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Mediatory Effect of Reading Skill in the Rapid Automatized Naming/Reading Comprehension Relationship

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Abstract

This study aims to explore the explanatory and predictive relations between Rapid Automatized Naming (RAN) and Reading and Comprehension Skills in a structural model and to examine the mediatory status of reading skills in a possible relationship. The participants of the research were 177 primary school second-grade students (98 girls and 79 boys) attending a state primary school in a city center of the Western Black Sea Region of Turkey. The structural equation modeling was utilized as latent variables were tested in the study, and it allowed for identifying the error in the variables. As the analysis results showed, it is argued that RAN has a directly predictive effect on the reading skill and the reading skill strongly predicts the comprehension skill. It was also seen that the reading skill had a fully mediatory role in the relationship between RAN and comprehension. It can be argued according to the results that students with better RAN performance have better reading skills and students with good reading skills achieve better reading comprehension.

Keywords

Rapid Automatized Naming
Reading
Reading Comprehension

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Introduction

Reading fluency requires readers to read with a smooth pronunciation at a certain rate and accurately by considering intonation and stresses. Achieving the reading fluency successfully, as it is defined, is about the healthy operation of the underlying processes. One of these processes that affect reading fluency directly is Rapid Automatized Naming (RAN). Recent studies have particularly found that students' skills of naming objects, letters, numbers and colors rapidly are closely and strongly related to reading fluently (Norton & Wolf, 2012). Hence, RAN and its underlying structures should be examined in more detail.

Rapid Automatized Naming

RAN is the body of tasks which utilize letters, shapes, colors and numbers presented in a mixed order, and which need to be named by the subject orally, accurately and rapidly as they appear from left to right (Norton & Wolf, 2012). The main principle in a RAN application is the requirement of enunciating the given objects, letters, numbers and colors as rapidly as possible and accurately. The time is measured during the rapid naming of objects in RAN, and the elapsed time is considered to be the raw score (Denckla & Rudel, 1976). It is mentioned in different names in the literature such as "serial visual naming", "continuous rapid naming", "rapid naming", and "naming speed" (Norton & Wolf,

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2012). Although they are named differently, RAN tests are generally similar to the format developed by Denckla and Rudel (1976) about 40 years ago. The RAN test, having found such an important place especially within the field of education, is strongly associated with reading. A RAN test can be used to estimate information about students' reading performances and to understand the reasons underlying poor reading (Denckla & Rudel, 1976; Wolff, 2014). RAN test's superiority in distinguishing students who are poor readers makes it irreplaceable for reading studies (Decker & Carboni, 2011). Rapid naming in the essence of RAN involves various components such as attention, visual discrimination, and integration between visible and semantic information, phonological attributes and pronunciation. Each of these components are vitally important for the fulfillment of the RAN task (Siddaiah & Padakannaya, 2015).

RAN and Reading

There is a strong relation between RAN and reading achievement (Li et al., 2009). RAN stands out with its predictive role in this relationship. In other words, it can be predicted in all probability that a student who scored low in the RAN test may have problems with reading (Siddaiah & Padakannaya, 2015). Students who have difficulty in RAN tests generally experience problems with reading, which has a negative impact on their comprehension (Decker & Carboni, 2011). It has been explored in several studies that RAN is a very strong predictor in oral reading fluency (Christo & Davis, 2008; Kasperski, Shany, & Katzir, 2016; Kim, Park, & Lombardino, 2015; Lipka, 2017; Papadopoulos, Spanoudis, & Georgiou, 2016). Several propositions have been argued to further detail the relationship between RAN and reading. The main purpose of these propositions is to explain the causation in the relationship in question. The first of the propositions argued to that end is that RAN can explain the changes in learning to read. The second is that differences in learning to read may lead to changes in RAN, and the third is that the association between RAN and reading may be a mutual one. The most dominant proposition among them is that RAN is effective in the reading development (Lervag & Hulme, 2009). When considering the RAN/reading relation with respect to the developmental process, RAN especially affects the first periods when one starts learning how to read (Wolff, 2014). It is stated in studies carried out in the USA, that children at the age of 5-6 pronounce colors and shapes more rapidly than letters and numbers. However, once reading is learned, they become faster with letters and numbers and gain automatization (Norton & Wolf, 2012). This is an important indicator that RAN/reading interaction continues even after learning how to read. It is argued that RAN is particularly related to reading accuracy and the reading rate which are directly observable and the most basic components of reading (Díaz-Giráldez, Delgado-Ríos, González-Valenzuela, & Martín-Ruiz, 2014; Keskin & Karadağ, 2017; Savage & Frederickson, 2005). It is suggested in the study performed by Savage and Frederickson (2005) that the test of numbers, which is a subtest of the RAN application is a significant predictor of the reading rate and reading accuracy. In another more detailed study, the reading rate and reading accuracy were found highly related to pausing time, which is also in the RAN test (Georgiou, Parrila, & Kirby, 2006).

