



Relationships among Reading Fluency, Rapid Automatized Naming and Phonemic Awareness in a Transparent Language

Soares AJC^{1,*} and Wertzner HF²

*1*Department of Communication and Hearing Sciences, Universidad Federal de São Paulo, UNIFESP, Brazil

*2*School of Medicine of the University of São Paulo, Physiotherapy, Speech-Language Pathology and Audiology, and Occupational Therapy Department, Brazil

*Corresponding author: Soares AJC, Department of Communication and Hearing Sciences, Universidad Federal de Sao Paulo, UNIFESP, Brazil; E-mail: ajcsoares@unifesp.br

Abstract

Background: Given that most studies about cross-language differences in reading have focused on European orthographies, much less is known about what occurs in orthography of other regions or also, in those that varies from European languages, such as Brazilian Portuguese. Hence, the present study aimed to investigate the relationship between reading fluency, rapid automatized naming and phonemic awareness in a transparent orthography.

Methods: The study included 29 elementary public-school children from 3rd grade and 28 from 4th grade, for a total of 57 children speakers of Brazilian Portuguese with mean age of 8.5. They underwent assessment regarding Rapid Automatized Naming (RAN), Phonological Awareness (PA) and Reading.

Results: The data indicated that PA and RAN are associated with reading fluency. However, this correlation varied according to schooling advancement. Both reading rate and accuracy were higher for G2 than for G1.

Conclusion: This research contributes to essential knowledge and provides a better understanding of reading acquisition, expanding our vision regarding the relationships of reading fluency, PA and RAN in order regions of the reading transparency-opacity level.

Keywords: Reading; Reading assessment; Phonemic awareness; Rapid automatized naming; Reading fluency

Introduction

The double route reading theory model has been studied by several authors either in isolation or in relation to the orthographic features of languages studied worldwide [1-4]. As a result of these investigations, depth orthography theory emerged, postulating that, in addition to the double reading route, the orthographic characteristics of idioms also play an important role in reading development of children [5,6]. According to this perspective, in alphabetical languages, regardless of orthographic depth, reading development starts in phonological skills and is followed by orthographic representations, which renders the reading process more efficient [1-7]. Moreover, it has been noted that phonemic awareness (PA) plays a large role in reading fluency (i.e. reading with proper rate and accuracy) development in languages with transparent orthographies, such as Finnish and

Dutch [2-8]. Despite these findings, some authors claim that PA influence may vary according to schooling advances; also, it has been noted that in transparent orthographies, such influence is mainly observed in the early stages of reading and tends to decrease as schooling advances, while the opposite effect was verified in deep orthographies [8,9]. According to this perspective, in alphabetical languages, regardless of orthographic depth, reading development starts in phonological skills and is followed by orthographic representations, which renders the reading process more efficient [1-7]. Moreover, it has been noted that phonemic awareness (PA) plays a large role in reading fluency (i.e. reading with proper rate and accuracy) development in languages with transparent orthographies, such as Finnish and Dutch [2-8]. Despite these findings, some authors claim that PA influence may vary according to schooling advances; also, it has been noted that in transparent orthographies, such influence is

Received date: 14 November 2023; **Accepted date:** 20 November 2023; **Published date:** 27 November 2023

Citation: Soares AJC, Wertzner HF. (2023). Relationships among Reading Fluency, Rapid Automatized Naming and Phonemic Awareness in a Transparent Language. SunText Rev Pediatr Care 4(1): 141.

