RAPID AUTOMATIZED NAMING IN RELATION TO SOME OTHER READING COMPONENTS AND READING SKILLS OF SECOND GRADERS

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Pelin Bella Abolafya

Boğaziçi University

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Thesis Abstract

Pelin Bella Abolafya, “Rapid Automatized Naming in Relation to Some Other Reading Components and Reading Skills of Second Graders”

The aim of the study was to investigate the role of Rapid Automatized Naming (RAN) in the components of reading process (word reading, reading comprehension, oral reading fluency, letter knowledge) among second grade students with varying reading abilities (poor and good readers). The participants were 118 second grade students.

To see the relationships among RAN and some other components of reading, correlational analysis were conducted. To examine the differences in terms of reading levels in RAN and other components of reading, t test analysis and one-way multivariate analysis of variance (MANOVA) were conducted. Correlational analyses indicated that RAN numbers were significantly correlated with RAN letters, sight-word reading, non-word reading, and oral reading fluency in poor readers. Furthermore, the results showed that RAN letters were significantly correlated with sight-word reading, non-word reading, oral reading fluency, reading comprehension, and letter knowledge in poor readers. Neverthless, except sight-word reading, there were no significant correlations between RAN numbers and other measures in good readers. Furthermore, except non-word reading, there were no significant relationships between RAN letters and other measures in good readers.

One-way multivariate analysis of variance (MANOVA) and t-test results indicated that, based on the reading level (poor and good readers), there were significant differences in RAN numbers, RAN letters, sight-word reading, non-word reading, reading comprehension and letter knowledge.

Findings of the study indicated that RAN tasks were shown to be related to the some other components of reading for poor readers. Results also revealed that poor readers have a general deficit in rapid naming tasks as well as other reading related tasks. However, further research is needed to examine the predictive role of RAN with different reading abilities.

Tez Özeti

Pelin Bella Abolafya, "İkinci Sınıf Öğrencilerinde Hızlı Otomatik İsimlendirmenin Okumanın Diğer Bileşenleri ve Okuma Becerileri İle İlişkisi"

Bu çalışmada, farklı okuma düzeylerine sahip (iyi ve kötü okuyucular) ikinci sınıf öğrencilerinde Hızlı Otomatik İsimlendirmenin (HOİ) okuma sürecinin diğer bileşenleri (kelime okuma, okuduğunu anlama, hızlı okuma, harf bilgisi) üzerindeki etkisi incelenmiştir. Araştırmaya ikinci sınıfa devam eden 118 öğrenci katılmıştır.

Hızlı Otomatik İsimlendirme ve okumanın diğer bileşenleri arasındaki ilişkiyi bulmak için korelasyon analizleri uygulanmıştır. Farklı okuma seviyelerindeki öğrencilerde, HOİ ve okumanın diğer bileşenleri ile ilgili farklılıkları bulmak için t-test ve çok değişkenli varyans analizi uygulanmıştır. Korelasyon analizleri, kötü okuyucularda HOİ ile kelime okuma, okuma hızı, okuduğunu anlama ve harf bilgisi arasında anlamlı bir ilişki bulunduğunu ortaya koymuştur. İyi okuyucularda HOİ rakamlar alt testi ile anlamlı kelime okuma arasında ve HOİ harfler alt testi ile anlamsız kelime okuma arasında anlamlı bir ilişki görülmüştür. Varyans ve t-test analizleri iyi ve kötü okuyucular arasında HOİ, kelime okuma, okuduğunu anlama ve harf bilgisi bakımından anlamlı farklılıklar olduğunu göstermiştir.

Sonuçlar, HOİ testlerinin kötü okuyucularda okumanın diğer bileşenleri ile ilişkisini ortaya koymuştur. Ayrıca, kötü okuyucularda isimlendirme hızı konusunda genel bir yetersizlik görülmüştür. Ancak, HOİ testlerinin, farklı yaş seviyelerinde okuma bozukluklarının tespitindeki rolünü araştıran başka çalışmalara gerek vardır.

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CHAPTER 1

INTRODUCTION

The purpose of this chapter is to provide a rationale for the study, to present the problem, and to discuss the significance of the study. The present study attempts to explore the relationships among RAN and other reading related components (word reading, oral reading fluency, reading comprehension, letter knowledge) in second graders with varying reading levels (poor and good readers). Correlational analyses were conducted to examine the concurrent relationships among these variables. Multivariate analysis of variance (MANOVA) and t-test analysis were conducted to examine differences between good and poor readers based on reading related variables. A set of measures were administered to 185 second grade children. The participants consisted of a variety of reading skills and academic achievement. Throughout the chapters, RAN, naming speed or rapid automatized naming will be interchangeably used unless otherwise stated.

Learning to read and write are the main goals of the first school years. As children progress through school, they are expected to read in order to succeed academically. Reading is a primary tool which is used to acquire knowledge throughout education (Adams, 1990). The simple view of reading proposes a model in which reading is viewed as the product of word recognition and language comprehension. According to the simple model of reading, successful reading is reached through success at both word recognition and comprehension (Gough & Tunmer, 1986; cited in Rose, 2006).

However, some children experience difficulties with reading and constantly deal with frustration and failure. Unfortunately, children who have difficulties in reading in first and second grades have a tendency to continue experiencing difficulties throughout their schooling (Torgesen, Alexandeer, Wagner, Rashotte, Voeller, & Conway, 2001; Torgesen, Wagner, & Rashotte, 1994). It is important to identify the factors that contribute to reading, as reading problems have such an impact on academic success and diminish the quality of life.

The ability to decode words is a very important component of reading success. In the last three decades, a substantial amount of research investigated the possible factors that are related to reading acquisition (e.g., Badian, 1998; Schatschneider, Carlson, Foorman & Fletcher, 2004). As a result, important progress has been made in understanding the impact of factors in reading acquisition. Findings of the many research studies indicated that phonological processing skills are the main causal factor in reading acquisition (Badian, 1998; Scarborough, 1998; Wagner & Torgesen, 1987; Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993). Although phonological awareness has been suggested as a main factor in reading acquisition, based on the findings of the many research studies, rapid automatized naming (RAN) was also suggested as a separate factor in reading acquisition. Therefore it is very important to understand its contribution to reading ability in Turkish speaking children.

Basically, RAN is the ability to verbalize the name of a visually presented object quickly and accurately (Denckla & Rudel, 1976a, 1976b). RAN tasks that are originally developed by Denckla and Rudel (1974) measure naming speed and consist of four subtests each having five symbols from a given category (objects,

colors, numbers, and letters). On each subtest these symbols are repeated randomly ten times for a total of fifty stimulus items.

Although deficits in phonological processing were suggested as the leading factor in poor reading skills (e.g., Wagner & Torgesen, 1987), impaired phonological processing does not completely account for all reading problems. Some researchers suggested RAN as a second independent core deficit of reading disability (Bowers & Wolf, 1993; Wolf & Bowers, 1999, 2000; Wolf, Bowers, & Biddle, 2000).

Based on extensive research findings, Bowers and Wolf (1993) have suggested an integrative model to reading disabilities and called it the "double deficit hypothesis". The double deficit hypothesis places emphasis on both phonological processes and "the fluency-related processes underlying naming speed" (Wolf, 1999, p. 5). The researchers demonstrated that the combination of these two core deficits leads to the most severe form of reading impaired children (Bowers & Wolf, 1993; Wolf, 1999).

RAN tests were used by many researchers who studied the connection between RAN and reading disability (e.g., Badian, 1997; Kirby, Pfeiffer, & Parrila, 2003). The relationship between naming speed and components of reading (word reading, comprehension, oral reading speed, letter knowledge) was investigated to assess reading problems and to identify the children at risk for later reading difficulties (e.g., Manis, Doi, & Bhadha, 2000; Meyer, Wood, Hart, & Felton, 1998; Schatschneider, Carlson, Foorman, & Fletcher, 2004). These studies indicated that RAN has significant direct impact on reading comprehension, word reading, oral reading fluency, and letter knowledge.

The role of RAN in reading acquisition was also studied across grades, reading levels, and languages (e.g., Ackerman & Dykman, 1993; Badian, 1996; Denckla & Rudel, 1976b; Felton & Brown, 1990; Manis, Doi, & Bhadha, 2000). These research findings documented that RAN has a strong role in reading acquisition across grades, reading levels, and languages (e.g., Wolf & Bowers, 1999; Wolf & Denckla, 2005).

Purpose of the Study

The purpose of the study is to investigate the relationships among RAN and other reading components (word reading, reading comprehension, oral reading fluency letter knowledge) in second grade students with varying reading abilities (poor and good readers).

Significance of the Study

Although RAN and other reading related components have been examined in some crosslinguistic studies (e.g., Katzir, Shaul, Breznitz, & Wolf, 2004; van Daal & van der Leij, 1999; Wimmer, Mayringer, & Landerl, 2000), these variables have not yet been studied for Turkish speaking children. RAN has shown to be highly correlated with different kinds of reading tasks (e.g., Bowers & Swanson, 1991; Wolf, Bally, &

Morris, 1986), therefore it is important to understand its contribution to reading ability in Turkish children.

So far, no other study has examined the relationship between naming speed and reading achievement in Turkey. Therefore this study, which aims to investigate the role of naming speed in Turkish reading acquisition, may contribute to the further understanding of reading development in early years of schooling.

Definitions of the Study

Dyslexia (Reading Disorder): "Reading achievement, as measured by individually administered standardized tests of reading accuracy or comprehension, is substantially below that expected given the individual's chronological age, level of intelligence, and age-appropriate education" (DSM-IV-TR, 2000, p.53).

Non-Word Reading: Non-word reading is the ability to access and integrate multiple phonological codes without having a lexical address (Wagner & Torgesen, 1987).

Rapid Automatized Naming (RAN): Rapid automatized naming is the ability to verbalize the name of a visually presented stimulus quickly and accurately (Denckla & Rudel, 1976a, 1976b).

Phonological Awareness: Phonological awareness is an ability to understand a word's sound structure and is the ability to form connections between sounds and letters when spelling (Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997).

Phonological Processing: "…mental operations that are involved when the phonological, or sound structure, of oral language is utilized in decoding written language" (Torgesen et al, 1997, p.162).

Processing Speed: Speed in information processing ability.

Word Reading (Decoding/word identification/single word reading/word recognition):

Word reading is the ability to accurately identify printed words.

CHAPTER 2

LITERATURE REVIEW

This section reviews five areas of the literature regarding theoretical background: beginning reading acquisition, history of RAN, types of RAN tasks, deficit theories underlying children's reading disabilities, the relationship of visual naming speed to different components of reading (word reading, reading comprehension, oral reading speed, letter knowledge), the relationship of different RAN formats to reading skills, and the role of RAN in reading acquisition across reading levels and languages.

Beginning Reading Acquisition

Reading, which is at the core of the educational experience, is an essential ability for success. Walker (1996, p. 4) defines reading as "a comprehensive and active process in which readers shift between sources of information, emphasize meaning and strategies, check their interpretation, and use the social context to focus their response". In another definition of reading, it is described as "a process by which individuals understand and interpret graphic symbols" (Hammill, 2004, p.466).

Although reading is a complex activity, it has two essential components which can be represented in a relatively simple way. Gough and Tunmer (1986, cited in Rose, 2006) identified two components of reading in the simple view of reading. They proposed a model in which reading is viewed as the product of word recognition and reading comprehension. According to their simple model of reading, if the value of either of the components is zero (i.e., the child cannot recognize any words, or has no language comprehension), reading ability will also be zero. In this view, the only route to successful reading is through success at both word recognition and language comprehension.

In their simple view of reading, Gough and Tunmer (1986, cited in Rose, 2006) explained 'word recognition' as the ability to recognize words presented out of context, and 'comprehension' as the process by which, given lexical (i.e. word) information, sentences and discourse are interpreted. Comprehension of both oral and written language requires a common set of linguistic processes.