While explaining the relationship between RAN and reading, Wolf and Denckla (2005) suggest that both skills use similar mental skills. From this point of view, it can be said that the mechanism of visual recognition and pronunciation is similar in both RAN and reading. The main difference between the two skills is that the fluency is better seen in the texts with the effect of estimation, and the text hints that will create this effect cannot be seen in RAN.

For fluent reading, it is essential that the text/sentence be read fluently and that the reader take care of the consistency in the text to obtain meaning (Pikulski & Chard, 2005). In RAN, the stimuli are in random order, and there is no rhythm required for fluency. The only criterion for the reader to be evaluated is quickly vocalize. In other words, the processes of contributing to the understanding of reading, such as estimation, punctuation, composition of meaning units, intonation and emphasis, is not found in RAN.

The studies investigating the relationship between RAN and reading accuracy and the reading rate have been conducted in several languages, and similar results have been achieved. For instance,

Song, Georgiou, Su, and Hua (2016) stated that there is a significant relationship between RAN and reading accuracy and the reading rate in Chinese, and based on the prevalence of the same relationship in other languages, they have argued that it has a universal quality. Yet, it is necessary to examine studies in other languages more closely to understand to what extent this universality prevails.

Studies Conducted in Different Languages

The first findings of rapid naming were obtained from studies in the USA (Denckla & Rudel, 1974, 1976). This raises the basic research question of what might be the case in other languages. For this reason, this section deals with studies on other languages. Especially in recent years, such studies have greatly contributed to the increasingly more powerful assertion of the relation between RAN and reading skills. In the studies carried out in different languages, subtests such as special letters and objects used in that language are adapted (Georgiou, Parrila, & Papadopoulos, 2016), or objects are used as they are in the original test (Ziegler et al., 2010). An important result achieved by the recent studies is that naming speed is independent from processes directly affecting reading, such as phonological awareness (Ibrahim, 2015).

Liao et al. (2015) found in their study performed in Mandarin, that RAN is related to reading accuracy. They also stated that RAN is partially related to reading fluency. Shirazi et al. (2014) stated in their study conducted for Farsi with dyslexic and non-dyslexic students, that naming speed is normally related to reading accuracy, but it is more strongly related to the reading rate than to reading accuracy. In a study conducted in the Korean language with students with reading difficulty, a relationship was found between oral reading fluency and word recognition and RAN (Kim et al., 2015). Similarly, studies have been conducted with Arabic which has different morphological characteristics, and it has been noted that RAN is an important predictor of word reading and reading comprehension (Layes, Lalonde, & Rebaï, 2017). Papadopoulos et al. (2016) used non-alpha-numerical characters in RAN measures and concluded that the RAN/reading relationship is not affected, and that RAN is one of the most important predictors of oral reading accuracy. Studies have been conducted in German, French, Finnish, Hebrew, Italian, Polish, Swedish, and Spanish, and it has been concluded that RAN has a role of predicting the reading skill (Norton & Wolf, 2012).

Nevertheless, RAN subtests exhibit differences in RAN's relationship with reading. For example, Ziegler et al. (2010) applied the original version of the RAN object test to participants from Holland, Portugal, Finland, Hungary, and France in their comparative study. In that study, they argued that the reading skill is likely to have a lower relationship with the RAN object test Than the RAN alpha-numerical tests and RAN is a universal, if not primary, factor in the prediction of reading.

While there are few studies on RAN on the Turkish language, a test development study was carried out by Bakır (2007) as a dissertation for measuring RAN in Turkish. In the study in question, four visual tests were found interrelated and it was stated that their interrelation was higher for numbers and for letters based on symbols (Bakır, 2007). In a study conducted by Demirtan (2017) in Turkish for students with reading difficulties, these students reached the result that they named objects, colors, letters and numbers for a longer period of time than students who were developing normally. Babayiğit and Stainthorp (2010) found that RAN tasks in a agglutinative language such as Turkish were a very reliable predictor of reading. Babayiğit and Stainthorp (2011) reported that RAN was a strong predictor of fluent reading in another study conducted with Turkish-speaking students in the Northern Cyprus. In another study conducted in Turkish, significant relationships were found between third-grade students' reading rates and reading accuracy skills and letter and number naming speeds (Keskin & Karadağ, 2017). Explored relationship between RAN findings and reading seems to be quite important. However, it is required to determine how RAN is related to reading comprehension rather than to the reading rate and accuracy in different languages; in other words, what RAN means in terms of reading comprehension skill.