DOI: <https://doi.org/10.51737/2766-5216.2023.041>

Copyright: © 2023 Soares AJC, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

mainly observed in the early stages of reading and tends to decrease as schooling advances, while the opposite effect was verified in deep orthographies [8,9]. Given that most studies about cross-language differences in reading have focused on European orthographies, much less is known about what occurs in orthographic of other regions or also, in those that varies from European languages, such as Brazilian Portuguese. Thus, we believe that the findings in such languages could expand the knowledge of reading acquisition and the skills related to it in a cross-linguistic manner, including orthographies and variations that is not often explored. Moreover, the findings of the current study may contribute for a knowledge enlarging concerning the studied variables both in relation to reading features (rate and accuracy) and to the orthographic features of a language that share similarities with a European language, but which also has exclusive characteristics [8,13,14]. We hypothesize that since Brazilian Portuguese is a transparent orthography, we will find stronger relations between PA and reading fluency than the observed between the former and RAN. It is worth mentioning that Brazilian Portuguese is considered more transparent toward the grapheme to phoneme than the reverse way since it presents only three graphemes that may be considered irregular [15]. Although Brazilian Portuguese orthography shows a range of consistent and inconsistent grapheme-to-phoneme relations, the inconsistent ones are organized in rules in which they are dependent on the grapheme context (i. e the grapheme “g”, for example, a grapheme that its sound representation depend on the subsequent vowel in the word (e.g. either /ʒ/ in gelo /'zelo/ (ice) or girafa /ʒi'rafa/ (giraffe) and /g/ in gato /'gato/ (cat) or gorro /goxo/ (cap). Just a few part of those inconsistent rules are irregular, that is, does not follow any rule and it comprises only three grapheme¹⁵ (i.e the graphemes “e” and “o” when not marked by diacritics (e.g. /ɛ/ in /ele /'ele/ (name of the letter “l”) and /e/ in ele /'ele/ (he); “gosto” may be read as ['gostu] (taste) and [ˈgøstu] (like); and the grapheme “x” between vowels where it may represent three sounds (e.g. /ʃ / in abacaxi/abaca'ʃi/ (pineapple), /s/ in máximo /'masimo/ (maximum) and /z/ in exame /ezãme/ (exam). Hence, the present study aimed to investigate the relationship between reading fluency, rapid automatized naming and phonemic awareness in a transparent orthography.

Methods

This study was approved by the Ethics Committee of the Institution. All of the parents/caretakers signed the Free Informed Consent Term to allow their children to participate in this research. The study included 29 elementary public-school children from 3rd grade (G1) and 28 from 4th grade (G2), for a total of 57 children speakers of Brazilian Portuguese. The mean age of the children in G1 was 8.5 years old, and the group

included 16 boys and 13 girls; G2 consisted of 12 girls and 16 boys with a mean age of 9.3 years old. It is important to emphasize that in Brazil, according to the Education Minister, children are expected to be literate at the end of 3rd grade. Thus, the present study involved typically developed children in early literacy in Brazil. To compose the sample, the following inclusion criteria were considered: lack of hearing, cognition or vision impairment; absence of previous communication disorders in either oral or written language; lack of concern regarding the child's learning process or current academic performance; proper scores on an oral phonological assessment standardized to Brazilian Portuguese [16]. And expected performance on a Brazilian test of academic school skills [17].

Data Collection

Reading rate and accuracy

From a group of texts specified for each elementary grade in Brazil withdrawn from a standardized test (Saraiva et al. 2009), one text was selected to assess G1 and another to assess G2. It is noteworthy to mention that several researchers claim that using texts according to the grade level of the students is the most adequate way of assessing reading [18,19]. Additionally, concerning reading assessment, there is wide variety of procedures used to assessing it in a wide range of studies in the field [19,20]. The children were asked to read the texts aloud, and their reading was recorded on video. The reading rate was counted by calculating the participants' number of words read per minute. Concerning reading accuracy, we considered all of the phoneme-grapheme correspondences and also the orthographic rules of Brazilian Portuguese. Accuracy was verified as the percentage of words correctly read.

RAN

RAN was assessed using the Comprehensive Test of Phonological Processing (CTOPP), which consists of four subtests: letters, number, objects and colours. We chose this test because there is a Brazilian Portuguese version adapted by two authors [21,22]. The test application followed the authors' instructions [23].