According to Gough and Tunmer's (cited in Rose, 2006) simple view of reading, four different patterns of performance may be observed across the two dimensions (word recognition – language comprehension). The first pattern of performance includes good readers, who read the words relatively effortlessly and understand the texts they read with relative ease. The second pattern includes children who read the words in the text with relatively little difficulty but whose poor language comprehension abilities dominate against their understanding written texts. In the third pattern, there are children who have difficulty reading the words in the text but have good language comprehension. The last pattern includes children who

experience difficulty in both dimensions, with problems both in reading words and in language comprehension (Gough & Tunmer, 1986, cited in Rose, 2006).

Recently, there is growing consensus that RAN is highly correlated with reading success (e.g., Bowers & Swanson, 1991) and serves as an accurate, early, time-efficient tool for reading achievement (Bowers & Wolf, 1993). Wolf and Denckla (2005) explained naming speed and reading as "overlapping systems of perceptual, linguistic, cognitive, and motoric systems that require rapidity and attention to perform" (p. 32). Both naming speed and reading have similar cognitive requirements.

Originally, Denckla and Rudel (1974, 1976a, 1976b) found that the length of time to name the stimuli varied with age and reading ability. Older children were able to name the letters, colors, numbers, and objects quicker than younger children, and children with higher reading ability were quicker than poor readers. This finding was reconfirmed through continuing studies.

A substantial amount of research suggests that RAN is strongly associated with word reading ability (e.g., Badian, 1993; Bowers & Swanson, 1991). Some studies have also shown that there significant correlations between RAN and reading comprehension measures (e.g., Samuels and Flor, 1997). These researchers indicated that readers, who have acquired automaticity, are able to direct their efforts into comprehending the text and don't need to use their energy to decode words.

Rapid Automatized Naming (RAN)

The following section presents the history of RAN, types of RAN tasks, and deficit theories underlying reading disabilities.

History of RAN

Rapid naming is the ability to verbalize the name of a visually presented object quickly and accurately (Denckla & Rudel, 1976a, 1976b). Research studies in the area of RAN are based on work in the neurosciences, attaining from a hypothesis about color naming by Geschwind (1965, cited in Wolf et al., 2000). Geschwind (1965, cited in Wolf & Denckla, 2005) argued that a child's early capacity for color naming would make a good early predictor of later reading, because both color naming and reading have similar cognitive requirements. Both of them require the retrieval of a verbal label for a visual stimulus, and their functions appear to employ similar neurological structures and similar cognitive, linguistics, and perceptual processes.

Based on Geschwind's hypothesis, Denckla (1972, cited in Denckla & Rudel, 1974), further examined children with and without reading disabilities by comparing their color naming abilities. Denckla reported that children with reading disabilities could name colors correctly, but not as rapidly as their peers. Denckla and Rudel

(1974, 1976a, 1976b) reported that the speed with which names were retrieved differentiated readers with dyslexia from others, rather than the accuracy in naming.

Denckla and Rudel (1974) developed the original set of RAN tasks, in which the child named 50 stimuli as rapidly as possible (e.g., five common letters, five numbers, five colors and five pictured objects, repeated randomly ten times). The first original RAN tasks, which measure continuous, serial naming speed performance on common visual stimuli, were designed by these researchers. Later on Wolf (1986, cited in Wolf & Denckla, 2005) supplemented the rapid alternating stimulus (RAS) tasks, which measure serial naming speed when the person is required to alternate between two types of symbol sets in a fixed pattern.

Types of RAN Tasks

RAN tasks include four categories: objects, colors, numbers, and letters. In each category, there are five symbols repeated randomly ten times, for a total of fifty stimuli.

Turkish RAN Objects subtest includes five stimulus items: *çiçek* (flower), *el* (hand), *kalem* (pen), *köpek* (dog), *masa* (table). These objects were chosen on the basis of their high frequency, from highly familiar semantic categories related to childhood (i.e., school items, animals, furniture, body, nature). When determining these objects their ease in articulation and syllable-structure were taken into consideration.

Turkish RAN Colors subtest consists of the five colors (red, yellow, blue, green, black) appearing twice in each row without repetitions. Turkish RAN Numbers subtest includes five numbers (2, 4, 6, 7, 9) appearing twice per row. Turkish RAN Letters subtest includes five high frequency lowercase letters (k, s, m, b, t) appearing twice per row. RAN tasks were measured by the time taken to name all visual items presented in random order.

Deficit Theories Underlying Reading Disabilities

Reading disabilities (RD) have drawn the attention of many researchers in diverse fields such as neuroscience, cognitive psychology, educational psychology and special education. Diagnostic and Statistical Manual of Mental Disorders Text Revision (DSM-IV-TR, 2000) defines the reading disorder as "reading achievement, as measured by individually administered standardized tests of reading accuracy or comprehension, is substantially below that expected given the individual's chronological age, level of intelligence, and age-appropriate education" (p. 53).

Different theories are often used to explain children's reading disabilities. These theories serve as highlights of the different processing systems involved in reading. Through the substantial amount of reading research, everyone probably agrees with the fact that all children with reading disabilities are not the same (e.g., Bowers & Wolf, 1993). Therefore, it is essential to know the basis of the reading disabilities, in order to carry out appropriate intervention programs.

Double-Deficit Hypothesis

During the past two decades, it has become obvious that a lack of ability in phonological processing is a commonly reported difficulty for reading acquisition (Adams, 1990; Torgesen et al., 1997). In general, phonological processing abilities measured in kindergarten were found to successfully predict reading success in the early grades (Wagner, Torgesen, & Rashotte, 1999).

Despite the considerable progress made in phonology-based research, there are still certain aspects of dyslexia that cannot be explained with the phonological theory. Although the phonological deficit hypothesis is able to account for the large majority of reading impairments, there remain individuals with adequate phonological skills but inadequate comprehension (Wolf, 1999). Recently, a competing hypothesis, the double-deficit hypothesis of developmental dyslexia was developed by Maryanne Wolf and Patricia G. Bowers (Wolf, Bowers, 1999, 2000). The double- deficit hypothesis implicates visual naming speed as a second independent core deficit of RD (Wolf, Bowers, 1999, 2000). The double-deficit theory proposes that developmental reading disability can be characterized with respect to two specific deficits in phonological awareness and visual naming speed (Bowers & Wolf, 1993). Naming speed deficit concerns deficiencies in rapidly accessing and retrieving names for visual symbols (Bowers & Wolf, 1993).

Until very recently processes underlying naming speed have been categorized by most researchers as part of the same phonological family (Torgesen et al., 1997), rather than as a separate source of additional disturbance. However, through their findings, Wolf and Bowers suggested that a naming speed deficit is a separate deficit

from a phonological deficit and affects reading acquisition independently (Wolf & Bowers, 1999, 2000).

Furthermore, Wolf and Bowers suggested that there are different degrees of reading disability and different types of processing impairment. Their classification includes two subtypes with single deficits and one double-deficit subtype. Readers with phonological deficit have phonological processing difficulties without naming speed problems. Readers with naming speed deficit have naming speed problems but no significant deficits in phonological decoding.

RAN and Reading

The relationship of naming speed to other components of reading (word reading, comprehension, oral reading speed) has been studied by many researchers (e.g., Badian, 1994; Manis, Doi, & Bhadha, 2000; McBride-Chang, & Manis, 1996; Meyer et al., 1998; Schatschneider et al., 2004). The following section presents the relationship of RAN to word reading, reading comprehension, oral reading speed, and letter knowledge, the relationship of different RAN tasks to reading skills, and the role of RAN in reading disability across grades, reading levels, populations, and languages.

RAN and Word Reading (Word / Non-Word Reading)

Word reading (decoding) is "to recognize and pronounce the word and thereby access the meaning." (Hoien & Lundberg, 2000, p. 21). Considerable evidence from naming speed research suggest that RAN accounts for a significant amount of variance in word reading when phonological skills and IQ are partialled out (Ackerman & Dykman, 1993; Badian, 1993; Bowers & Swanson, 1991; Felton & Brown, 1990). Felton and Brown (1990) reported rapid naming of letters and numbers in kindergarten as one of the best predictors of first-grade word identification, but not of word attack skills, in a sample of at-risk students. Badian (1993) investigated the differential effects of the rate of letter versus object naming in a sample of 6- through 10-year olds who were considered at risk for learning problems. With IQ and reading experience controlled, Badian found that letter naming speed made the largest independent contribution to a concurrent level of word recognition (16.6 % of variance). These findings demonstrate that RAN predicts word identification skills.

Bowers and Swanson (1991) reported that RAN numbers are correlated with both regular (.49) and irregular words (.57). In a population of elementary children with severe reading disabilities, Cornwall (1992) found that rapid letter naming added significantly to the prediction of word identification ($r = .49$) after controlling for IQ, SES, age, and behavior problems. These studies suggest that RAN is strongly associated with word reading.

McBride-Chang and Manis (1996) investigated the relationship of naming speed, phonological awareness and verbal intelligence to word reading in good and poor readers in the third and fourth grades. Findings suggested that naming speed was strongly associated with word reading only in poor readers. In a longitudinal study, Meyer and colleagues (1998) examined the predictive power of RAN tests on reading tasks in two large-samples from third grade through eighth grade. The researchers found that rapid naming was a strong predictor of fifth and eighth grade word reading only in poor readers, even when IQ, SES, and third grade single word reading were statistically controlled. These findings suggest that deficit in RAN have a long-term impact on reading disabilities.

RAN and Reading Comprehension

Reading comprehension is an essential part of the reading process. In one of the earliest definitions of the comprehension processes, Thorndike (1917, cited in Kingham, 2003) states that,

> Understanding a paragraph is like solving a problem in mathematics. It consists of selecting elements of the situation and putting them together in the right relation, and also with the right amount of weight of influence of force for each... all under the influence of the right mental set or purpose or demand (p. 329).

Reading comprehension has been conceptualized as a process of constructing meaning from written texts, based on a complex coordination of a number of interrelated sources of information (Anderson, Hiebert, Scott, & Wilkinson, 1985). More recently, reading comprehension is defined as the process of simultaneously extracting and constructing meaning through interaction and involvement with written language (Snow, 2002). Comprehension involves "higher cognitive processes that allow the reader to extract the meaning of the text, to think about it, and to draw conclusions from it" (Hoien & Lundberg, 2000, p. 21).

Research has provided some prerequisites of successful reading comprehension. A substantial amount of research has shown that reading comprehension skill builds on the fact that children who can read words accurately and rapidly have a good foundation for language comprehension (Snow, 2002). Language comprehension cannot fully operate in comprehending the text, until the child has gained sufficient fluency (Adams, 1990; Stanovich, 1991). Konold, Juel, Mc Kinnon, and Deffes (2003) also suggested that due to the many tasks required by successful reading, some processes should be automatic. If children have letters, syllables and word recognition at a level of automaticity, it allows them to pay greater attention on comprehending what is being read (Konold et al., 2003).

Samuels and Flor (1997) argued that there is a direct link between automaticity and reading comprehension. The researchers indicated that fluent readers, who have acquired automaticity, do not need to use their attention or energy to decode words and are able to direct their efforts into comprehending the text. They also stated that beginner readers first use their cognitive resources on decoding the text, and once decoding is automatic, they focus their attention to comprehending the

text. Another study also reported a substantial correlation between the oral reading fluency (the number of words read aloud correctly per minute), and standardized reading comprehension performance (Fuchs, Fuchs, Hosp & Jenkins, 2001).

It is also well documented that automatic word decoding skill is a prerequisite for understanding written text (Adams, 1990; Dymock, 1993; Snow, 2002; Snowling, 2000). A slow and faulty word decoding process consumes cognitive resources, leaving less mental resources available for the comprehension process (Hoien & Lundberg, 2000). Especially at the early stage of learning to read, ability in word decoding explains most of the variance in reading written text (Rose, 2006).

Sprugevica and Hoien (2004) suggested rapid naming as another phonological skill that may have impact on reading comprehension. The researchers reported that rapid naming had significant direct impact on reading comprehension.