RAN and Reading Comprehension

Another element investigated along with reading skills in RAN studies is reading comprehension. In recent years, several studies have been carried out to scrutinize the interaction

between RAN and reading comprehension. Weng, Li, and Li (2016) found a relationship between RAN (numbers) and reading despite not determining any mediatory effect in their study, research that investigated the mediatory role of visually driven memory in the RAN-/reading comprehension relationship. In the study performed by Christo and Davis (2008), it is stated that rapid naming is a stronger predictor of word reading and reading comprehension than the phonological process is. Considering that RAN is not composed only of letters, it is seen that morphological awareness also has a role in its relationship with comprehension (Layes et al., 2017). Accurate perception and rapid enunciation of RAN stimuli are quite similar to the act of reading. Yet, reading accuracy and the reading rate maintain their weights in the RAN/reading connection. Indeed in their meta-analysis study, Araújo, Reis, Petersson, and Faísca (2015) concluded that the strongest relationship was between RAN and text and word reading while stating that RAN contributed to comprehension.

Extension of naming time in RAN has a negative impact on reading comprehension (Arnell, Joanisse, Klein, Busseri, & Tannock, 2009). In meta-analytical studies, it is noted that there is a positive but weak relationship between RAN and reading comprehension (Tighe & Schatschneider, 2016). However, the idea that the relation between RAN and comprehension is an indirect one is more weighty. Li, Kirby and Georgiou (2011) argue that RAN affects word recognition and reading fluency, therefore affecting the reading comprehension. The relationship, thus, is an indirect one.

One can have a better understanding of this indirect relationship when it is considered within the framework of the automatization theory of LaBerge and Samuels (1974). The contribution of reading rate and reading accuracy to comprehension occurs when the reader who has come to the automatization stage can make meaning of what he/she reads without breaking away from context. In other words, achieving the most appropriate reading rate and accuracy and becoming automatized, the students can read fluently and spare a great part of their cognitive capacity to comprehension (LaBerge & Samuels, 1974). Because they do not have problem with word recognition, they can read fluently and achieve reading comprehension through automatization (Pikulski & Chard, 2005). However, no research has been conducted for Turkish on whether RAN's contribution to comprehension occurs directly or through text and word reading. To meet this gap in the field, it is required to guage on what level basic reading skills mediate the relationship between RAN and reading comprehension. With this study, hence, the aim was to investigate the explanatory and predictive connections between RAN and reading and reading comprehension. To that end, answers to three questions were sought: 1) Is RAN a significant predictor of basic reading skill? 2) Is reading skill a significant predictor of reading comprehension? 3) What kind of a mediatory role does reading skill have between RAN and reading comprehension? An exogenous variable of the theoretical model is RAN, and its endogenous variables are reading and reading comprehension. The model is presented in Figure 1.