Phonemic awareness

All children underwent the Consciences Phonological: Instrumental de Avaliacao Sequential, a Phonological Awareness test standardized to Brazilian Portuguese, to assess their phonemic skills [24]. The test involves the recognition and manipulation of phonemes in seven tasks presented at an increasing level of difficulty, including producing a word that starts with a defined phoneme, identifying a word's initial phoneme, phoneme exclusion, and split and mixed phonemes.

Statistical analysis

To compare PA performance, the time spent on RAN, reading rate and accuracy (for both measures), the Mann-Whitney test was applied for both groups. A nonparametric test was used because the normal probability graph of these variables indicated

a deviation from a normal distribution. All of the errors in each group of RAN stimuli for both groups of children were compared, considering that the number of errors had a Poisson distribution. Spearman’s correlation coefficient was applied to verify the correlations among reading fluency, PA and RAN.

Table 1: Descriptive analysis of reading rates, percentage of syllables correctly read and phonemic awareness performance by G1.

Measurement	Group	N	Mean	Standard deviation	Minimum	Median	Maximum
Syllables read per minute	G1	29	60,1	27.4	17.3	55.2	134
	G2	28	60,2	24.4	20.1	60	108
% Syllables correctly read	G1	29	85.9	9.5	59.7	89.1	94.5
	G2	28	95.7	2.0	91.1	95.8	98.8
Phonemic Awareness	G1	29	21.5	4.2	13	21	28
	G2	28	23.6	4.6	14	26	30

Table 2: Time spent naming RAN and its errors for G1 and G2.

RAN- Time spent naming	Group	N	Mean	Standard deviation	Minimum	Median	Maximum
Objects	G1	29	88.0	18.2	61	82	138
	G2	28	84.4	22.7	56	77	137
Letters	G1	29	51.1	12.4	35	47	84
	G2	28	45.8	11.6	30	45.5	74
Numbers	G1	29	48.0	10.3	36	44	78
	G2	28	41.5	9.4	28	41	73
Colors	G1	29	95.7	23.2	62	92	174
	G2	28	92.2	24.8	42	89.5	169
RAN - errors							
Objects	GP1	29	1.5	1.3	0	1	4
	GP2	28	2.1	3.3	0	1	13
Letters	GP1	29	1.0	1.5	0	0	5
	GP2	28	0.7	1.2	0	0	5
Numbers	GP1	29	1.1	1.1	0	1	4
	GP2	28	0.3	0.7	0	0	3
Colors	GP1	29	3.7	2.0	0	4	8
	GP2	28	3.4	3.4	0	2	12

Table 3: Spearman’s coefficient correlations among RAN, PA and reading fluency.



		G1				G2			
		Reading rate		Accuracy (%)		Reading rate		Accuracy (%)	
Variables		Words read per minute		Words		Words read per minute		Words	
Phonemic Awareness	r	0.14		0.49		0.22		0.38	
	p	0.486		0.007		0.258		0.046	
	N	29		29		28		28	
Times spent on RAN									
OBJECTS	r	-0.39		-0.12		-0.71		-0.35	
	p	0.037		0.542		<0.001		0.067	
	N	29		29		28		28	
LETTERS	r	-0.9		-0.08		-0.79		-0.51	
	p	0.007		0.667		<0.001		0.005	
	N	29		29		28		28	
NUMBERS	r	-0.19		-0.24		-0.77		-0.59	
	p	0.325		0.210		<0.001		0.001	
	N	29		29		28		28	
COLORS	r	-0.43		-0.01		-0.66		-0.40	
	p	0.021		0.968		<0.001		0.037	
	N	29		29		28		28	
ERRORS IN RAN									
OBJECTS	r	-0.28		-0.37		-0.26		-0.04	
	p	0.145		0.051		0.181		0.838	
	N	29		29		28		28	
LETTERS	r	-0.01		-0.04		-0.10		0.08	
	p	0.974		0.843		0.628		0.694	
	N	29		29		28		28	
NUMBERS	r	-0.08		-0.32		-0.20		0.02	
	p	0.681		0.089		0.305		0.905	
	N	29		29		28		28	
COLORS	r	0,00		-0.41		-0.16		-0.05	
	p	0.996		0.029		0.420		0.819	
	N	29		29		28		28	

Table 4: Regression analysis in relation to the main variables Reading Rate and Accuracy versus PA and RAN (time spent naming and errors) in 3rd grade.