In another study, examining the extent to which mora deletion (phonological analysis), nonword repetition (phonological memory), rapid automatized naming (RAN), and visual search abilities predict reading in Japanese kindergartners and first graders, Kobayashi, Haynes, Macaruso, Hook, and Kato (2005) reported that the strongest predictors of reading fluency and comprehension in beginning reading of Japanese were RAN tasks.

In a sample of 6 through 10 year olds, who were considered at risk for learning problems, Badian (1993) investigated the differential effects of the rate of letter versus object naming. Badian found that object naming speed made the largest independent contribution to concurrent level of reading comprehension (14% of

variance) on the Woodcock Reading Mastery Test-Revised, with IQ and reading experience controlled.

RAN and Oral Reading Speed

In recent years, research on reading fluency was actively studied, and many reading researchers proposed definitions of reading fluency. Unfortunately, there is still no consensus about definitions of reading fluency (Wolf & Katzir-Cohen, 2001). However, it is claimed to be closely related to the automaticity, speed of processing, reading rate/speed, word recognition proficiency and comprehension (Katzir et al., 2004). Through a thorough review of previous fluency literature, Wolf and Katzir-Cohen (2001) proposed their own working definition:

> In its beginning, reading fluency is the product of the initial development of accuracy and the subsequent development of automaticity in underlying sublexical processes, lexical processes, and their integration in single-word reading and connected text. These include perceptual, phonological, orthographic, and morphological processes at the letter, letter-pattern, and word levels, as well as semantic and syntactic processes at the word level and connected-text level. After it is fully developed, reading fluency refers to a level of accuracy and rate where decoding is relatively effortless; where oral reading is smooth and accurate with correct prosody; and where attention can be allocated to comprehension. (Wolf & Katzir-Cohen, 2001, p. 219).

Speece and Ritchey (2005, p. 387) defined the reading fluency as "the speed and accuracy with which the text is read orally". In another definition fluency defined as "the acquisition of smooth rates of processing speed in reading outcomes (e.g., word attack, word identification, and comprehension)" (Wolf, Miller, & Donnelly, 2000, p. 377). Reading fluency can be assessed through oral reading. Oral reading speed simply is the total number of words read aloud correctly per minute.

In a longitudinal study, Schatschneider and colleagues (2004) studied the power of some measures (e.g., naming speed, phonological awareness, letter knowledge) to predict later reading skills. They followed the children from the beginning of kindergarten to the end of first and second grade. Their findings suggested that RAN Letters were more strongly correlated with reading fluency than phonological awareness, letter sound knowledge, and letter name knowledge. RAN Objects were also related to reading fluency with a lower degree compared to RAN Letters, at the end of the first grade. This study indicated that, naming speed measures were mostly associated with reading fluency in first and second grade.

Cornwall (1992) found that rapid letter naming added significantly to the passage speed and accuracy scores ($r = .35$) after controlling for IQ, SES, age, and behavior problems, in a population of elementary children with severe reading disabilities. In another study, Kobayashi and colleagues (2005) reported that the strongest predictors of reading fluency and comprehension in beginning reading of Japanese were RAN tasks. These studies suggest that RAN is strongly associated with accurate and fluent reading.

RAN and Letter Knowledge

Letter knowledge is the ability to recognize and manipulate the letters of the alphabet (Wren, 2001). The letter is the basic unit of reading and writing and familiarity with the letters has shown to be one of the best predictors of later reading (Wren, 2001). Identifying printed words by recalling their letters, and attaching sounds to those letters are the basis of decoding ability (Konold et al., 2003).

Schatschneider and colleagues (2004) investigated some reading components (e.g., naming speed, phonological awareness, reading fluency, and letter knowledge) and their power to predict later reading ability in a longitudinal study. The researchers followed the children from the beginning of kindergarten to the end of first and second grade. They found that, following the reading fluency, letter name knowledge and letter sound knowledge, were strongly correlated with RAN letters.

The Relationship of Different RAN Tasks to Reading Skills

Many researchers have examined the relationship between RAN tasks (objects, colors, numbers, and letters) and reading skills (e.g., Felton and Brown, 1990; Schatschneider et al., 2004).

The different types of RAN tasks may be related differently to the various components of reading. Some studies have reported a strong relationship between kindergarten letter and number naming and later reading. For example, Felton and

Brown (1990) found that rapid naming of letters and numbers in kindergarten were the best predictors of first-grade word identification in a sample of at-risk students. Bowers and Swanson (1991) also reported that RAN numbers are correlated with both regular (.49) and irregular words (.57).

Schatschneider and colleagues (2004) followed the children from the beginning of kindergarten to the end of first and second grade, and studied the power of some measures (e.g., naming speed, phonological awareness, letter knowledge) to predict later reading skills. Their findings suggested that RAN letters were strongly correlated with reading fluency. RAN objects were also related to reading fluency with a lower degree compared to RAN letters, at the end of the first grade.

Badian (1993) examined the predictive power of RAN letters versus RAN objects. With IQ and reading experience controlled, the reseacher found that letter naming speed made the largest independent contribution to a concurrent level of word recognition (16.6 % of variance), whereas RAN objects made the largest independent contribution to reading comprehension (14% of variance).

Wolf, Bally and Morris (1986) reported that the predictive power of RAN colors and objects diminished after kindergarten, while numbers and letters continued to be good predictors of early reading success until second grade.

All the RAN tasks used in numerous studies demonstrated the relationship of RAN to reading ability (e.g., Badian, 1993; Denckla & Rudel, 1976b; Schatschneider et al., 2004; Wolf et al., 1986). Based on these findings, RAN letters and numbers had stronger contribution to reading ability than RAN colors and objects. Also, the researchers reported that RAN letters and numbers distinguished good and poor

readers better than rapid naming of colors and objects (Wolf, 1999; Wolf, Bally & Morris, 1986).

The Role of RAN of in Reading Acquisiton

The Role of RAN in Reading Acquisition across Good and Poor Readers

Good readers can be identified as those who "…(a) associate speech sounds with letters (phonemes-graphemes); (b) pronounce printed words; (c) gain meaning from print; and (d) read orally or silently with sufficient accuracy and speed" (Hammill, 2004, p. 464). Poor readers are the ones who have difficulties in these abilities (Hammill, 2004).

The research underlying the differences between good or average readers and poor readers can be explained in cross-sectional, longitudinal or cross-linguistic studies. The substantial amount of cross-sectional, longitudinal, and cross-linguistic research on RAN has demonstrated that naming speed tasks differentiate dyslexic readers from average readers (Denckla & Rudel, 1976a, 1976b; Kirby, Parilla, & Pfeiffer, 2003; Schatschneider, Carlson, Francis, Foorman, & Fletcher, 2002; Torgesen et al., 1997; Wolf, Bally, & Morris, 1986) and readers with other learning disabilities from kindergarten through adulthood (Ackerman & Dykman, 1993; Denckla & Rudel, 1976b; Felton & Brown, 1990).

Denckla and Rudel (1974, 1976b) used the RAN tests (i.e., colors, objects, letters, and numbers) to see whether they differentiate the dyslexic group from

average readers and from non-dyslexic group with other learning disabilities. Results showed that average readers were significantly faster than the non-dyslexic learning disabled group, and the non-dyslexic learning disabled group was significantly faster than the dyslexic group, on all naming speed tasks. The results also revealed that letters and numbers were easier for all groups. On the other hand, objects were the hardest tasks to name rapidly. This study revealed that, when asked to name rapidly the letters, numbers, colors, and objects, individuals with dyslexia differed significantly from average readers and from non-dyslexic learning disabled readers.

In a longitudinal study, Meyer and colleagues (1998) studied the predictive value of rapid naming tasks for various aspects of later reading. The researchers obtained data from two different samples of students from third through eighth grades. The first sample included 154 students with varying degrees of reading ability. The second group consisted of 64 poor readers separate from the first sample. The researchers found that rapid naming was predictive of single word reading at fifth- and eighth-grade only in poor readers.

McBride-Chang and Manis (1996) examined the relationship of naming speed, phonological awareness and verbal intelligence to word reading in good and poor readers in the third and fourth grades. The researchers demonstrated that phonological awareness was an indicator of word reading ability in both poor and good readers, whereas naming speed was strongly associated with word reading only in poor readers. For this sample, naming speed was not found as a predictor of word reading ability in good readers (McBride-Chang & Manis, 1996).

Penney, Leung, and Chan (2005) investigated processing speed in good and poor readers of Chinese. The sample included 20 good readers and 19 poor readers, with a total of 39 third grade students. The researchers measured processing speed with the RAN numbers subtest. The researchers found that good readers were faster than good readers in the RAN numbers subtest.

In a recent longitudinal study, Catts, Gillispie, Leonard, Kail, and Miller (2002) examined reading differences in poor and good readers. The researchers investigated the role of the speed of processing, rapid naming, and phonological awareness in reading achievement. Measures of response time in motor, visual, lexical, grammatical, and phonological tasks were applied to 279 children in third grade. Also, measures of rapid object naming, phonological awareness, and reading achievement were administered in second and fourth grades. The results demonstrated that poor readers were significantly slower than good readers on response time measures and on the rapid object naming task. This finding indicated that some poor readers have a general deficit in speed of processing and their problems in rapid object naming are in part a reflection of this deficit.

The Role of RAN in Reading Acquisition across Languages

Naming-speed differences have also been studied among dyslexic readers across languages including German (Wimmer,1993), Dutch (van Daal & van der Leij, 1999), and Spanish (Novoa & Wolf, 1984; cited in Wolf, Bowers, & Biddle, 2000). In both German (Wimmer, 1993) and Dutch (van Daal & van der Leij, 1999), which are languages with a more regular orthography than English, naming speed is

reported to be stronger predictor of reading performance than phonological awareness measures. These cross-linguistic findings eliminate the irregularity of English orthography as a possible explanatory factor in the naming-speed findings.

Wimmer and colleagues (2000) investigated the role of naming speed and phonological awareness in German-speaking children with reading difficulties. They found that naming speed is much more predictive of later reading achievement than phonological awareness.

Katzir, Shaul, Breznitz, and Wolf (2004) investigated the shared and distinctive characteristics of readers with dyslexia, across two different orthographies (Hebrew and English). 30 Hebrew-speaking and 30 English-speaking dyslexic children in third to fourth grade were administered a set of cognitive, linguistic and reading measures. Naming speed was measured by using three subtests of RAN tests (numbers, letters, and objects). Naming speed performances were compared on the basis of speed and accuracy. In terms of accuracy, no differences were found between the two groups. However, in terms of reaction times, Hebrew-speaking dyslexic children were significantly faster than English-speaking dyslexic children, in naming numbers, letters and objects. The results also revealed that, students in both groups were severely impaired on rapid naming tasks, which indicated that impaired naming speed was a common characteristic of dyslexic children in different orthographies.

Kobayashi and colleagues (2005) examined the extent to which mora deletion, nonword repetition, RAN, and visual search abilities predict reading in Japanese kindergartners and first graders. Since Chinese has a morphemic-based

orthography the connection between a visual symbol and verbal label, which is similar with naming speed, is important. Three RAN task (numbers, objects, syllabary symbols –hiragana-) along with accuracy and speed of passage reading were used with kindergartners. An additional kanji (a system of morphosyllabic symbols) RAN task and reading comprehension test were included for first graders. The researchers reported that, in kindergartners, number RAN and hiragana RAN were the only significant predictors of reading accuracy and speed, whereas kanji RAN and hiragana RAN predicted reading speed in first graders. Reading comprehension was also predicted by kanji RAN.

Research Questions

Based on the literature review, and the relevant research findings, the following research questions were developed to examine the relationships between RAN and other reading related variables (word reading, oral reading fluency, reading comprehension, letter knowledge), and differences in RAN and some other reading related variables (word reading, reading comprehension, letter knowledge) between poor and good readers:

Research Question 1: Are the tasks of RAN (numbers and letters) related to different reading components (word/ non-word reading, reading comprehension, oral reading speed, letter knowledge) in terms of reading level (poor and good readers)?

