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Rapid Automatized Naming (RAN) and Vocabulary are significant predictors of reading in consisting orthographies: A comparison of reading acquisition procedures in Bulgarian and Spanish

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Abstract

Introduction. The present study provides description of two typologically diverse languages in origin (Slavic vs. Latin), script (Cyrillic vs. Roman), and internal structure. One of the similarities, between the two studied orthographies is that spelling-sound transparency is quite consistent in both languages. The goal of the present study was to offer a comparison of learning to read in these languages. Specifically, the study compared the importance of several predictors in the development of reading among children learning two consistent orthographies (Bulgarian and Spanish).

Method. A total of 157 children, native speakers of Bulgarian (n=80) and Spanish (n=77), were recruited from three public schools (one in Sofia and two in Madrid) located in middle-class areas. Correlational and regression analyses revealed that Bulgarian and Spanish data were fitted by the same predictors of passage reading efficiency and reading speed.

Results. The analyses showed that RAN-Letters played an important role in predicting reading fluency and passage reading efficiency among children in both languages. In addition, Vocabulary appeared to be a core component skill of reading comprehension, which was equally important for learners of both orthographies. Results showed that when equivalent reading predictors are assessed, the core components of fluency and higher level literacy skills (reading comprehension) appear to be very similar in both consistent orthographies.

Discussion and Conclusion. Theoretical and educational implications that highlight the importance of RAN and Vocabulary assessement and intervention in the first primary school years are discussed.

Keywords: cross-linguistic, reading, vocabulary, phonological awareness, rapid automatized naming, comprehension.

Resumen

Introducción. El presente estudio presenta la descripción de dos lenguas tipológicamente diferentes en origen (eslavo y latín), alfabeto (cirílico y romano) y estructura. Una de las similitudes entre las dos lenguas es que la transparencia entre la correspondencia grafema-fonema es muy consistente en ambas. El objetivo del presente estudio fue presentar una comparación del aprendizaje de la lectura en las dos lenguas. Concretamente, el estudio comparó la importancia de varios predictores en el desarrollo de la lectura en niños aprendiendo a leer en dos ortografías consistentes (Búlgaro y Español).

Método. Un total de 157 niños, hablantes nativos del búlgaro (n=80) y español (n=77), participaron en el estudio, procedentes de tres escuelas públicas (una en Sofía y dos en Madrid) localizadas en áreas de clase social media. Los análisis de correlación y regresión realizados muestran que los datos de los niños Búlgaros y Españoles en eficiencia y velocidad lectora-fueron explicados por las mismas variables.

Resultados. Los análisis realizados mostraron que la velocidad de nombrar letras (VN-L) juega un rol importante en la predicción de la fluidez y eficiencia lectora en ambas lenguas. Además, el vocabulario es la variable que mejor explica la comprensión lectora, igualmente importante para los aprendices en ambas ortografías. Los resultados mostraron que cuando se evalúan predictores de la lectura equivalentes, los componentes básicos de la fluidez y de habilidades superiores de la lectura (comprensión lectora) son muy similares en las dos ortografías consistentes estudiadas.

Discusión y conclusiones. Se discuten las implicaciones teóricas y prácticas que subrayan la importancia de la evaluación e intervención en la VN y el vocabulario en los primeros cursos de primaria.

Palabras Clave: comparación lingüística, lectura, vocabulario, conciencia fonológica, velocidad de nombrar, comprensión.

Introduction

The impact of variation between languages on the cognitive underpinnings for literacy acquisition and the development of reading and spelling skills, at different ages, has been well documented in cross-linguistic studies (Duncan et al., 2013; Ellis et al., 2004; Furnes & Samuelsson, 2009 and 2011; Georgiou, Torppa, Manolitsis, Lyytinen, Parrila, 2012; Katzir, Schiff, Kim, 2012; Miller Guron & Lundberg, 2004; Moll et al., 2014; Seymour, Aro, & Erskine, 2003; Ziegler et al., 2010). Koda & Zehler (2008) report in the introduction of the book "learning to read across languages" that theory of reading universals is critical because it specifies the learning-to-read requisites imposed on all learners in all languages. Therefore, by comparing how the requisite tasks are accomplished in diverse languages, we can identify the language-specific constraints and describe similarities and differences in learning-to-read experiences systematically across languages (p. 5).