Main Variables	Model-variables	Coefficient	Standard error	p	Relating variables	p
Syllables read per minute	Intercept	181	30,5	<0,001	PA	0,401
	RAN-letters	-1,4	0,58	0,016	Objects	0,575
					RAN- Numbers	0,401
					RAN- Colours	0,430
					RAN- Objects (errors)	0,342
					RAN- Letters (errors)	0,368
					RAN- Numbers (errors)	0,936

					RAN-Colours (errors)	0,803
Word-reading accuracy	Intercept	68	7,1	<0,001	RAN- Objects (time)	0,795
	PA	0,9	0,32	0,006	-RAN Letters(time)	0,624
					RAN-Numbers (time)	0,453
					RAN-Cores (time)	0,352
					RAN-Objects (errors)	0,075
					RAN-Letters (errors)	0,358
					RAN-Numbers (errors)	0,254
					RAN-Colours (errors)	0,159
Reading accuracy	Intercept	82,73	2,97	<0,001	RAN-Objects (time)	0,638
	PA	0,33	0,13	0,013	RAN-Letters (time)	0,667
	RAN-Numbers (errors)	-1,55	0,50	0,002	RAN-Numbers (time)	0,575
					RAN-Colours(time)	0,667
					RAN-Objects (errors)	0,484
					RAN-Letters (errors)	0,271
					RAN-Colours (errors)	0,271

Legend: RAN – Rapid Automatized Naming; PA – Phonemic awareness.

Table 5: Regression analysis in relation to the main variables Reading Rate and Accuracy versus PA and RAN (time spent naming and errors) in 4th grade.

Main Variables	Model-variables	Coefficient	Standard error	p	Relating variables	p
	intercept	343,4	22,9	<0,001	PA	0,865
Syllables read per minute	RAN-letters	-4,30	0,49	<0,001	RAN-Objects(time)	0,653
	RAN- Objects (errors)	-9,30	2,40	<0,001	RAN- Numbers (time)	0,424
	RAN- Colours (errors)	4,82	2,33	0,036	RAN- Colours (time)	0,944
					RAN-Letters (errors)	0,944
					RAN-Numbers (errors)	0,298
Word-reading accuracy	Intercept	100,74	1,45	<0,001	PA	0,087
	RAN-numbers	-0,11	0,03	<0,001	RAN- Objects (time)	0,667
					RAN-Letters(time)	0,660
					RAN- Colours (time)	0,289
					RAN-Objects (errors)	0,719
					RAN-Letters (errors)	0,624
					RAN-Numbers (errors)	0,234
					RAN-Colours (errors)	0,857
Reading accuracy	Intercept	90,6	1,2	<0,001	RAN-Objects (time)	0,624

	RAN- numbers	-0,03	0,02	0,023	RAN – Letters (time)	0,131
	RAN-numbers (errors)	0,51	0,24	0,032	RAN- Colours (time)	0,873
	pa	0,07	0,03	0,033	RAN-Objects (errors)	0,865
					RAN- Letters (errors)	0,162
					RAN- Colours (errors)	0,503

Legend: RAN – Rapid Automatized Naming; PA – Phonemic awareness.

All of the coefficients were separately compared within each group. To compare intragroup and intergroup reading accuracy, we applied variance analysis with repeated measures; when differences were found in the analysis, and p-values were standardized by Bonferroni’s procedure. In hypothesis testing, the significance level was 0.05. Regarding regression analysis, it was considered reading rate and accuracy as main variables and the PA and RAN as the relating variables. Initially, the models were adjusted using the least squares method and the assumptions of normality and equality of variances in the error of the models and they were checked by residuals analysis investigation. As this analysis pointed to the existence of aberrant values, the analysis was redone considering a robust adjustment method. In adjusting the models, the forward variable selection method was adopted. Adjustments were made separately for the third and fourth years. In the hypothesis tests, a significance level of 0.05 was set. The rim routine of the R application was used to adjust the models.