Research Question 2: Are there any differences between poor and good readers in terms of their performances on the tasks of RAN (numbers, letters)?

Research Question 3: Are there any differences between poor and good readers in terms of their performances on word reading (sight-word reading, non-word reading)?

Research Question 4: Are there any differences between poor and good readers in terms of their performances on reading comprehension?

Research Question 5: Are there any differences between poor and good readers in terms of their performances on letter knowledge?

CHAPTER 3

METHODOLOGY

The purpose of this study was to investigate the relationships between RAN and other reading related variables (word reading, oral reading fluency, reading comprehension, letter knowledge), and differences in RAN and some other reading related variables (word reading, reading comprehension, letter knowledge) between poor and good readers. In order to investigate the relationships among RAN and other components of reading, correlational analysis were conducted. To examine the differences between reading levels (poor and good readers) in reading comprehension and letter knowledge, t-test analysis were conducted. RAN (numbers, letters) and word reading (sight-word reading, non-word reading) differences between poor and good readers were examined by multivariate analysis of variance (MANOVA). Part of the data was collected through the project funded by Boğaziçi University Research Foundation (BAP-project 05D101). This section describes: a) selection of the participants, b) instruments, c) procedures, and d) data analysis.

Selection of Participants

A total of 185 students were chosen from eight elementary schools (two private and six public schools) in Istanbul. These schools represented different demographic

characteristics and populations of varying socio-economic status (SES). Only second grade students enrolled in the study. The reason for including only second graders in the study is that the reading development of second graders was proper for our research purposes.

When choosing the participants, equal representation of gender was taken into consideration. The participants consisted of a variety of reading skills and academic achievement. Those who met these criteria were randomly sampled.

Demographic Characteristics of the Sample

At the beginning of the study, a total of 185 students were selected from eight different schools. The participants were divided into 3 groups (poor, moderate, good readers) on the basis of the number of accurate words on oral reading fluency test. The poor readers group (n=63) consisted of students, who read between 0-70 words in a minute. This group consisted of 0-33 percentiles of the sample. The moderate readers group (n=67) consisted of students, who read between 71-94 words in a minute. This group consisted of 34-67 percentiles of the sample. The good readers group (n=55) consisted of students, who read between 95-132 words in a minute. This group consisted of 68-100 percentiles of the sample. Reading level groups are presented in Table 1. Means and standard deviations for Oral Reading Fluency scores by reading levels are displayed in the Table 2, together with minimum and maximum scores.

Table 1. Reading Levels of the Participants (N=185)

Reading Level	n	Percentiles	Number of Words Read Per Minute
Poor Reader	63	0-33	0-70
Moderate Reader	67	34-67	71-94
Good Reader	55	68-100	95-132

As the purpose of the study was to investigate performance differences on RAN and other reading related variables between poor and good readers, moderate readers (n=67) were excluded from the analysis. As a result, all of the following analyses were conducted using the remaining sample of 118 students.

Table 2. Means and Standard Deviations for Oral Reading Fluency Scores According to Reading Levels (N=185)

Reading Level	n	Mean	(SD)	min	max
Poor Reader	63	55.13	12.76	22	70
Moderate Reader	67	83.12	7.21	71	94
Good Reader	55	110.22	10.37	96	131
Total Group	185	81.64	24.31	22	131

Participants in the study were 118 children between the ages of 85-110 months (7 years 1 month - 8 years 9 months) from different socio-economic levels. All participants spoke Turkish as their native language. Students were from two private and six public schools in Istanbul. The test administration took place during April and May, 2008. The demographic characteristics of the reading level groups are presented in Table 3. As seen in Table 3, a total of 118 students, 66 female students (56 %) and 52 male students (44 %) were the participants of the study.

Table 3. Demographic Characteristics of Reading Level Groups (N=118)

Characteristics	Poor Readers		Good Readers	
	n	%	n	%
GENDER				
Female	34	54	32	58
Male	29	46	23	42
AGE				
85-96 months	47	75	41	75
97-110 months	16	25	11	20
No Information	0	0	3	
SCHOOL TYPES				
Public	53	84	43	78
Private	10	16	12	22
HAS PRESCHOOL EDUCATION				
Yes	25	40	35	64
No	34	54	10	18
No Information	4	6	10	18

Teachers provided information about parental occupation (Table 4, Table 5). Table 4 and Table 5 present the distribution of parental occupation in terms of reading level. The categorization of this information was accomplished under five main headings: The first group included skilled (technician, tailor, plumber, cook, driver, etc.), semi skilled (security personnel, construction worker, receptionist, etc.), or unskilled (factory worker, office-boy, maid, etc.) blue collar workers. The second group consisted of clerical staff (secretary, police, telephone operator, etc.) and civil servant (teacher, nurse, accountant, salesman, reporter, adviser, etc.). The third group consisted of white collar workers who are professionals with theoretical training (e.g., doctors, engineers, managers, general managers, architects, or professors). The fourth group consisted of owners of small organizations, or the self employed (e.g., real estate agent, coffee-shop owner, grocer). Owners of big organizations

represented the fifth group. Those who were retired, housewives or not working were categorized as economically inactive.

Table 4. Distribution for Parental Occupation of Poor Readers (N=63)

Work Type	Mothers		Fathers	
	n	%	n	%
Blue collar workers	3	4.8	22	34.9
Clerical staff and civil servant	9	14.3	14	22.2
Professionals	2	3.2	6	9.5
Owners of small scale business, self-employed	0	0.0	16	25.4
Owners of big organizations	0	0.0	0	0.0
Economically inactive	45	71.4	1	1.6
Missing Data	4	6.3	4	6.4

Table 5. Distribution for Parental Occupation of Good Readers (N=55)

Work Type	Mothers		Fathers	
	n	%	n	%
Blue collar workers	5	9.1	15	27.3
Clerical staff and civil servant	13	23.6	8	14.5
Professionals	3	5.4	5	9.1
Owners of small scale business, self-employed	0	0.0	17	30.9
Owners of big organizations	0	0.0	0	0.0
Economically inactive	25	45.5	1	1.8
Missing Data	9	16.4	9	16.4

As depicted in Table 4, in the poor readers group, while most of the mothers were not working (71.4%), only 1.6 % of the fathers were economically inactive. Most of the fathers were blue collar workers (34.9%). In the good readers group, the percentage of economically inactive mothers (45.5%) was lower than in the poor

readers, whereas the percentage of economically inactive fathers (1.6%) was nearly equal. Most of the fathers were owners of small scale business and self-employed (30.9%) in good readers.

Data about parents' educational level was obtained from the demographic information form and categorized below (Table 6). Table 6 indicates that the percentage of fathers with undergraduate and graduate degrees (40 %) in good readers is higher than the percentage of fathers with undergraduate and graduate degrees (25 %) in poor readers. The percentage of mothers with undergraduate and graduate degrees (31 %) in good readers is also higher than the percentage of mothers with undergraduate and graduate degrees (14 %) in poor readers.

Table 6. Educational Attainment of Parents by Reading Level Groups (N=118)

	Poor Readers				Good Readers			
	Mothers		Fathers		Mothers		Fathers	
	f	%	f	%	f	%	f	%
Illiterate	1	1	1	2	0	0	0	0
Literate	4	6	1	2	0	0	0	0
Elemantary Education	15	24	8	13	5	9	3	6
Junior High School	12	19	10	16	6	11	6	11
Secondary School	18	28	23	37	18	33	14	25
Undergradute degree	8	13	16	25	16	29	20	36
Graduate degree	1	1	0	0	1	2	2	4
Missing Data	4	6	4	6	9	16	10	18

The information about students' reading skills and academic performance was gathered from their teachers. Teachers were also asked to evaluate their students'

achievement in Turkish and Mathematics courses. The frequency distribution by reading levels is given in Table 7.

Table 7. Achievement in Turkish and Mathematics Courses by Reading Levels (Teacher Evaluation) (N=118)

Course	Poor Readers				Good Readers			
	Turkish		Mathematics		Turkish		Mathematics	
	n	%	n	%	n	%	n	%
Inadequate	12	19	11	18	0	0	0	0
Adequate	41	65	41	65	21	38	22	40
Superior	6	10	7	11	25	46	24	44
Missing Data	4	6	4	6	9	16	9	16

Table 7 shows that in poor readers, more than half of the participants' achievement (65 %) was adequate in both courses according to their teachers' responses. Teachers evaluated almost half of the good readers as superior in both Turkish (45.5 %) and mathematics (43.6 %) courses. None of the good readers were evaluated as inadequate in both courses.

Instruments

In this study, six instruments were used: Demographic Information Form, Turkish RAN Tests (numbers and letters), Turkish Test of Word Reading Efficiency (TOWRE) (word and non-word reading), Oral Reading Fluency Test, Letter

Knowledge Test (upper, lower case letters and sound of letters), and Reading Comprehension measures consisting of four different reading passages.

Demographic Information Form. This form was completed by the classroom teachers of the students who participated in the study. This form consisted of questions about the participants such as date of birth, gender, name of the school, preschool education, and hearing or language problems. Parents' occupation and educational levels were also asked in the form (Appendix A). In addition, teachers were asked to evaluate their students' reading levels and academic performances based on current and previous Turkish and Math achievement scores.

Turkish RAN Test. The Rapid Automatized Naming (RAN) test, originally designed by Denckla (1972) and later developed by Denckla and Rudel (1974, 1976a, 1976b). RAN Test was adapted to Turkish by Babür (BAP 05D101, in progress) and Bakır (2007), who also conducted a pilot study to assess validity and reliability of the test. The Turkish Rapid Automatized Naming (RAN) test[1] is developed to measure a person's ability to perceive a visual symbol and retrieve the name for it accurately and rapidly, which is referred to as naming speed. The Turkish RAN test may be administered to students between the ages of 5 years 0 months and 10 years11 months.

1 As studies involving RAN tests have not been completed, it is not presented in the appendices section. To access the RAN tests, permission can be obtained from Assistant Professor Nalan Babür, Faculty of Education, Boğaziçi University.

The Turkish RAN test is composed of four subtests: Pictures, colors, numbers, and letters. The objects, colors, numbers and letters tests are made up of five stimuli that are repeated randomly ten times in an array of five rows for a total of fifty stimulus items. On all the RAN tests, the examinee is asked to name each stimulus item as quickly as possible without making any mistakes. Scores are based on the amount of time required to name all the stimulus items on each test. It is a speed test and lower scores indicate better performances. In this study, two subtests (numbers and letters) of the RAN test were used. RAN Numbers included a set of randomly sequenced numbers in five rows (2, 4, 6, 7, and 9). RAN Letters consisted of five high frequency letters in five rows (b, k, m, s, and t). The materials were two stimulus cards, a stopwatch and the examiner record form. Stimulus cards were formed suitable to the original version of the RAN tests.

Psychometric Properties of the Original and Turkish RAN Tests

Test-retest reliability coefficients of the original RAN were investigated using a group of 216 students, and ranged from .81 to .98 for all age groups, with a test-retest interval of approximately 2 weeks (Wolf & Denckla, 2005). During the pilot study of the Turkish RAN Test, test-retest reliability for each subtest of the Turkish RAN were investigated using a group of 79 students out of 277, in a two week interval. The students ranged from kindergarten to fifth grade. Test-retest reliability coefficients of the Turkish RAN ranged from .85 to .95 (BAP 05D101, Babür, in progress & Bakır, 2007), which were consistent with reliability coefficients obtained from the original version of the RAN test (Wolf & Denckla, 2005).

Inter-rater reliabilities of the original RAN test indicate a high level of agreement between raters, with coefficients ranging from .98 to .99 (Wolf & Denckla, 2005). In the Turkish RAN test, inter-rater reliability for each subtest was measured by the correlation among the scorers and was determined by calculating Pearson product-moment reliability coefficients. The coefficients were very high, ranging from .99 to 1.00 (BAP 05D101, Babür, in progress & Bakır, 2007), and indicated a high level of agreement between scorers.