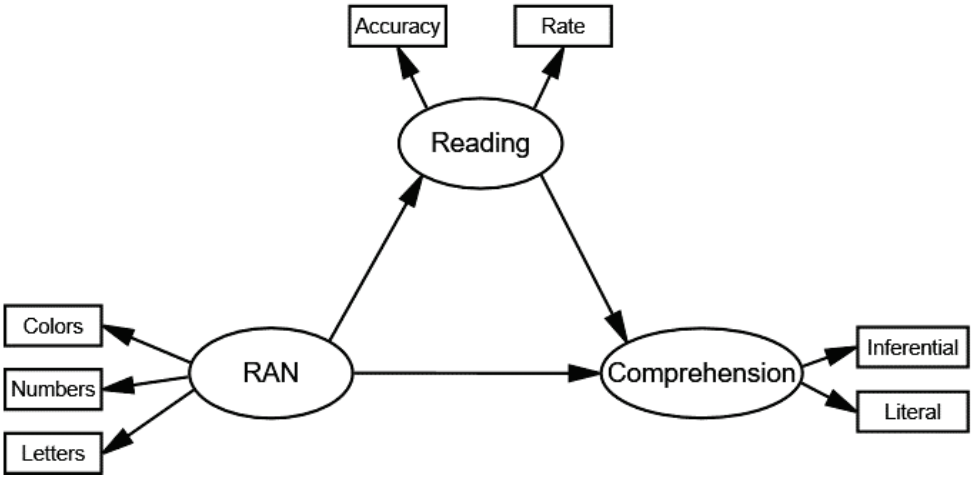

Figure 1. Theoretical Model

Method

Participants

177 primary school second-grade students (98 girls and 79 boys) attending a state primary school in a city center in the Western Black Sea Region of Turkey participated in this study. The average age of the students was 95.36 months (*SD*=4.27), and there were no students among them diagnosed with any mental problem. The school where the research was conducted was randomly chosen from schools in the city center. The school is in a neighborhood inhabited by people who are mostly public and private sector employees on a moderate socioeconomic level. For purpose of the study, it was important that the participants be from the same school. Considering that schools are clusters, it has been stated that students who study together in the same school tend to present a similar structure (Finch, Bolin, & Kelley, 2014).

Measurement Tools

Reading Comprehension

A so-called Informal Reading Inventory was used for measuring reading comprehension (Akyol, 2006). Open-ended questions about the text were asked of students who did reading according to the inventory to measure both their inferential and literal comprehension levels. The literal comprehension questions were WH questions for which answers could be found by the student within the texts. A sample question is: *"Who planted and watered the trees?"* The inferential comprehension questions require students to make inferences from the text they read. Example: *"Why would all living things hurt if trees became extinct?"* When grading the comprehension questions according to the inventory, fully-answered questions were rewarded 2 points, partially answered questions 1 point, and unanswered questions were rewarded 0 in literal comprehension. In inferential comprehension, fully answered questions were rewarded 3 points. If the answer was slightly incomplete but more than half of the expected answer, it was rewarded 2 points, partially answered questions 1 point, and unanswered were rewarded 0 (Akyol, 2006, p. 239). For the reading text, a text named "Trees Are Talking" (*"Ağaçlar Konuşuyor"* in Turkish) approved by MoNE and found in the second-grade textbook was used (Arhan & Coşkun, 2014). The textbook of this reading text was not used in the region of the study school.

Reading Rate and Reading Accuracy

The number of words read accurately in one minute was calculated for reading rate. For reading accuracy, the number of accurately read words was divided by the total number of words to obtain the reading accuracy rate. Such a measurement of the reading rate and reading accuracy is a reliable method frequently used in the field of reading (Deno, 2003; Shenker & Cockrum, 2014). The 121-word "White Pigeon and the Ant" (*"Beyaz Güvercin ve Karınca"* in Turkish) in the manual "Okumayı Değerlendirme" (Evaluation of Reading) prepared by Akyol, Yıldırım, Ateş, Çetinkaya, and Rasinski (2014) to evaluate reading at primary schools was utilized for evaluating the reading rate and reading accuracy.

RAN Subtests

In this study, three subtests of the original RAN test were used, including numbers, letters and colors. The colors subtest was comprised of five colors (blue, black, yellow, red, and green) and ran five rows in total with ten colors being randomly repeated in each row. In the numbers subtest, there were numbers in a total of five rows (2, 4, 6, 7, 9) with ten numbers in each row. Similarly, letters ran five rows in total with ten random letters (a, d, o, p, s) in each row for the letters subtest. None of the stimuli was repeated consecutively in any RAN test (e.g. a-a, p-p) (Wolf & Denckla, 2005). RAN subtests had a sufficient level of test/retest reliability (Colors = .90, Numbers = .92, Letters = .90) (Wolf & Denckla, 2005, p. 29).