Current evidence suggests that phonological awareness (PA) and rapid automatized naming (RAN), moderated by the language transparency, are two of the most important predictors to reading development (Alburquerque, 2012; Cardoso-Martins & Pennington, 2004; Furnes & Samuelson, 2009 and 2011). However, the relative importance of PA and RAN for reading development is an issue that is not yet resolved as it seems to depend on a range of factors such as the characteristics of the orthography, the age of assessment, and the type of reading task.

Numerous studies suggested a diminishing role of PA in reading of regular or consistent orthographies as reading is established (Furnes & Samuelson, 2010; Landerl &Wimmer, 2008; Nikopoulos, Goulandris, Hulme, & Snowling, 2006). In contrast, the results of the studies by Caravolas, Volín, & Hulme (2005); Caravolas et al., (2012); Spencer & Hanley (2003); Ziegler et al., (2010), pointed out to a strong and universal role of PA in reading beyond an early stage of reading acquisition.

RAN has also been related to reading of various scripts. Some findings suggested a larger role of RAN in reading in regular orthographies than in reading of irregular ones (Furnes & Samuelson, 2010; Georgiou, Parrilla, & Papadopoulos, 2008). Recent comparisons of the relations between RAN and reading of various European orthographies, showed, however, a significant and continuous role of RAN in fluency in reading consistent and inconsistent

orthographies (Caravolas et al., 2012; de Jong & van der Leij, 2002; Furnes & Samuelsson, 2010; Landerl & Wimmer, 2008; Vaessen & Blomert, 2010).

Specifically, in the Spanish orthography, the research done so far on PA and reading showed that PA is significantly associated to word reading accuracy during the first years of school (Calet, Gutiérrez-Palma, Simpson, González-Trujillo, & Defior, 2015; Suarez Coalla, Garcia De Castro, & Cuetos, 2013; Rodriguez, van den Boer, Jiménez, de Jong, 2015). Nevertheless, RAN, both alphanumeric (letter and digits), and non-alphanumeric (colors and objects) measures: (a) correlate and predict word reading accuracy during the first years of primary school in Spanish (López-Escribano, Suro, Leal, & Sánchez, 2014; Rodriguez et al., 2015); (b) are the best predictors of reading speed or fluency (see the review of studies on RAN and reading in Spanish done by López-Escribano, et al., 2014); and, (c) show a significant and higher relationship than PA to pseudoword reading accuracy, and this relationship remained stable from Grades 2 to 6 (see the study by Rodriguez et al., 2015). In the Bulgarian language the relationship among PA, RAN, and reading has been less investigated. The study by Shtereva (2013) showed that there is a significant relationship between reading speed, PA, and RAN.

To our knowledge, there are only a few cross-linguistic studies comparing relationships between cognitive and language skills to reading comprehension (Caravolas et al., 2005; Goodwin, August, & Calderon, 2015). The study by Caravolas et al., (2005) assessed reading in Czech-speaking children, for Grades 2 to 5, and in English-speaking children, for Grades 2 to 7, and suggested that both, vocabulary and digit span, correlated with reading comprehension in Czech, as well as, in English in a similar way. The study by Goodwin et al., (2015) compared reading in Spanish and English for fourth-grade Spanish-speaking English learners (ELs), the results suggested that morphological awareness, phonological decoding, and vocabulary contributed to reading comprehension in Spanish whereas only morphological awareness and phonological decoding contributed to reading comprehension in English.

One of the theoretical models of reading comprehension is the simple view of reading (Gough & Tunmer, 1986). According to this view, reading comprehension is a product of listening comprehension and decoding. In particular, numerous studies have proven that vocabulary, an important component of language comprehension, is the critical skill for reading comprehension as summarized in the National Reading Panel Report (National Institute of

Child Health and Human Development [NICHD], 2000). The study by Kim & Pallante (2012) investigated the predictors of reading comprehension in native Spanish-speaking first grade students showing that word reading, nonsense word fluency and vocabulary were positively and uniquely related to reading comprehension. As far as we know, reading comprehension has not yet been studied in relation to other reading variables such as PA, RAN or vocabulary in the Bulgarian language. The present research would be the first published study on reading comprehension related to other reading variables in the Bulgarian language.