Good evidence of validity for the original RAN is demonstrated via content-description validity, criterion-prediction validity, and construct-identification validity (Wolf & Denckla, 2005). In order to provide evidence for construct validity for the Turkish RAN Test, oral reading fluency measures were used and the results showed that RAN performance was significantly correlated with oral reading fluency (BAP 05D101, Babür, in progress & Bakır, 2007). The reason for using oral reading fluency measures was the absence of reliable and valid measures to identify reading difficulties for Turkish children. Construct validity was also determined by the intercorrelation among RAN subtests and age differentiation. All RAN subtests were significantly correlated with each other since they all measure visual naming speed. Correlation analyses indicated that as children get older, the total time to name visually presented items diminished. The selection of the RAN stimulus items in Turkish and expert judgments provided support for the content validity of the Turkish RAN Test.

Turkish Test of Word Reading Efficiency (TOWRE). (BAP 05D101, Babür, Haznedar, Erçetin, and Çekerek, in progress). The original TOWRE was developed by Torgesen, Wagner, and Rashotte (1999), and is a measure of word reading accuracy and fluency. The TOWRE test was adapted to Turkish by Babür, Haznedar, Erçetin, and Çekerek (in progress). Validity and reliability of the Turkish TOWRE pilot study have not been completed yet. As reliability and validity studies have not been completed, the whole form of the test is not presented in the appendices section. A few examples from sight-word and non-word reading tests can be seen in Appendix B.

The TOWRE is a diagnostic assessment tool, which can be used to help identify those who are experiencing difficulties and falling behind in their word reading (Torgesen, Wagner, & Rashotte, 1999). The test is based upon research evidence, underlying the importance of accurate word recognition and good phonemic skills for efficient reading. It can be administered very quickly, and provides information of two kinds of word reading skills that are crucial in the development of overall reading ability: the ability to accurately recognize familiar words as whole units or "sight words" and the ability to "sound out" words quickly (Torgesen, Wagner, & Rashotte, 1999). The TOWRE contains two subtests, each of which has two alternate forms. For this study, one of the two alternative forms of each subtests were used. The Sight Word Efficiency (SWE) subtest assesses the number of real printed words that can be accurately identified within 45 seconds. The Phonemic Decoding Efficiency (PDE) subtest is a measure of the test taker's ability to decode pronounceable non-words using knowledge of grapheme-phoneme correspondence within 45 seconds (Torgesen, Wagner, & Rashotte, 1999).

When adapting the original TOWRE to Turkish, first, a frequent words list for Turkish was provided. In order to provide this list, four Turkish course books at primary school level, and 463 story books written for pre-school and primary school students were scanned. After the scanning process, a list of 53,747 words was obtained. On the basis of this list, two forms of the SWE subtest were developed by this team, including two special education specialists, a linguist, and two graduate students. In order to construct the PDE subtest, original forms were analyzed in terms of morphological and phonological structures and numbers of syllables. Turkish forms of the PDE subtest were designed by the same project team, consistent with the original forms. A total of four forms of two subtests were administered to 50 students through first and fifth grade, from three different primary schools for the pilot study. The forms were rearranged according to the pilot study results.

Psychometric Properties of the Original TOWRE

Test-retest reliability coefficients of TOWRE were investigated using a group of 72 individuals, and ranged from .82 to .97 for all age groups, with a test-retest interval of approximately 2 weeks (Torgesen, Wagner, & Rashotte, 1999).

Inter-scorer reliability of TOWRE was measured by the correlation among the scorers. A set of 30 completed protocols were selected randomly from the normative samples. The sample ranged from first through twelfth graders. The results provided convincing evidence of the inter-scorer reliability, with a coefficient of .99 (Torgesen, Wagner, Rashotte, 1999).

Extensive evidence of the validity of TOWRE test scores is provided for

content-description validity, criterion-prediction validity, and construct-identification validity.

Reading Comprehension Measures. For this measure four reading passages were prepared on the basis of second grade level. Two of the reading comprehension passages are narrative and the others are expository. A narrative passage is a text including a theme, plot, characters, and a setting, which tells about a sequence of events, actual or fictional. Expository texts, on the other hand, explain something by definition, sequence, categorization, comparison-contrast, enumeration, process, problem-solution, description, or cause-effect. Where the narrative text uses story to inform and persuade, the expository text uses facts and details, opinions and examples.

Three of the passages had seven questions and one of the passages had eight questions, with a total of 29 questions (Table 8). Font size, question types, and number of words and for the passages were arranged based on the second grade passages of the Comprehensive Reading Inventory (Cooter, Flynt, & Cooter, 2007). All of the reading passages included knowledge and inferential questions. Participants were asked to read the passages silently, and answer the questions orally (Appendix C). The questions were asked by the examiners orally. The score for this measure was obtained by counting the number of correct answers. The maximum point that can be obtained is 29.

Table 8. Characteristics of Reading Comprehension Passages

Reading Passage	Font Size	Font Type	Total number of words	Number of questions
Erman'ın Kumbarası	16	Century Gothic	141	8
Uçan Çiçekler	16	Century Gothic	116	7
Kerem'in Hatası	16	Century Gothic	148	7
Sağlıklı Beslenme	16	Century Gothic	134	7

Two of the passages ("Erman'ın Kumbarası" and "Sağlıklı Beslenme") were written by the volunteer students who are the part of a project (BAP 05D101, 2007) conducted by Babür (in progress). One of the passages ("Kerem'in Hatası") was written by the researcher. The other passage was translated from Comprehensive Reading Inventory (Cooter, Flynt, & Cooter, 2007), and designed for this age group by the researcher.

A pilot study, consisting of 25 second grade students, was conducted to evaluate appropriateness of the reading comprehension passages. In addition to this, seven classroom teachers evaluated each passage in terms of grade level appropriateness. According to their feedback, the reading comprehension passages were rearranged if necessary.

Oral Reading Fluency Test. The Oral Reading Fluency test used in this study was based on the previous research conducted by Bakır (2007). Bakır (2007) used a reading passage, which was written by a professor who also writes children story books. This passage was rearranged for the current study, and designed in accordance with second grade reading level. A total of 20 classroom teachers

evaluated the passage in terms of grade level appropriateness. It was reexamined and rearranged according to teachers' feedback. The reading passage includes a total of 132 words. The number of words in each sentence and the font size also were arranged based on the second grade passages of the Comprehensive Reading Inventory (Cooter, Flynt, & Cooter, 2007). For this measure participants were asked to read the reading passage orally (Appendix D).

The score for this measure was obtained by counting the number of words read correctly in one minute. When reading orally, the examiner noted the examinee's mistakes and self-corrections.

Letter Knowledge Test. This informal test was adopted from Mather and Goldstein (2001) to measure the participants' letter knowledge. For this measure, students are asked to say the name (upper and lower case) and the sound of the letter (upper case), which they see on the paper (Appendix E). There are three columns, each of which has the 29 letters of the Turkish alphabet, in a different random order. The first and last columns include upper-case letters, and the column in the middle includes lower-case letters. Upper case letters were written with Times New Roman font type, and 18 font size. For lower case letters, 18 font size, and Script MT Bold font type, which is a type of cursive writing, was used, because Ministry of Education uses cursive writing in the new curriculum. When determining font sizes and types, teachers' opinions were taken into consideration. For the first and second columns, students are asked to say the name of the letters and for the third column, they are asked to say the sound of the letter.

The Letter Knowledge Test was conducted with 25 second graders for the pilot study, to evaluate appropriateness of the test. Also, seven classroom teachers evaluated the test in terms of grade level appropriateness. The score for this measure was obtained by counting the number of correct answers. The maximum point that can be obtained is 87.

Procedures

The test administration took place in March and April, 2008. As the total time for the test administration is more than an hour, each of the participants were administered the test in two consecutive days.

The Ministry of Education granted permission for the administration of these tests in the selected schools. Also, permission was obtained from Bogazici University Committee on Ethical Conduct in Research with Human Participants. After the administrative requirements were completed, the sample schools were informed about the purpose of the study.

All participants were tested individually in a quiet, separate room, in their schools. The examiners were undergraduate students, who were part of the project (BAP 05D101, in progress) conducted by Babür. The examiners were trained and provided with detailed information and consultation before and during the administration process.

Data Analysis

The results were computed using The Statistical Package for Social Studies (SPSS-16). For all analyses, statistical significance level was defined at the level of .05.

In order to investigate the relationships among RAN and other components of reading, correlational analysis were conducted. To examine the differences between reading levels (poor and good readers) in reading comprehension and letter knowledge, t-test analysis were conducted. RAN (numbers, letters) and word reading (sight-word reading, non-word reading) differences between groups were examined by multivariate analysis of variance (MANOVA).

CHAPTER 4

RESULTS

This chapter presents the results of the study and is organized around preliminary analysis and research questions. To answer the questions presented in Chapter 2, correlational analysis, t-test analysis, and multivariate analysis of variance (MANOVA) were conducted. Statistical significance was determined using a probability level of .05 for all analyses, unless otherwise stated. The findings were discussed on the basis of five research questions.

Preliminary Analysis

For preliminary analysis, group differences in terms of parental educational levels for oral reading fluency scores were investigated. Parental educational levels were taken into consideration to categorize the students into low and high parental educational levels. High parental educational level (n=58) consisted of students, whose parents had at least high school education. The low parental educational level group (n=47) consisted of students, who had parents with less than high school educational background. Parental educational level groups are presented in Table 9.

Table 9. Parental Educational Level Groups of the Participants (N=118)

Parental Educational Level	n	%
Low Parental Educational Level	47	40
High Parental Educational Level	58	49
Missing Data	13	11

Means and standard deviations for oral reading fluency scores by parental educational levels were presented in Table 10. As presented in Table 10, participants from the low parental educational level had lower mean score (*M*=71.38) than the high parental educational level (*M*=85.93) in oral reading fluency.

Table 10. Means and Standard Deviations for Oral Reading Fluency Scores by Parental Educational Level (N=105)

Parental Educational Level	n	Mean	SD
Low Parental Educational Level	47	71.38	28.75
High Parental Educational Level	58	85.93	30.02

To examine the difference between low and high parental educational level in oral reading fluency scores, the Mann-Whitney U test was conducted. The results revealed that, there was no significant difference (z= -1.931, p>.05) between two groups in terms of oral reading fluency. Therefore, parental educational levels of participants were not taken into the consideration for further analyses.

Research Question 1: Are the tasks of RAN (numbers and letters) related to different reading components (word/ non-word reading, reading comprehension, oral reading speed, letter knowledge) in terms of reading level (poor and good readers)?

The first research question examined the relationship of RAN tasks (numbers, letters) to different reading components (sight-word/ non-word reading, reading comprehension, oral reading speed, letter knowledge) by reading levels (poor and good readers).

RAN tasks are recorded in seconds and higher scores indicate slower naming speeds. Table 11 shows that participants took less time to recall letters than numbers.

For the TOWRE, both word and non-word reading tasks, the scores are obtained as the number of words that can be accurately identified within 45 seconds. For reading comprehension measures and the letter knowledge test, the total scores were obtained by counting the number of correct answers. In the oral reading fluency test, the score was obtained by counting the number of words read correctly in one minute. Higher scores indicate better performances in all the reading measures. Means and standard deviations for all the measures by poor readers are displayed in the Table 11 and by good readers in the Table 12, together with minimum and maximum scores.