Procedure and Analyses

Once the research permit was received from the Provincial Directorate of National Education in the province where the research was conducted, the administrators and teachers of the school were interviewed and informed of the study. From the school administration, a room was requested for conducting the tests, and so a separate room was allocated to the researchers. The classroom teachers were interviewed again right before the application and informed of the study format, and the students were summoned from their classrooms for the applications of RAN subtests in the allocated room. The students were subjected to the test individually in the first place. It was primarily explained to the students that this was not an achievement test, preliminary preparations were made in accordance with the descriptions in the RAN instruction, and tests were started in May 2017. The applications took two weeks. Before each test, each student was reminded of the descriptions in the evaluation form. Students' errors, omissions and self-corrections during the rapid naming were marked on the forms. The total application time for each test was measured separately with the Delta SW305 Chronometer, and the application was completed. Subsequently, the obtained data were converted to age-adjusted scores. In the second phase, each student was made read the text "White Pigeon and the Ant" orally, and the number of words read in one minute and the reading errors were identified. The number of errors was extracted from the total number of words read (TNWR) to achieve the number of words read accurately (NWRA). Next, the reading accuracy rate was calculated [(NWRA/TNWR) *100]. Efforts to measure the comprehension were managed by the researchers in the classrooms with the teacher's consent. Before the application, the students were told that the study was not an exam and that those who wished not to take part were excused participation. The students were given the reading text at first; After each student had completed the reading, the texts were collected, the comprehension questions were distributed, and the students were asked to answer them. Each 3 of these questions (6 in total) aimed to measure the literal comprehension and the inferential comprehension. The answers were evaluated by two different raters. The Pearson correlation coefficient between the raters in the total points was .86.

The Structural Equation Modeling (SEM) was used in the analysis of the data research. There were latent variables for the situations tested in the research. The use of latent variables in SEM allows for the determination of the error in the variables. Moreover, parameter values estimated were calculated in a more reliable way in SEM studies (Şimşek, 2007, p. 16). Normed Chi-Square (χ^2/df), Akaike Information Criteria (AIC), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Good Fit Index (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Incremental Fit Index (IFI) were considered in the evaluation of SEM results. Normed Chi-square indicates acceptable fit when lower than 5 and good fit when lower than 2. Similarly, The RMSEA value indicates acceptable with when lower than .08 and a perfect fit when lower than .05. If the SRMR value is less than .05, it indicates that the model-data fit is good. When values of GFI, CFI, TLI and IFI are above 95, it indicates that a model exhibits perfect fit (Byrne, 2009; Hu & Bentler, 1999; Jöreskog & Sörbom, 1996; Kline, 2011; Raykov & Marcoulides, 2006; Schumacker & Lomax, 2004; Sümer, 2000; Şimşek, 2007).

There were a few limitations to the research. First, the fact that research sample was from a single school and therefore its generalizability was limited can be shown as a threat to the external reliability. Yet, if students had been chosen from different schools, it would have reflected a variance due to the schools in the research environment. However, this limitation stemming from the sample should be mentioned. Another limitation is that the study was conducted only with second-grade students.

Results

Preliminary Analyses

First, descriptive statistics of the data were obtained (Table 1.) The results included mean and standard deviations of 7 variables for 177 students. Multi-variable normal distribution was investigated with AMOS (Arbuckle, 2014) to designate the method to be used in the model test, and the kurtosis z coefficient was achieved (z_{Kurt}=1.827). According to Bentler, this value being lower than 5 indicates that the data fit the multi-variable normal distribution (as cited in Byrne, 2009, p. 104). Next, Pearson's correlation test was performed to describe the interrelations of the variables, and the results are given in Table 1.

Table 1. Descriptive Statistics of Variables and Correlation Analysis Results

	M	*SD*	*Colors*	*Numbers*	*Letters*	*Rate*	*Accuracy*	*Literal*
RAN Tests								
Colors	98.05	12.23	-					
Numbers	106.77	11.22	.654**	-				
Letters	104.05	11.70	.592**	.711**	-			
Reading Skills								
Rate	70.23	24.29	.466**	.538**	.615**	-		
Accuracy	92.92	5.19	.327**	.401**	.516**	.776**	-	
Reading Comprehension								
Literal	2.78	1.75	.104	.040	.170*	.366**	.314**	-
Inferential	4.57	2.46	.161*	.222**	.336**	.326**	.275**	.183*

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

According to the results of the correlation analysis, other variables besides the RAN subtests had a positive relationship except for simple comprehension and Color and Number RAN subtests.

Examination of Mediation

For the mediation structure in the model, relations between the variables were examined in accordance with the mediation prerequisites by Baron and Kenny (1986). First, the regression relation between RAN and Comprehension was examined, and it was found to be significant (β=.44, p<.01). According to this result, one can mention the presence of a to mediation relationship (Şimşek, 2007, p. 23). Next, the relationship between RAN and Reading Comprehension was examined and found to be significant (β=.67, p<.01). In the third step, a regression equation between Reading and Comprehension where RAN was controlled was set. It was seen in this equation that reading was a significant predictor of comprehension (β=.86, p<.01) and that the regression coefficient between RAN and Comprehension greatly dropped and lost its significance (β=-.15, p=.201).