Results

In this section, we show the statistical analysis of the obtained data regarding the performance of both groups in each test applied and the correlations in the data. Analysis and comparison of group performance based on the tests applied. Regarding reading fluency, specifically reading rate, the data in Table 1 showed similar results for words read per minute (p=0.930) in both groups. No significant difference was found between the groups. Concerning reading accuracy, the data showed that G2 presented a greater percentage of words read correctly, as shown in Table 1. Data also shows that both groups had similar scores for PA. It is important to note that there was a tendency toward significance in the data (p=0.054) because the p-value was very close to 0.05 (Table 1). Concerning the time spent to name the stimuli on the RAN test (sec), G2 performed better on all of the items (Tables 2-5). No statistically significant differences were found in the time needed to name objects (p=0.264), letters (p=0.162), and colours (p=0.604) between the groups. The children in G2 tended to require less time to name numbers (p=0.010) than the children from G1. Regarding the total errors in RAN, the results showed that the children in G2 tended to make more mistakes than the children in G1, as Table 5 shows. However, no significant differences were found in the total number of errors in naming objects (p=0.722), letters (p=0.374) and colours (p=0.506)

between the groups. The children in G2 tended to make fewer errors in naming numbers than the children in G1 (p=0.001).

Correlations between assessed skills

Table 3 shows the Spearman’s correlation coefficients for PA, RAN and both components of reading fluency. A positive significant correlation was found between PA and reading accuracy in both groups. Therefore, the better the PA performance was, the greater the reading accuracy. No significant correlations were found between PA and reading rate in G1 and G2. The correlation coefficients between the time spent to name objects, letters, numbers and colours and the components of reading fluency were greater for G2, which also had a higher number of significant coefficients. These coefficients were negative, indicating that the more time that was spent naming the RAN stimuli, the lower the reading rate and accuracy were. Letter naming was the item most strongly correlated with reading rate; number naming was more strongly correlated with reading accuracy in G2. There was a significant and negative correlation between errors in number and colour naming and reading accuracy only in G1.

Regression Analysis

In the first column of Tables 4 and 5, the main variables are identified. In the second, we present the relating variables selected to compose the final model of the adjustment process. The values of the coefficients of such variables and their respective standard errors are found in the third and fourth columns. In the fifth column of each Table, we present the p-values obtained in the tests of significance of the coefficients of the selected variables. Finally, the variables that were not selected are presented in the sixth column, and the p-values obtained in the coefficient significance tests are in the seventh column. It should be noted that the values of the coefficient of a main variable corresponds to the increase (or decrease, if the coefficient is negative) that is expected in the relating variables, when its scores raises one point and the remaining relating variables remain constant. Thus, there were similar results for the third and fourth year, in which a relationship is observed between reading accuracy, PA and the number of errors in RAN. The model used indicated that when we maintain constant the number of errors in the naming of numbers, each extra point scored in PA provides an



increase of 0.33% in reading accuracy for both groups. Similarly, when we maintain constant the PA score and increase an extra unit of error in the RAN of numbers, there is a 1.55% decrease in reading accuracy also for both groups.

Discussion

The data indicated that PA and RAN are associated with reading skills. However, this correlation varied according to schooling advancement. Both reading rate and accuracy were greater for G2 than for G1

