hızı

Örnek Madde

A.

B.

Alıştırmalar

TEST OF MEMORY CAPACITY

a) Digit Span Forward

MADDE	DENEME 1	DENEME 2
1	7-4	5-9
2	3-8-6	6-1-2

b) Digit Span Backward

MADDE	DENEME 1	DENEME 2
1	2-5	6-3
2	3-7-4	2-5-9

APPENDIX B

APPROVAL OF BOĞAZİÇİ UNIVERSITY ETHICS COMMITTEE

Evrak Tarih ve Sayısı: 02.03.2023-115799

T.C.
BOĞAZİÇİ ÜNİVERSİTESİ
SOSYAL VE BEŞERİ BİLİMLER YÜKSEK LİSANS VE DOKTORA TEZLERİ ETİK İNCELEME KOMİSYONU
TOPLANTI KARAR TUTANAĞI

Toplantı Sayısı	:	40
Toplantı Tarihi	:	08.02.2023
Toplantı Saati	:	14:00
Toplantı Yeri	:	Zoom Sanal Toplantı
Bulunanlar	:	Prof. Dr. Feyza Çorapçı, Doç. Dr. Arhan S. Ertan, Doç. Dr. Senem Yıldız, Dr. Öğr. Üyesi Yasemin Sohtorik İlkmen, Dr. Öğr. Üyesi Ayşegül Metindoğan
Bulunmayanlar	:	

Merve Filiz
Yabancı Diller Eğitimi

Sayın Araştırmacı,

"Okuduğunu Anlamada Morfolojik Farkındalığın 4. Ve 5. Sınıf Öğrencilerinin Bilişsel Becerileriyle İlişkisi (The relationship between morphological awareness and cognitive skills of 4th and 5th grade students in reading comprehension)" başlıklı projeniz ile ilgili olarak yaptığınız SBB-EAK 2023/17 sayılı başvuru komisyonumuz tarafından 8 Şubat 2023 tarihli toplantıda incelenmiş ve uygun bulunmuştur.

Bu karar üyelerin toplantıya çevrimiçi olarak katılımı ve oy birliği ile alınmıştır. Onay mektubu üye ve raportör olarak Yasemin Sohtorik İlkmen tarafından toplantıya katılan bütün üyeler adına e-imzalanmıştır.

Saygılarımızla, bilgilerinizi rica ederiz.

Dr. Öğr. Üyesi Yasemin
SOHTORİK İLKMEN
Öğretim Üyesi

e-imzalıdır
Dr. Öğr. ÜyesiYasemin Sohtorik
İlkmen
Öğretim Üyesi
Raportör

SOBETİK 40 08.02.2023

Bu belge, güvenli elektronik imza ile imzalanmıştır.

APPENDIX C

APPROVAL OF THE PROVINCAL DIRECTORATE

OF NATIONAL EDUCATION

T.C.
İSTANBUL VALİLİĞİ
İl Millî Eğitim Müdürlüğü

Sayı : E-59090411-20-89552562 13/11/2023
Konu : Anket ve Araştırma İzni (Merve FİLİZ)

VALİLİK MAKAMINA

İlgi : a) Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 21.01.2020 tarihli ve 2020/2 sayılı genelgesi.
b) Boğaziçi Üniversitesinin 27.09.2023 tarihli ve E-60914867-302.14.03-146821 sayılı yazısı.
c) Müdürlüğümüz Araştırma ve Anket Komisyonunun 06.10.2023 tarihli tutanağı.

Araştırma Konusu	: Okuduğunu Anlamada Mortofolojik Farkındalığın 4. Ve 5. Sınıf Öğrencilerinin Bilişsel Becerileriyle İlişkisi (The relationship between morphological awareness and cognitive Skills of 4th and 5th grade students in reading comprehension)
Araştırma Türü	: Anket
Araştırma Yeri	: Sarıyer Türkan Şoray Ortaokulu
Araştırma Kişiler	: İlkokul, Ortaokul Öğrencileri
Araştırmanın Süresi	: 2023 - 2024 Eğitim - Öğretim Yılı

Yukarıda bilgileri verilen araştırmanın; 6698 sayılı Kişisel Verilerin Korunması Kanununa aykırı olarak kişisel veri istenmemesi, öğrenci velilerinden açık rıza onayı alınması, bir örneği Müdürlüğümüzde muhafaza edilen mühürlü ve imzalı veri toplama araçlarının kurumlarımıza araştırmacı tarafından ulaştırılarak uygulanması, katılımcıların gönüllülük esasına göre seçilmesi, araştırma sonuç raporunun kamuoyuyla paylaşılmaması ve araştırma bittikten sonra 2 (iki) hafta içerisinde Müdürlüğümüze gönderilmesi, okul idarelerinin denetim, gözetim ve sorumluluğunda, eğitim ve öğretimi aksatmayacak şekilde, ilgi (a) genelge esasları dâhilinde uygulanması kaydıyla Müdürlüğümüzce uygun görülmektedir.
Makamınızca da uygun görüldüğü takdirde olurlarınıza arz ederim.

Medet EKŞİ
İl Milli Eğitim Müdür V.

OLUR

Mustafa KAYA
Vali a.
Vali Yardımcısı

Ek:
1- İlgi (b) Yazı ve Ekleri (21 Sayfa)
2- İlgi (c) Tutanak (1 Sayfa)

Bu belge güvenli elektronik imza ile imzalanmıştır.
Adres : Binbirdirek Mah. İmran Öktem Cad. No: 1 Sultanahmet Fatih İstanbul
Telefon : 0212 384 36 32
E-posta : stratejigelistirme34@meb.gov.tr
Kep Adresi : meb@hs01.kep.tr
Belge Doğrulama : https://www.turkiye.gov.tr/meb-ebys
Bilgi İçin : Aykut ÇELİK
Unvanı : Büro Hizmetleri
İnternet Adresi : http://istanbul.meb.gov.tr/
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