Analysis of the Structural Model

When analyzing the structural model, the Chi-square value was found to be significant. This result shows that the covariance matrices of population and sample were different ($\chi^2_{(11,\ N=177)}$ =24.63, p=.010). On the other hand, the RMSEA and SRMR values were found to be outside the acceptable range (RMSEA=.084>.08, SRMR=.0539>.05). The AIC value, which is an important indicator in the model comparison, was found to be 58.63.

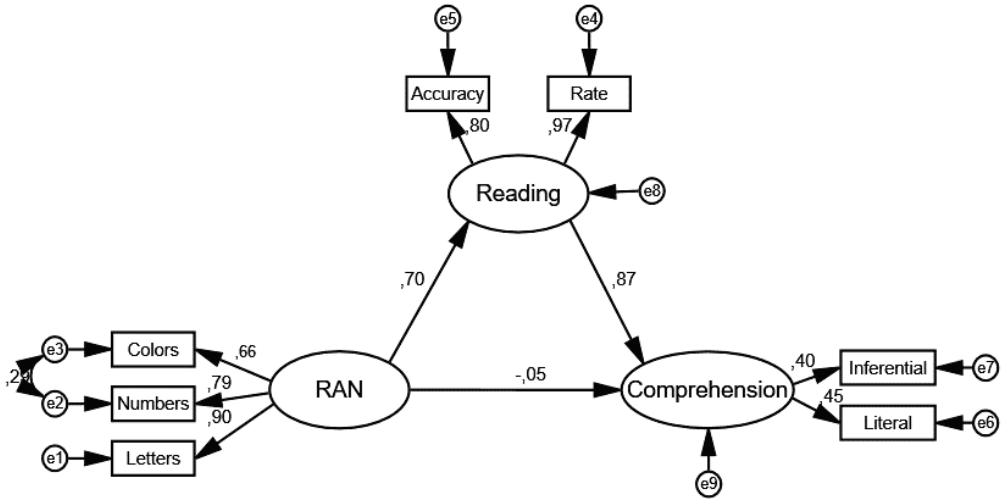

Figure 2. Structural Model

Following these results, error association was performed for the Colors and Numbers tests based on the modification suggestions for the model, and the analysis was repeated. After the association, χ^2, SRMR and AIC values seemed to improve (χ^2 (10, N=177) =18.288, p=.050, SRMR=.0447, AIC=54.28), and the RMSEA was within the acceptable limits (.069). Other indicators were reviewed, too, and it was observed that the model exhibited a good fit (χ^2/df=1.83 <2, GFI=.97, CFI=.98, TLI=97 and IFI=.98). As for the standardized direct effects, it was seen that RAN was a significant predictor of reading (β=.70, p<.01) and that reading was a significant predictor of comprehension (β=.87, p<.01). However, the relationship between RAN and comprehension was insignificant (β=-.047, p=.819>.05). It can be accordingly assumed that the latent variable of reading had the full mediatory effect in the model. In addition to the analyses, the full mediatory effect of the reading variable on the RAN-comprehension relationship was also confirmed with the Sobel test (z=3.372, p<.001). Regression weights of the model are given in Table 2.

Table 2. Regression Weights of the Structural Model

			Estimate (Std)	Estimate	S.E.	C.R.	*p*
Reading	<---	RAN	.702	1.571	.171	9.183	***
Comprehension	<---	Reading	.865	.029	.008	3.698	***
Comprehension	<---	RAN	-.047	-.004	.015	-.229	.819
Letters	<---	RAN	.903	1			
Numbers	<---	RAN	.786	.836	.083	10.127	***
Colors	<---	RAN	.659	.763	.092	8.335	***
Rate	<---	Reading	.973	1			
Accuracy	<---	Reading	.797	.175	.015	11.926	***
Literal	<---	Comprehension	.453	1			
Inferential	<---	Comprehension	.404	1.258	.350	3.590	***

****p< .05*

As for the regression weights of the structural model, it is seen that the relationship between RAN and comprehension (p>.05) while all other relationships are significant (p<.05). Direct, indirect and total effects of the model were reviewed in the next step (Table 3).

Table 3. Standardized Direct, Indirect and Total Effects of the Structural Model

Type of Effect		RAN	READ.	COMP.
Standardized Total Effects	READ.	.702	.000	.000
	COMP.	.560	.865	.000
Standardized Direct Effects	READ.	.702	.000	.000
	COMP.	-.047	.865	.000
Standardized Indirect Effects	READ.	.000	.000	.000
	COMP.	.607	.000	.000

According to Table 3, students' RAN skills directly and positively affected their reading skills. Their reading comprehension levels were directly and positively affected by their reading skills. RAN had an indirect effect on comprehension, and reading skills mediated this effect.