Table 11. Means, Standard Deviations, and Minimum/Maximum Scores for RAN Numbers and Letters Subtests, TOWRE (Word/Non-word Reading), Reading Comprehension Measures, Oral Reading Fluency Test, Letter Knowledge Test by Poor Readers (N=63)

Measure	Mean	(SD)	Min.	Max.
RAN Numbers	35.81	7.04	24.40	53.81
RAN Letters	34.28	8.26	21.27	56.27
TOWRE (Sight word Reading)	24.19	5.08	10	35
TOWRE (Non-word Reading)	15.27	4.24	7	26
Reading Comprehension	17.35	5.50	2	27
Oral Reading Fluency	55.13	12.76	22	70
Letter Knowledge	74.10	12.24	51	87

Table 12. Means, Standard Deviations, and Minimum/Maximum Scores for RAN Numbers and Letters Subtests, TOWRE (Sight Word/Non-word Reading), Reading Comprehension Measures, Oral Reading Fluency Test, Letter Knowledge Test by Good Readers (N=55)

Measure	Mean	(SD)	Min.	Max.
RAN Numbers	26.94	3.85	21.19	36.15
RAN Letters	26.14	4.83	19.36	42.62
TOWRE (Sight word Reading)	45.93	9.31	27	67
TOWRE (Non-word Reading)	25.00	6.15	9	41
Reading Comprehension	22.29	3.82	13	28
Oral Reading Fluency	110.22	10.37	96	131
Letter Knowledge	79.67	9.81	55	87

As presented in Table 11 and Table 12, good readers had lower mean scores, which indicated better performances, in both RAN numbers and RAN letters compared to poor readers. Poor readers had lower mean scores than good readers in sight-word reading, non-word reading, reading comprehension, oral reading fluency, and letter knowledge tasks.

Pearson-moment correlation analyses were used to address the relationship of RAN tasks (numbers, letters) to sight-word and non-word reading, reading comprehension, oral reading speed and letter knowledge. Correlations among the variables for poor readers are presented in Table 13. Correlations among the variables for good readers are presented in Table 14.

Table 13. Correlation Matrix for Relations Among Measures by Poor Readers (N=63)

Measures	1	2	3	4	5	6	7
1. RAN Numbers	---						
2. RAN Letters	.66**	---					
3. TOWRE (Sight-word)	- .47**	- .57**	---				
4. TOWRE (Non-word)	- .59**	- .55**	.68**	---			
5. Reading Comprehension	.57	- .25*	.14	.01	---		
6. Oral Reading Fluency	- .42**	- .48**	.66**	.53**	.30*	---	
7. Letter Knowledge	- .12	- .26*	.11	.13	.33**	.28*	---

**p<.01 * p<.05

Since all RAN subtests measure visual naming speed, RAN numbers and letters subtests were found to be significantly correlated with each other (r=.66, p<.01) for poor readers. The results for poor readers revealed that there were significant negative correlations between RAN numbers and TOWRE sight-word reading (r= -.47, p<.01), TOWRE non-word reading (r= -.59, p<.01), and oral reading fluency (r= -.42, p<.01). However, results indicated no significant correlations between RAN numbers and reading comprehension, and letter knowledge for poor readers. The correlations among RAN letters and other measures revealed that, there were significant negative correlations between RAN letters and

TOWRE sight-word reading (r= -.57, p<.01), TOWRE non-word reading (r= -.55, p<.01), and oral reading fluency (r= -.48, p<.01) for poor readers. However, the correlations between RAN letters and reading comprehension (r= -.25, p<.05), and between RAN letters and letter knowledge (r= -.26, p<.05) were low in poor readers.

The results for poor readers also indicated a significant positive correlation between sight-word reading and non-word reading tasks (r=.68, p<.01). Oral reading fluency correlated positively and significantly with sight-word reading (r=.66, p<.01), non-word reading (r=.53, p<.01), and reading comprehension (r=.30, p<.05).

Table 14. Correlation Matrix for Relations Among Measures by Good Readers (N=55)

Measures	1	2	3	4	5	6	7
1. RAN Numbers	---						
2. RAN Letters	.66**	---					
3. TOWRE (Sight-word)	- .33*	- .26	---				
4. TOWRE (Non-word)	- .21	- .29*	.73**	---			
5. Reading Comprehension	- .06	- .04	.17	.24	---		
6. Oral Reading Fluency	.18	- .12	.52**	.45**	.08	---	
7. Letter Knowledge	.26	.26	.01	.07	.21	- .38**	---

**p<.01 * p<.05

The two symbolic tasks (numbers and letters) of RAN were significantly correlated with each other (r=.66, p<.01) for good readers. Correlation coefficients between RAN numbers and letters, for both poor and good readers were equal (r=.66, p<.01).

The results for good readers revealed that there were no significant correlations between RAN numbers and other measures, except TOWRE sight-word reading. Sight-word reading correlated negatively and significantly with RAN numbers ($r= -.33$, $p<.05$). Results also indicated no significant relationships between RAN letters and other measures, except TOWRE non-word reading. Non-word reading correlated negatively and significantly with RAN letters ($r= -.29$, $p<.05$).

The results for good readers also revealed that there was a significant positive correlation between sight-word reading and non-word reading tasks ($r=.73$, $p<.01$). Oral reading fluency correlated positively and significantly with sight-word reading ($r=.52$, $p<.01$) and non-word reading ($r=.45$, $p<.01$).

Research Question 2: Are there any differences between poor and good readers in terms of their performances on the tasks of RAN (numbers, letters)?

The aim of the second research question was to see whether there were significant differences between poor and good readers, in terms of their RAN (numbers, letters) scores. Means and standard deviations for RAN tasks (numbers, letters) by reading levels were presented in Table 15. As seen in Table 15, good readers had lower mean scores, which indicated better performances, in both RAN numbers and letters compared to poor readers.

Table 15. Means and Standard Deviations for RAN Tasks by Reading Levels (N=118)

Reading Level		RAN Numbers		RAN Letters	
	n	Mean	SD	Mean	SD
Poor Reader	63	35.81	7.04	34.28	8.26
Good Reader	55	26.94	3.85	26.14	4.83

To avoid Type I error and to test overall group differences between poor and good readers, one-way multivariate analysis of variance (MANOVA) was conducted. One-way MANOVA results are interpreted by Pillai's Trace criterion, which is considered to have acceptable power and to be the most robust statistic against violations of assumptions. Pillai's test indicated overall differences between poor and good readers (*F* (error df: 115.000) = 34.97; p=.000) for RAN tasks (Table 16).

Table 16. Multivariate Analysis of Variance of RAN Numbers and Letters by Reading Levels (N=118)

Effect	Value	F	Hypothesis df	Error df	p	Partial Eta Squared
Intercept	.97	1.78*	2.000	115.000	.000	.97
Reading Level (R)	.38	34.97*	2.000	115.000	.000	.38

Note: Multivariate F ratios were generated from Pillai's statistic.
* p<.001

Table 17 demonstrates the examination of the univariate F-tests by reading level. Poor readers' RAN numbers scores (*F*=69.06, p<.001) and RAN letters scores

(F=41.15, p<.001) were found significantly different than good readers. Using η_p^2 as the measure of effect size, reading levels accounted for 37% of the total variability in RAN Numbers scores, and 26% of the total variability in RAN Letters scores.

Table 17. Univariate Analysis of Variance of RAN Numbers and Letters by Reading Levels (N=118)

Source		SS	df	MS	F	p	Partial Eta Squared
Corrected Model	RAN Numbers	2307.96	1	2307.96	69.06	.000	.37
	RAN Letters	1947.10	1	1947.10	41.15	.000	.26
Intercept	RAN Numbers	115629.06	1	115629.06	3459.70	.000	.97
	RAN Letters	107217.94	1	107217.94	2265.96	.000	.95
Reading Level	RAN Numbers	2307.96	1	2307.96	69.06	.000	.37
	RAN Letters	1947.10	1	1947.10	41.15	.000	.26
Error	RAN Numbers	3876.91	116	33.42			
	RAN Letters	5488.76	116	47.32			
Total	RAN Numbers	124583.80	118				
	RAN Letters	117126.08	118				

Research Question 3: Are there any differences between poor and good readers in terms of their performances on word reading (sight-word reading, non-word reading)?

Means and standard deviations for word reading (sight-word reading, non-word reading) by reading level were presented in Table18. As demonstrated in Table

18, poor readers had a lower mean score than good readers in both sight-word reading and non-word reading.

Table 18. Means and Standard Deviations for Word Reading by Reading Levels

Group		Sight-word Reading		Non-word Reading	
	n	Mean	SD	Mean	SD
Poor Reader	63	24.19	5.08	15.27	4.24
Good Reader	55	45.93	9.31	25.00	6.15

To test overall group differences by reading levels, a one-way multivariate analysis of variance (MANOVA) was conducted. One-way MANOVA results are interpreted by Pillai's Trace criterion. Pillai's test revealed overall differences between poor and good readers (*F* (error df: 115.000) = 128.61; p=.000) for sight-word reading and non-word reading (Table 19).

Table 19. Multivariate Analysis of Variance of Sight-Word Reading and Non-Word Reading by Reading Levels (N=118)

Effect	Value	F	Hypothesis df	Error df	p	Partial Eta Squared
Intercept	.96	1.35*	2.000	115.000	.000	.96
Reading Level (R)	.69	128.61*	2.000	115.000	.000	.69

Note: Multivariate F ratios were generated from Pillai's statistic.
* p<.001

Table 20 presents the univariate F-tests for sight-word reading and non-word reading by reading levels. There were significant differences in sight word reading

(*F*=102.30, p<.001), and non-word reading scores (*F*=256.22, p<.001) of poor readers and good readers. Using η_p^2 as the measure of effect size, reading levels accounted for 47% of the total variability in sight-word reading scores, and 69% of the total variability in non-word reading scores.

Table 20. Univariate Analysis of Variance of Sight-Word Reading and Non-Word Reading by Reading Levels (N=118)

Source		SS	df	MS	F	p	Partial Eta Squared
Corrected Model	Sight-word	2780.10	1	2780.10	102.30	.000	.47
	Non-word	13874.34	1	13874.34	256.22	.000	.69
Intercept	Sight-word	47619.09	1	47619.09	1752.25	.000	.94
	Non-word	144370.07	1	144370.07	2666.10	.000	.96
Reading Level	Sight-word	2780.10	1	2780.10	102.30	.000	.47
	Non-word	13874.34	1	13874.34	256.22	.000	.69
Error	Sight-word	3152.41	116	27.18			
	Non-word	6281.42	116	54.15			
Total	Sight-word	52217.00	118				
	Non-word	159160.00	118				

Research Question 4: Are there any differences between poor and good readers in terms of their performances on reading comprehension?

Means and standard deviations for reading comprehension in terms of reading level were presented in Table 21. As presented in Table 21, poor readers had a lower mean score (*M*=17.35) than good readers (*M*=22.29) in reading comprehension.

Table 21. Means and Standard Deviations for Reading Comprehension by Reading Levels (N=118)

Group	n	Mean	SD
Poor Reader	63	17.35	5.50
Good Reader	55	22.29	3.82

T-test analysis was conducted to test group differences for reading comprehension scores. Table 22 displays the t-test results regarding reading comprehension scores of reading levels. As can be seen, there was a significant difference in reading comprehension performances (t= -5.59, p< .001) of poor and good readers.

Table 22. T-test Results for Reading Comprehension by Reading Levels (N=118)

	df	t	p
Reading Comprehension	116	-5.59	.000

Research Question 5: Are there any differences between poor and good readers in terms of their performances on letter knowledge?

Means and standard deviations for letter knowledge in terms of reading level were presented in Table 23. As presented in Table 23, poor readers had lower mean score (M=74.10) than good readers (M=79.69) in letter knowledge.

Table 23. Means and Standard Deviations for Letter Knowledge by Reading Levels (N=118)

Group	n	Mean	SD
Poor Reader	63	74.10	12.25
Good Reader	55	79.67	9.81

T-test analysis was conducted to test group differences for letter knowledge scores. As seen in Table 24, there was a significant difference in letter knowledge (t= -2.70, p< .01) between poor readers and good readers.