Performance in Reading Skills, PA and RAN

Concerning reading rate, the groups showed similar means, and it is worth consider that the children in the present sample were in similar school grades (3rd and 4th), which might have favoured similar performance in reading activity. Concerning accuracy, the results suggested that the children in 3rd grade may have committed more mistakes in reading. It is important to highlight, however, that in a transparent orthography such results are not expected and may be related to the poor education levels in Brazil which may lead children to rely on the phonological routes for more than described in literature [4-18]. The children in G2, however, made a lower mean number of errors and seemed to be more familiar with the orthographic patterns of the language, suggesting that they typically used the lexical route [3-11]. Regarding phonemic awareness, the results showed similar means and standard deviations for both groups, assuring a steady pattern of scores for the children. Because the children in G1 and G2 were at different schooling levels, we expected to find significant differences in their scores, as some authors have previously claimed [10-20]. However, the statistical analysis showed a tendency toward significance that might have occurred had the sample been larger. Regarding RAN, the children in G2 required less time to name the stimuli and made fewer errors; however, no statistically significant differences were found. Both groups required more time to name colours and objects than letters and numbers. RAN has been studied for decades, and a broad range of studies have claimed that objects and colours require more time to be named than other stimuli. These stimuli demand the use of attentional, perceptive and visual processes to retrieve the larger lexical structure, which requires more time for rapid and sequential naming [7,8].

Correlation between the assessed skills

PA was correlated with reading accuracy in both groups, suggesting that this skill is extremely important for consolidating accurate reading in early Brazilian readers. Thus, PA contributes not only to reading acquisition but also to its improvement. These data are in agreement with different studies showing that explicit

teaching of the phonemes, as well as intervention programs that rely on phonological skills, results in great improvement in reading skills in alphabetic languages [4-27]. Such correlation found in Brazilian Portuguese and confirmed by the regression analysis, allows the speculation that PA might be essential not only for reading acquisition but also for its accuracy, leading to best practices regarding reading stimulation for struggling readers. These data provide evidence of the importance of PA both to acquisition and to reading improvement in alphabetical orthographies, mainly those that is transparent such as Brazilian Portuguese. Although no direct correlation was found between PA and reading rate, it is important to note that it is through PA that children acquire and establish letter-sound correspondences that help lead them to know and retain the orthographic patterns of the language, thus improving their reading rate [7-26]. Overall, it appears that PA is important early in reading acquisition, but when children reach the limits of their ability to decode words accurately, a shift occurs, and the relationship between RAN and reading becomes much stronger. The orthographic depth of the language dictates when this shift from reliance on phonology to fluency-related skills occurs; children reading more transparent languages shift away from phonology earlier in schooling [2-11]. Based on this hypothesis, data from the present study suggest that the behavioural patterns of Brazilian Portuguese readers differ from those observed in transparent orthographies in which the influence of PA tends to decrease as the advancement of schooling increases [8,9]. Thus, the present study suggests that PA skills also may play an important role throughout years of literacy in transparent orthographies. However, it is important to highlight that such results point to the need of further studies on this theme involving children from a larger range of scholar grades in order to confirm the relation between PA and the reading development throughout the scholar advancement. It is also important to point out that data from the present study indicates the need of cross-linguistic studies involving languages other than English and Europeans for a better understanding of how skills that underlie reading correlate to the particularities of each language in which children are literate. Regarding RAN, there were greater correlation coefficients with reading rate in G2. Several studies have shown the importance of RAN in the consolidation of orthographic reading, mainly in readers exposed to irregular words and in deep orthographies [4,5]. The present study expands this vision because it also provides evidence that RAN is also important to reading acquisition in a transparent orthography such as Brazilian Portuguese. These indicate that in a transparent orthography, RAN may play an important role such as that observed in a deep orthography such as English [6-9]. Similar results were reported when the relation between RAN and reading development of Greek children from the fourth grade, same grade of G2 from the present study, were studied [8-28]. Regression