Discussion

This study aimed to explore the explanatory and predictive relations between RAN and Reading and Comprehension Skills on a structural model and to examine the mediatory status of reading skills in a possible relationship. It is especially important for Turkish to identify direct and indirect relationships between the variables of RAN, reading and comprehension because there are scarcely any studies within the scope of research on reading for Turkish that investigate the relationships between the variables addressed in this research. Considering the research results shown, it is argued that RAN had a directly predictive effect on the reading skill and the reading skill strongly predicted the comprehension skill. It was also concluded that the reading skill had a fully mediatory role between RAN and comprehension within the model.

When addressing the findings in order, it was primarily concluded that RAN predicted the reading skills. In other words, better RAN performance contributed to the increased reading rate.

How this contribution took place is related to how the RAN and reading processes took place. Wolf and Denckla (2005), the developers of the RAN test, conceptualized the relationship between reading and RAN as systems with overlapping perceptual, cognitive, linguistic and motoric processes. Both reading and RAN are based on the name of the images in a series. For example, a student who learns new reading makes a vocalization with the help of letters. For this reason, vocalization of the visual appearance is the main component in both reading and RAN tasks. It is essential that there is attention to the stimuli during this naming process. Then, the diagnosis is made by the bi-hemispheric visual processes responsible for pattern identification. Integrating visual characteristics and pattern information with stored orthographic representations after diagnosis, visual and orthographic representations are integrated with stored phonological representations. After this stage, comes access to phonological labels and the integration and activation of semantic and conceptual information with inputs. Then the motoric activation which leads to articulation is realized (Wolf & Denckla, 2005, p. 2). Interruption or deterioration at any stage of the above process also leads to deterioration of reading ability. The fact that RAN stands out as a predictor of reading skill is the operation of reading similar to the above process. For example, it is very difficult to predict a pupil's reading skill in preschool, as he has not yet learned to read. However, it is possible to estimate this by means of RAN, which operates with skills similar to reading.

In the study performed by Arnell et al. (2009), it was seen that the participants with low RAN performance had also low reading rates. Huff, Sorenson, and Dancer (2002) stated in the study conducted with third-grade students that the reading rate drops as the RAN time extends. Keskin and Karadağ (2017) found a significant relationship between RAN Numbers and Letters subtests and the reading rate in their study with third-grade students. Beyond the findings based on the

interrelationships in the previous studies, predictive results were also achieved. Wolff (2014) argued in the study performed with third-grade students, that RAN can be regarded as an important predictor in the early periods of reading. Lervag and Hulme (2009) stated that RAN wass an especially strong predictor of reading rate among poor readers. Babayiğit and Stainthorp (2010) in the longitudinal study also pointed out that RAN was a strong predictor of reading speed. Similarly, Díaz-Giráldez et al. (2014) concluded in their study investigating the predictive relationship between naming speed and reading accuracy skill that naming speed explains 13% of the variance in reading accuracy. Again, in the study performed by Kasperski et al. (2016), RAN explains about 21% of the variance in the reading rate. According to the results of this study, there was an importantly predictive relationship between RAN and reading skills. This result seems to be supported by the results of previous studies in the literature. On the other hand, the fact that it was achieved in a study conducted with children who speak Turkish as the mother tongue is a particularly important and new situation.

Another research result showed that reading skills were important predictors of reading comprehension. The findings in the literature also tend to follow this trend. Berninger, Abbott, Vermeulen and Fulton (2006) stated that accurate letter reading (decoding) predicted word recognition and that rapid automatized naming of letters predicted the reading rate. Similarly, in the longitudinal study carried out by Sénéchal and LeFevre (2002), reading comprehension levels of the students who acquired reading skills early and improved their word reading skills with the parental support were affected by this improvement. A relationship was found between word reading and understanding the word meaning and the reading comprehension skill in the relational study conducted by English, Barnes, Fletcher, Dennis, and Raghubar (2010). Johnston and Kirby (2006) stated that a great part of the variance in reading comprehension was explained by decoding. It is possible to suggest that accurate word reading is a prerequisite of reading comprehension. Another reading variable, reading speed, also contributes to a similar understanding because the speed gained through the speed of autonomy allows us to use our attention to understand text instead of decoding (Deeney, 2010). However, text is to be read at a suitable speed rather than reading as fast as possible (Akyol, 2006). These findings somehow confirm that accurate pronunciation of word and achieving an appropriate rate are required for reading comprehension available in the nature of reading because it is quite difficult to understand a word which cannot be read accurately. The reading rate is as important as reading accuracy as reading too fast or too slowly affects comprehension negatively (Akyol, 2006). Thus, the reading rate is recognized as one of the basic indicators of reading skills (Deno, 2003).