Table 24. T-test Results for Letter Knowledge by Reading Levels (N=118)

	df	t	p
Letter Knowledge	116	-2.704	.008

CHAPTER 5

DISCUSSION

This final chapter is presented in four sections: a review of findings in terms of research questions, implications of the current study, limitations of the study, and suggestions for future research.

Review of Findings

This study aimed at investigating the role of RAN in the components of reading process (word reading, oral reading fluency, reading comprehension, letter knowledge) among second graders with different reading levels (poor and good readers).

The first research question was addressed to examine the relationship of RAN tasks (numbers, letters) to different reading components (word/ non-word reading, reading comprehension, oral reading speed, letter knowledge) by reading levels. A total of 118 students (66 girls and 52 boys) were the participants. All of the participants were second graders and spoke Turkish as their native language. 63 of the participants were poor readers and 55 of the participants were good readers. Correlational analyses were conducted to answer this research question.

The findings of this research question were consistent with previous research (e.g., Bowers & Swanson, 1991; Cornwall, 1992; McBride-Chang & Manis, 1996; Wolf & Denckla, 2005). Results revealed that the two symbolic tasks (numbers and letters) of RAN were significantly correlated with each other ($r=.66$, $p<.01$) for both poor and good readers. Correlation coefficients for both poor and good readers, between RAN numbers and letters, were in expected directions, with magnitudes comparable to the previous findings (Wolf & Denckla, 2005).

McBride-Chang and Manis (1996) examined the relationship of naming speed, phonological awareness and verbal intelligence to word reading in good and poor readers in the third and fourth grades. The researchers demonstrated that naming speed was strongly associated with word reading only in poor readers (McBride-Chang & Manis, 1996). In line with McBride-Chang and Manis (1996), the present study indicated a significant correlation between naming speed tasks (numbers, letters) and word reading tasks for poor readers.

The findings of the study were also consistent with Bowers and Swanson's (1991), who reported that RAN numbers are negatively correlated with both sight (- .49) and non-words (- .57). The present study revealed that RAN numbers correlated significantly with sight-word ($r= -.47$, $p<.01$), and non-word reading ($r= -.59$, $p<.01$) for poor readers; and with sight-word reading ($r= -.33$, $p<.05$) for good readers.

In line with Cornwall (1992), who found that rapid letter naming added significantly to the prediction of word reading, the present study demonstrated significant negative correlations between RAN letters and sight-word reading (r= -

.57, p<.01), and non-word reading (r= -.55, p<.01) for poor readers. However, for good readers, RAN letters only found to be significantly correlated with non-word reading (r= -.29, p<.05).

As outlined by Wolf and Denckla (2005), "naming speed, particularly for letters, represents an early approximation of reading speed for words and is an important predictor of reading fluency" (p.2). In line with Wolf and Denckla (2005), the present study demonstrated that RAN tasks (numbers, letters) correlated significantly and negatively with oral reading fluency for poor readers.

Findings of the current study, about the relationship between naming speed and reading comprehension, were somewhat different than from previous research (Sprugevica & Hoien, 2004). Sprugevica and Hoien (2004) reported correlation coefficients between 0.30 and 0.40 between rapid naming tasks and reading comprehension. However, in the current study, results indicated no significant correlations between RAN tasks (numbers, letters) and reading comprehension for good readers; and between RAN numbers and reading comprehension for poor readers. Only, a significant and respectively low correlation (r= -.25, p<.05), was found between RAN letters and reading comprehension for poor readers.

The second research question was addressed to examine whether there were significant differences between reading levels, namely between poor and good readers, in terms of their RAN scores. For analyses of this research question, multivariate analysis of variance (MANOVA) were conducted. The results indicated that there were significant differences between poor and good readers in RAN numbers and RAN letters scores.

The findings of the second research question were consistent with previous research (Catts et al., 2002; Denckla & Rudel, 1974, 1976a,1976b; McBride-Chang & Manis, 1996). The current study indicated that children with higher reading ability were quicker than poor readers to name the letters and numbers, as Denckla and Rudel (1974, 1976a, 1976b) originally indicated many years ago. Denckla and Rudel (1974, 1976b) also showed that, average readers were significantly faster than non-dyslexic learning disabled group, and non-dyslexic learning disabled group were significantly faster than dyslexic group, on all naming speed tasks.

In a recent longitudinal study, Catts and colleagues (2002) examined reading differences in poor and good readers. The researchers investigated the role of the speed of processing, rapid naming, and phonological awareness in reading achievement. The results demonstrated that poor readers were significantly slower than good readers on response time measures and on the rapid naming tasks. In line with Catts and colleagues (2002), the current study indicated that poor readers were significantly slower in RAN numbers and letters tasks.

The third research question investigated the differences between poor readers and good readers in terms of sight-word reading, and non-word reading scores. Multivariate analysis of variance (MANOVA) results indicated that there were significant differences between reader types in sight-word and non-word reading scores.

The fourth research question explored the differences between poor and good readers in terms of reading comprehension scores. T-test analysis results revealed significant difference between two groups in reading comprehension scores.

The findings of the second research question were consistent with Samuels and Flor (1997). As outlined by Samuels and Flor (1997), readers who have acquired automaticity, are able to direct their efforts into comprehending the text and don't need to use their energy to decode words. The results of the current study also revealed that good readers (readers who have acquired automaticity) had significantly higher reading comprehension scores than poor readers. In another words, poor readers, who use their cognitive resources to decode words and leave less mental resources available for comprehension process (Hoien & Lundberg, 2000), had worse reading comprehension scores than good readers.

The fifth research question examined the differences between poor and good readers in terms of letter knowledge scores. T-test analysis results revealed significant difference between two groups in letter knowledge scores. In line with previous research findings (Wren, 2001), which indicate that letter knowledge is one the best indicators of reading ability, the current study results revealed significant differences between poor and good readers in letter knowledge.

As a conclusion, the findings of this study are important for several reasons. This study presented that RAN tests are correlated with other components of reading (sigth-word reading, non-word reading, oral reading fluency, reading comprehension, and letter knowledge). This study also documented that RAN tests significantly differentiate poor readers and good readers. Results also supported the fact that RAN tests are valid and reliable measures of reading ability and can be used in Turkey as one of the screening measures of reading ability.

Implications of the Study

The first major implication of this study is that the findings indicated that poor readers have a general deficit in rapid naming tasks, which is the indicator of the problems in speed of processing. Poor readers also showed lower performances than good readers in word reading, reading comprehension, and letter knowldege measures. In order to provide effective early reading interventions for these poor readers, it is important to identify them at the earliest possible time frame. Identification of the readers who are at risk, and providing them appropriate intervention programs based on improving their automatization and fluency levels, will help to overcome their reading problem. A review study estimates that the number of children who are typically identified as poor readers and served through either special education or compensatory education programs, could be reduced by up to 70% through early identification and prevention (Lyon, Shaywitz, Shaywitz; 2003). At this point, RAN tests serve as an accurate, early, time-efficient tool for reading achievement (Bowers & Wolf, 1993).

Another major implication of this study is that in Turkey, the lack of adequate assessment tools for early reading acquisition is a problem and Bingöl (2003) pointed out the need of a reading achievement test for the Turkish language. The present study indicated that RAN tasks are related to reading ability and can be added to kindergarten and first grade screening batteries as a naming speed measure.

The present study documented that RAN tasks significantly differentiate poor readers and good readers. For this reason, teachers and school counselors can benefit

from RAN tests to identify children at risk for reading fluency problems. All RAN subtests take a few minutes in total and they are easy and quick to administer.

Another implication of this study for researchers is that RAN tests provide guidance for further cross-linguistic studies through the comparison of the RAN performances of Turkish children with other children, speaking different languages. Turkish is a transparent language with regular orthography and the correspondence between letters and sounds is almost one-to-one (Bingöl, 2003). Comparing naming speed deficits in Turkish and other regular and irregular orthographies may contribute to further understanding of the role of naming speed in reading disability.

Limitations of the Study

This study has a number of limitations:

1. This study included only second grade students. In order to examine developmental differences more thoroughly, it would be beneficial to include children from kindergarten through second grade.
2. Although the distribution of subjects by reading types was nearly equal, the distribution by parental educational level groups was not equal. For instance, there were 19 students in the low parental educational level group, whereas the high parental educational group consisted of 57 students. This may lead to difficulty in interpreting the results.
3. Reading comprehension measures and letter knowledge tests were developed by the researcher, but reliability and validity studies of these measures were

not completed yet. For that reason using these measures might affect the results.

Suggestions for Future Research

The present study suggests that RAN tests, as a valid and reliable tool, should be standardized and norms should be established for Turkish children. Further research is needed for examining the predictive role of RAN in reading disability across grades. Also, longitudinal comparative studies will be helpful to understand the role of RAN in different stages of reading development. Another issue to be explored in future studies is the comparison of RAN performances of Turkish children with other children, speaking different languages.

For further research, the relationship of RAN to phonological awareness should be investigated. Phonological awareness and naming speed are the two specific deficits of developmental reading disability as double-deficit theory suggested (Bowers & Wolf, 1993), therefore it is important to identify their roles in Turkish reading acquisition.

Although the present study attempted to investigate the differences between poor and good readers on RAN and other components of reading (word reading, reading comprehension, letter knowledge), the investigation of whether RAN distinguishes children with dyslexia from other reader types (average and good readers) remains unexplored.

APPENDICES

APPENDIX A

DEMOGRAPHIC INFORMATION FORM

ÖĞRENCİ BİLGİ FORMU

- Öğrenci Adı-Soyadı : .....
- Öğrencinin Doğum Tarihi(gün-ay-yıl): ---/ --- / -------
- Okulu: .....
- Öğrencinin Cinsiyeti: Kız ( ) Erkek ( )
- Öğrencinin Okulöncesi Eğitimi (Yuva, kreş...): Var ( ) Yok ( )
- Evde ikinci bir dil konuşuluyor mu? Evet ( ) Hayır ( ) Bilgim yok ( )
- **Annenin Eğitim Düzeyi :**

Okuryazar değil ( ) Okuryazar ( ) İlkokul ( ) Ortaokul ( )

Lise ( ) Üniversite ( ) Lisansüstü ( )

- **Babanın Eğitim Düzeyi :**

Okuryazar değil ( ) Okuryazar ( ) İlkokul ( ) Ortaokul ( )

Lise ( ) Üniversite ( ) Lisansüstü ( )

- Annenin Mesleği:…….. Babanın Mesleği:……
- Öğrencinin işitme problemi var mı? Evet ( ) Hayır ( )
- Öğrencinin dil ve konuşma problemi var mı? Evet ( ) Hayır ( )
- Dikkat eksikliği ve/veya hiperaktivite bozukluğu... gibi tanılardan herhangi birini almış mı? Evet ( ) Evet ise hangisi?..... Hayır ( ) Bilgim Yok ( )
- Lütfen öğrencinizin **okuma akıcılığı** yönünden hangi gruba girdiğini işaretleyiniz.

İyi okuyor ☐ **Zayıf** okuyor (çoğu zaman heceler, akıcı okuyamaz, kelime atlar) ☐

- Lütfen öğrencinizin okumayı ne zaman öğrendiğini belirtiniz:

1. Sınıfta 1. Dönem……. 1. Sınıfta 2. Dönem…… 2. Sınıfta 1. Dönem…...

Başarı durumu:

- Türkçe ders notu (birinci yarıyıl): _____
- Akademik performansı ile zeka düzeyi arasında fark görüyor musunuz?Evet()Hayır()
- Öğrencinin her iki dersteki başarısını aşağıda belirtilen ölçütlere göre değerlendirerek uygun gördüğünüz seçeneğe X işareti koyunuz.