analysis indicated that the errors in naming number were the most influential variable to reading accuracy, which confirms that alphanumeric tasks in RAN seems to be more related to reading than objects and colours because the former demand multiple lexicon access skills [29,30]. Noteworthy to mention that these data could be related to the Brazilian Portuguese orthography irregularity as previously mentioned in the introduction section. Such features of Brazilian Portuguese explain why the relation between RAN and reading occur, since in some words there is the need of rescuing the word as a whole because letter-to-sound rules would result in inaccurate reading. There is a hypothesis that indicate RAN has relations not only to orthographic processing but also to the phonological processing, which could explain its relation to reading acquisition in a transparent language such as Brazilian Portuguese [13]. It is important to emphasize that a research [7]. Reported similar results concerning the relationships among RAN, PA and reading fluency for European Portuguese, which is opaquer than the Brazilian. In the aforementioned study, PA was correlated with accuracy and RAN with reading rate. Thus, despite the differences between spoken European and Brazilian Portuguese in reading acquisition, both languages present, in particular manners, regularities and irregularities that led children to behave similarly in the literacy process. Thus, in both types of Portuguese, RAN and PA play essential roles for reading acquisition, also reinforcing the importance of both skills for languages more transparent than English. Additionally, a researcher noted a change in the pattern of associations of reading, PA and RAN from first to second grade, that is, an increase in most RAN correlations with reading fluency and a decrease in the associations among PAs. Hence, the author assumed that reading initially involves phonological processing, but as reading acquisition progresses, it involves other processes, such as lexical. In this regard, the data differ between dialects of Portuguese since PA was shown to be more important both to reading acquisition and to accuracy in later grades in Brazilian Portuguese, which was not observed in European Portuguese, much probably due the fact that Brazilian Portuguese is more transparent than the European. The data are relevant because they indicate that even in similar orthographies, relationships between reading fluency development and its underlying skills can vary. This indicate the need for further investigations to achieve results that can be generalized either to orthographies with extreme features or to those with intermediate features, and even in the same language as verified in the aforementioned differences between Brazilian and European Portuguese. The present study contributes to a better understanding of reading acquisition and to the processes and skills related to reading at different moments of acquisition of children from a non-European transparent orthography. These data are extremely important to enlarge knowledge in reading including languages that are not commonly

discussed in papers of the field. Additionally, data have indicated the importance of the stimulation of such skills throughout the grades and not only at the beginning in transparent languages.

Conclusions

There is important evidence that the data from the present study will expand our understanding of reading fluency, both in relation to its development and the skills that are correlated with it in a language of alphabetic bases. This research contributes to essential knowledge and provides a better understanding of reading acquisition, expanding our vision regarding the relationships of reading fluency, PA and RAN in a transparent orthography suggesting that there is a range of relationships between reading and PA and RAN that may vary according to the orthographic features of a language.

References

1. Lallier M, Valdois S, Lassus-Sangosse D, Prado C, Kandel S. Impact of orthographic transparency on typical and atypical reading development: evidence in french-spanish bilingual children. *Res Dev Disabil*. 2014; 35: 1177-1190.
2. Bar-Kochva I, Breznitz Z. Reading scripts that differ in orthographic transparency: a within-participant-and-language investigation of underlying skills. *J Exp Child Psychol*. 2014; 121: 12-27.
3. Van den Boer M, van Bergen E, de Jong PF. Underlying skills of oral and silent reading. *J Exp Child Psychol*. 2014; 128: 138-151.
4. Megherbi H, Elbro C, Oakhill J, Segui J, New B. The emergence of automaticity in reading: effects of orthographic depth and word decoding ability on an adjusted stroop measure. *J Exp Child Psychol*. 2018; 166: 652-663.
5. Deacon SH. Sounds, letters and meanings: The independent influences of phonological, morphological and orthographic skills on early word reading accuracy. *J Res Read*. 2012; 35: 456-475.
6. Caravolas M, Lervag A, Defior S, Seidlova Malkova G, Hulme C. Different patterns, but equivalent predictors, of growth in reading in consistent and inconsistent orthographies. *Psychol Sci*. 2013; 24: 1398-1407.
7. Albuquerque CP. Rapid naming contributions to reading and writing acquisition of European Portuguese. *Read Writ*. 2012; 25: 775-797.
8. Papadopoulos TC, Spanoudis GC, Georgiou GK. How is RAN related to reading fluency? A comprehensive examination of the prominent theoretical accounts. *Front Psychol*. 2016; 7: 1-15.
9. Moll K, Ramus F, Bartling J, Bruder J, Kunze S, Neuhoff N, et al. Cognitive mechanisms underlying reading and spelling development in five European orthographies. *Learn Instr*. 2014; 29: 65-77.
10. Furnes B, Samuelsson S. Phonological awareness and rapid automatized naming predicting early development in reading and spelling: Results from a cross-linguistic longitudinal study. 2011; 46: 564-574.
11. Grainger J, Dufau S, Ziegler JC. A vision of reading. *Trends Cogn Sci*. 2016; 20: 171-179.