In the prerequisite analyses described by Baron and Kenny (1986) for the mediation test stage of the research, RAN was found to be a significant predictor of reading comprehension, but by adding the reading skills in the model, this prediction became insignificant. Similar results have been achieved in the predictive studies directly conducted in the literature. Christo and Davis (2008) concluded in their study with second- to fifth-grade students who had reading difficulty, that the number naming speed scores predicted the scores of spelling tests, word reading and reading comprehension. In another study performed with students who did not have any difficulty, naming speed was a low, but significant predictor of reading comprehension in fourth- and fifth-grade students (2% and 1.4% respectively) (Johnston & Kirby, 2006). It was seen that RAN had a distinctive effect on comprehension performances of individuals with or without reading difficulty. The results obtained from the students without a reading difficulty in this study bore resemblance to the results of previous studies. The remarkable point is that the prediction level was found to be significant and quite low (Arnell et al., 2009; Johnston & Kirby, 2006) or insignificant (Wolff, 2014) in the predictive relationship between naming speed and reading comprehension in certain studies.

Hence, it is understandable how the relationship between RAN and comprehension became insignificant as mediatory variables in the study with the addition of reading skills in the model. One can have a better understanding of the case once it is addressed in terms of the meaning-making process in reading. The process of recognizing letters/words seen and transferring them in meaningful units to the mind during reading runs dynamically, which leads to meaning making (Güneş, 2013). The operation of RAN is somehow a simpler version of the reading act because meaning is made and orally expressed right after a stimulus has been seen.

The mental processes used during rapid naming are, in a way, a lower representation of the mental processes used in reading. At the core of this process, is the conversion of visually presented stimuli into a verbal production. For smooth reading skills, these processes must work without any problems. Especially the fast naming of the letters in RAN is a dimension which can predict the quality of reading performance in early period. The fast reading of letters and thus words is an important point for fluent reading (Wolf & Denckla, 2005). At this point, while fluent reading is a strong predictor of reading comprehension (Pikulski & Chard, 2005), the importance of RAN, which can predict fluent reading skills in the early stages, is better understood.

In an overview of the research results, it is seen once again that the reading rate and accurate word recognition are critical for a qualified skill of reading/comprehension. This is because RAN is regarded as a cognitive process underlying efficient word recognition, itself an inseparable element of the reading-comprehension process (Scarborough, 1998). To put it more conceptually, it can be argued that naming speed is an important skill which paves the way for the development of a qualified comprehension skill. The research results, as stated by Scarborough (1998), showed that RAN was a cognitive process underlying the efficient word recognition by positioning the reading accurately in the RAN-comprehension relationship within the tested model. In other words, in the reading comprehension process, the RAN skill plays a role that increases the quality in the reading skills as well as being an indicator alone. Hence, diagnosing students' RAN skills at early ages can provide an indicator for their reading comprehension performances, and the diagnosis can be used for preventing possible problems in the future. This is because delayed reading development among children may have a negative impact on the development of intellectual skills such as recalling, thinking, analyzing, synthesis, selection, and sorting. In terms of economy, taking precautions even before the problem emerges is considered more economic than its elimination after its emergence.

On the other hand, the fact that this study will add Turkish to the studies that reinforce the RAN/reading relationship and have been conducted in other different languages that turn into universal findings, is one of its basic attainments. Investigation of the matters such as what other variables can be found in the RAN-reading-comprehension relationship and what the prediction levels can be and to what extent a similar model can be confirmed among children who learn multiple languages is one of the main recommendations of this study.

It is necessary to test and extend the research results for different grade and age levels with similar models so that a Turkish RAN test may be developed by taking into consideration the vocalization time and frequency of the words in Turkish. Obtaining similar results in different studies is quite important in that more distinct information and implications can be put forth at and particularly for the Turkish language. Such importance can be directly related to the fields of early reading and writing instruction and Turkish teaching since teachers expect comprehension to occur on the highest level in reading activities. Identifying and assisting the students who perform poorly in the chain of RAN/Reading Skills-Reading Comprehension can help imporve the quality of their academic lives.

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