	YETERSİZ	***YETERLİ***	***ÜSTÜN***
TÜRKÇE			
MATEMATİK			

APPENDIX B

TURKISH TEST OF WORD READING EFFICIENCY (TOWRE)

SIGHT-WORD READING

NON-WORD READING

EXAMPLES FROM SIGHT-WORD READING TEST

kapanmış

minnacık

görünürde

konuşuyormuş

dönüştürecek

ayakkabıları

EXAMPLES FROM NON-WORD READING TEST

ge

çakur

kinketil

yalkoma

focuktavar

yörtümlerecek

APPENDIX C

READING COMPREHENSION MEASURES

ERMAN'IN KUMBARASI

Ermanların evindeki buzdolabı eskimişti. Zaman zaman arızalanmaktaydı. Yemekler bozuluyor ve meyveler çürüyordu. Ailesi yeni bir buzdolabı almak istiyordu. Bu yüzden para biriktiriyorlardı.

Erman'ın en büyük hayali bir bisiklet almaktı. Onun küçük, mavi bir kumbarası vardı. Çok uzun süredir harçlıklarını kumbarasında biriktiriyordu. Erman para biriktirmek için çeşitli yollara başvuruyordu. Örneğin, arkadaşları kantinden sandviç alırken, O evden getirdiği yiyecekleri yiyordu. Böylece Erman'ın kumbarasında çok para birikmişti.

Bir gün Erman'ın babası beyaz eşya satılan mağazaya gitti. Buzdolabının çok pahalı olduğunu gördü ve üzgün olarak eve döndü. Annesi ve babası akşam yemeğinde parayı nereden bulabileceklerini konuştular. Erman bunu duydu. Ailesinin ihtiyaç duyduğu para kumbarasında vardı. Erman hem topladığı parayı ailesine vermek istiyordu, hem de kırmızı, vitesli bir bisiklet almak istiyordu. Erman'ın kafası karışmıştı. Acaba Erman ne yapmalıydı? Akşam yatağında epeyce düşündü. Ne yapacağına karar verdi. Sabah, kumbarasını babasına verdi. O, artık çok mutluydu.

Öğrenci Adı Soyadı: ……
Okulu : ……
Uygulama Tarihi : …. /…./2008

YÖNERGE:

Bu hikaye Erman hakkındadır. Hikayeyi oku ve edindiğin bilgileri aklında tutmaya çalış. Okuman bitince kağıdı bana geri vereceksin. Senden, okumanı bitirdikten sonra vereceğim soruları cevaplamanı istiyorum.

Değerlendirme Formu (Erman'ın Kumbarası) (141 kelime)

------- 1. Erman'ın ailesi niçin para biriktiriyordu?

------- 2. Erman'ın en büyük hayali neydi?

------- 3. Erman'ın ailesi niçin yeni bir buzdolabı almak istiyordu?

------- 4. Erman harçlıklarını nasıl biriktirdi?

------- 5. Erman'ın babası niçin eve üzgün döndü?

------- 6. Erman'ın kafası neden karıştı?

------- 7. Hikâyenin sonunda Erman neden çok mutlu oldu?

------- 8. İnsanlar neden para biriktirirler?

SAĞLIKLI BESLENME

Canlıların yaşamını sürdürmesi için beslenmesi gereklidir. Sağlıklı olmak için dengeli ve yeterli beslenmeliyiz.

Dengeli ve yeterli beslenmek için her besin grubundan yeterince tüketmeliyiz. Gün içerisinde üç ana öğünümüz vardır. Sabah kahvaltısı, öğle yemeği ve akşam yemeği. Bu öğünleri, her gün aynı saatlerde yemeye özen göstermeliyiz. Sabah kahvaltısı en önemli öğündür. Kahvaltı yaparsak kendimizi iyi hissederiz. Derslerimizi daha kolay öğrenir ve daha başarılı oluruz. Bu nedenle her sabah, kahvaltı yapmalıyız. Kahvaltıda peynir, yumurta, zeytin gibi gıdalar yemeliyiz.

Öğle yemeği için farklı besinler tüketmeliyiz. Et, tavuk, balık, nohut, kuru fasulye gibi yiyecekler bu öğünde yenebilir.

Akşam yemeğimiz mevsimlik sebzelerden oluşmalıdır. Az yağlı ve sulu yemekler yemeli, kızartma ve hamur işlerinden kaçınmalıyız.

Gün boyunca bol bol su içmeliyiz. Katı gıdaların yanında, süt, ayran ve meyve suyu içebiliriz.

Her türlü besinden yeteri kadar alırsak sağlıklı oluruz.

Öğrenci Adı Soyadı: ……
Okulu : ……
Uygulama Tarihi : …. /…./2008

YÖNERGE:

Bu hikaye sağlıklı beslenme ile ilgilidir. Hikayeyi oku ve edindiğin bilgileri aklında tutmaya çalış. Okuman bitince kağıdı bana geri vereceksin. Senden, okumanı bitirdikten sonra vereceğim soruları cevaplamanı istiyorum.

Değerlendirme Formu (Sağlıklı Beslenme) (134 kelime)

------- 1. Sağlıklı olmak için nasıl beslenmeliyiz?

------- 2. Kaç ana öğün vardır? İsimleri nelerdir?

------- 3. Günün en önemli öğünü hangisidir?

------- 4. Gün boyunca bol bol ne içmeliyiz?

------- 5. Güne kahvaltı yapmadan başlamak doğru mudur? Neden?

------- 6. Her akşam patates kızartması ve hamburger yemek sağlıklı mıdır? Neden?

------- 7. Sağlığımız için çok gerekli olan ve okuma parçasında sözü edilmeyen 2 yiyecek ismi söyle.

KEREM'İN HATASI

Bir cumartesi günüydü. O akşam Kerem'in anne ve babası bir düğüne davetliydi. Eve çok geç döneceklerdi. Bu yüzden anneannesi Kerem ile kalmaya geldi. Akşam anne ve babası düğün için hazırlanıp çıktılar. Anneannesi ve Kerem beraber yemek yediler. Televizyon seyrettiler. Kerem'in uyku saati gelmişti.

Kerem iki yıldır basketbol oynuyordu. Çok iyi bir oyuncu olduğu için takımın kaptanı olmuştu. Ertesi sabah çok önemli bir maçları vardı. Bu yüzden zamanında yatıp uykusunu alması gerekiyordu. Ama televizyonda en sevdiği dizi başlamıştı. Anneannesinin tüm çabalarına rağmen Kerem dizi bitene kadar yatmaya gitmedi. O akşam Kerem uyuduğunda saat epey geç olmuştu.

Ertesi sabah Kerem çok zor uyanabildi. Basketbol salonuna geldiğinde kendini hala çok yorgun hissediyordu. Maç boyunca istediği kadar hızlı koşamadı ve basketlerin birçoğunu kaçırdı. Takım arkadaşları Kerem'in durumuna çok şaşırmıştı.

O gün Kerem'in takımı maçı kaybetti. Maçın bitiminde Kerem çok üzgündü. O, yaptığı hatayı anlamıştı. Çünkü Kerem niçin iyi oynayamadığını çok iyi biliyordu.

Öğrenci Adı Soyadı: ……
Okulu : ……
Uygulama Tarihi : …. /…./2008

YÖNERGE:

Bu hikaye Kerem ile ilgilidir. Hikayeyi oku ve edindiğin bilgileri aklında tutmaya çalış. Okuman bitince kağıdı bana geri vereceksin. Senden, okumanı bitirdikten sonra vereceğim soruları cevaplamanı istiyorum.

Değerlendirme Formu (Kerem'in Hatası) (148 kelime)

------- 1. Niçin anneannesi Keremlere kalmaya geldi?

------- 2. Hikayede Kerem'den başka kimler vardır?

------- 3. Niçin Kerem'in zamanında yatıp uykusunu alması gerekiyordu?

------- 4. Kerem'in maçı hangi gün oynanmıştır?

------- 5. Neden o akşam Kerem geç yattı?

------- 6. Takım arkadaşları neden Kerem'in durumuna çok şaşırdılar?

------- 7. Sence Kerem'in yaptığı hata neydi?

UÇAN ÇİÇEKLER

Birçok böcek türü vardır. Büyük böcekler, küçük böcekler, çirkin böcekler, yararlı böcekler, zararlı böcekler… Ama öyle bir böcek vardır ki, pek çok insan onun böceklerin en güzeli olduğuna inanır. Bu böceğin adı kelebektir. Bazı insanlar ona uçan çiçek derler.

Kelebeklerin iki çift kanadı vardır. Bu kanatlar renk renktir. Kelebekler ince ve uzun duyargalarını kullanarak koku alır ve işitirler. Kelebekler ısıramaz ya da çiğneyemez. Onlar boruya benzeyen uzun dillerini kullanarak yemeklerini çiçeklerden alırlar.

Kelebekler yumurta olarak hayata başlarlar. Sonra tırtıla dönüşürler. Tırtıllar kalın bir kabuk oluşturup, bu kabuğun içine saklanırlar. Onlar, bu kalın kabuğu kırıp dışarı çıkarlar. O andan itibaren, artık renkli ve kanatlı kelebekler olmuşlardır. Kelebekler uzun yaşamazlar. Bu yüzden en kısa zamanda yumurtlamaları gerekir.

Öğrenci Adı Soyadı: ……
Okulu : ……
Uygulama Tarihi : …. /…./2008

YÖNERGE:

Bu hikaye kelebeklerle ilgilidir. Hikayeyi oku ve edindiğin bilgileri aklında tutmaya çalış. Okuman bitince kağıdı bana geri vereceksin. Senden, okumanı bitirdikten sonra vereceğim soruları cevaplamanı istiyorum.

Değerlendirme Formu (Uçan Çiçekler) (116 kelime)

------- 1. Hikayede hangi böcek türü anlatılmaktadır?

------- 2. Sence neden bazı insanlar kelebeklere uçan çiçekler derler?

------- 3. Kelebeğin duyargası ne işe yarar?

------- 4. Kelebekler yemeklerini nereden sağlarlar?

------- 5. Kelebekler yemeklerini çiçeklerden nasıl alırlar?

------- 6. Kelebek yumurtası tırtıla dönüştükten sonra ne olur?

------- 7. Niçin kelebeklerin en kısa zamanda yumurtlamaları gerekir?

APPENDIX D

ORAL READING FLUENCY TEST

Okuma Parçası

Hakan annesiyle birlikte köyde yaşıyor. Bir de köpeği var. Kerpiç bir evde oturuyor. Onların evi tek odalı. Hakan okula gidiyor, ama şimdi okul kapalı. Tatilde şehirdeki teyzesine gitmek istiyor. Şehir köyden çok farklı bir yer. Şehir, koca caddeler, otobüsler ve arabalarla dolu. Evlerin çoğu çok katlı, balkonsuz ve bahçesiz. Hakan'ın teyzesi iki katlı bir evde yaşıyor. Onun evi, şehir merkezinden epey uzak. Ama güzel bir ev. Bahçesi de var. Hakan teyzesini ziyarete gidiyor. Teyzesi çok seviniyor. Çünkü Hakan'ı uzun zamandır görmemiş. Sarılıp sarılıp onu öpüyor. Hakan çok sevinçli ama köyünü de özlüyor. Köyün yeşilliğini, kaval sesini özlüyor. Hakan en güzel yer kendi evim diye düşünüyor. Hakan tatil bitince köyüne dönecek. Annesine şehirde gördüklerini anlatacak. Okullar açılınca arkadaşlarını görecek. Onlara da tatilde yaptıklarını anlatacak. Teyzesinin evini, şehrin kalabalığını anlatacak. Hakan şimdiden çok heyecanlanıyor.

APPENDIX E

LETTER KNOWLEDGE TEST

BÜYÜK HARF	KÜÇÜK HARF	SES
H	s	D
K	i	H
E	c	P
N	ö	L
Z	l	U
T	f	A
Ğ	u	F
Ş	g	J
A	n	Ö
P	v	C
Ü	ı	Ü
C	r	V
Ö	h	G
S	d	O
Ç	m	N
R	s	Y
D	a	Ğ
U	j	S
F	y	I
I	o	B
M	g	M
B	k	Ç
L	b	T
İ	t	Z
Y	e	İ
G	z	K
V	ç	E
J	ü	Ş
O	p	R

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