12. Georgiou GK, Parrila R, Cui Y, Papadopoulos TC. Why rapid automatized naming is related to reading?. *J Exp Child Psychol.* 2013; 115: 218-225.
13. Araujo S, Reis A, Petersson KM, Faisca L. Rapid automatized naming and reading performance: a meta-analysis. *J Educ Psychol.* 2015; 107: 868-883.
14. Lima CF, Castro SL. Reading strategies in orthographies of intermediate depth are flexible: modulation of length effects in Portuguese. *Eur J Cogn Psychol.* 2010; 22: 190-215.
15. Scliar-Cabral L. Principles of the Brazilian Portuguese alphabetic system. 1st ed. Sao Paulo: Context. 2003; 250.
16. Wertzner HF. Phonology test. 1st. carapicuíba: pro-fono. 2004; 35.
17. Stein LM. School Performance Test. 1a. Sao Paulo: Psychologist's House. 1994; 187.
18. Petscher Y, Kim YS. The utility and accuracy of oral reading fluency score types in predicting reading comprehension. *J Sch Psychol.* 2011; 49: 107-129.
19. Solari EJ, Grimm RP, McIntyre NS, Denton CA. Reading comprehension development in at-risk vs. not at-risk first grade readers: The differential roles of listening comprehension, decoding, and fluency. *Learn Individ Differ.* 2018; 65: 195-206.
20. Stern JMB, Dubeck MM, Dick A. Using early grade reading assessment (EGRA) data for targeted instructional support: Learning profiles and instructional needs in Indonesia. *Int J Educ Dev.* 2018; 6: 64-71.
21. Rosal CAR. Phonemic segmentation skills in normal children in the first, second and third grades of elementary school. Universidade de Sao Paulo. 2002.
22. Simoes V. Study of the performance of children in the initial grades of elementary school in reading, writing and rapid naming tests. Universidade de Sao Paulo; 2006.
23. Wagner RK, Torgensen JK, Rashot CA. Comprehensive test of phonological processing. 1st ed. Austin: Proed; 1999; 199.
24. Moojen S, Lamprecht RR, Santos RM, Freitas GM, Brodacz R, Siqueira M, et al. Confidences- phonological awareness: Sequential assessment instrument. Sao Paulo: Casa do Psicologo. 2003.
25. Soares AJC, Carnio MS. Phonemic awareness in students before and after language workshops. *J Soc Bras Fonoaudiol.* 2012; 24: 69-75.
26. Pritchard SC, Coltheart M, Marinus E, Castles A. Modelling the implicit learning of phonological decoding from training on whole-word spellings and pronunciations. *Sci Stud Read.* 2016; 20: 49-63.
27. Van de Ven M, Voeten M, Steenbeek-Planting EG, Verhoeven L. Post-primary reading fluency development: A latent change approach. *Learn Individ Differ.* 2017; 55: 1-12.
28. Vaessen A, Blomert L. Long-term cognitive dynamics of fluent reading development. *J Exp Child Psychol.* 2010; 105: 213-231.
29. Savage R, Pillay V, Melidona S. Deconstructing rapid automatized naming: Component processes and the prediction of reading difficulties. *Learn individ differ.* 2007; 17: 129-146.
30. Narhi V, Ahonen T, Aro M, Leppasaari T, Korhonen TT, Tolvanen A, et al. Rapid serial naming: relations between different stimuli and neuropsychological factors. *Brain Lang.* 2005; 92: 45-57.