These findings, across languages, are informative on literacy development and have important implications for assessment, and reading instruction. In itself, changes in the relationship of PA and RAN with reading are important, as they might reveal changes in the reading processes underlying reading in different scripts as development proceeds. Reading comprehension is a multidimensional ability and a variety of potential, cognitive, linguistic, and social factors are related to it. Few cross-linguistic studies have been performed on the examination of the effect of cognitive precursors on reading comprehension. The ultimate goal of reading development is efficient reading comprehension. Consequently, research is needed to understand the universals and language/orthography-specific predictors on the acquisition of reading comprehension.

In the writing systems of Bulgarian and Spanish, the relationship between symbol and sound is highly consistent. These two languages are referred to as consistent or shallow orthographies. The Bulgarian and Spanish languages, are characterized by their very regular orthographic code and consistent grapheme-phoneme correspondence.

The Bulgarian language

The Bulgarian writing system has transparent, clear orthography in the relation between sound and letter. The number of graphemes is 30. An important feature is that in the Bulgarian writing system and alphabet there is an established syllabic principle of writing, historically following the Russian model, characterized by the presence of glide plus vowel; namely, combinations of a palatal consonant and the vowel a /a/ or y /u/ are transmitted in Bulgarian writing system as the letters я and ю – тя [tʲa], тюл [tʲul] (Boyadzhiev & Tilkov, 1999, p. 267).

In the sound construction of the Bulgarian literary language vowel phonemes compared with consonants are too limited in number. The number of consonantal phonemes in Bulgarian literary language is 39 and the number of vowels are 6. Notwithstanding their limited presence, vowel phonemes have broad participation in building the phonetic structure of the Bulgarian word. This is explained by the fact that with the emergence of vowel phonemes in syntagmatic plan there are no specific position limits, i.e. they can be realized at the beginning, at the end or in the middle of the word.

In Bulgarian phonological system, in middle position, consonants occur in two-, three- and four-consonants combinations. The combinations at the end of the word are limited in type, since in Bulgarian a word cannot end on palatal consonants except under special phonetic conditions (Boyadzhiev & Tilkov, 1999, p. 171). In the Bulgarian language, combinations of vowel plus a vowel are very rare and found mostly in foreign origin words. Combinations of three vowels in any position are impossible. The Bulgarian language is very rich in terms of morphological diversity. Words change, and form new words through a series of prefixes, suffixes and endings. Nouns change in gender, number, article and cases. Verbs have person and number agreement, tense, voice, and conjugation. Adjectives and numerals need to agree in gender and number depending on the word they define.

Teaching literacy in Bulgarian schools is carried out in the sound analytic-synthetic method (Daskalova, 1994, p. 224). Typical of the Bulgarian educational system is the simultaneous learning of the reading and writing script. Thus, the Bulgarian child is faced simultaneously with the studying of four written characters (two printed letters and two handwritten letters) for each letter, which in many cases are significantly different.

The Spanish language

Spanish is highly regular in its symbol-to-sound mappings for reading, though less so in its sound-symbol mappings for spelling. A consistent orthography in reading, such as Spanish, may not be as consistent in writing. That is, certain words contain phonemes that are represented by a variety of graphemes, with no phonological rule specifying the appropriate grapheme for the correct word spelling. For instance, the [b] sound is represented by the letters “b” and “v”.

In spoken Spanish there are five vowels and twenty-two consonants. There are also five digraphs «ch», «ll», «rr», «gu» y «qu». Syllables are the most consistent sub-lexical units in Spanish both for reading and for spelling (Carreiras, Álvarez, & de Vega, 1993; Carreiras & Grainger, 2004). In Spanish the syllable has clearly defined boundaries, and children learn to distinguish syllables, in particular the prototypical syllable of consonant followed by vowel (CV). There are nineteen types of syllables structures, the most frequent types are: CV as in "casa" [house]; CVC as in "palmas" [applause; clapping]; V as in "oso" [bear]; VC as in "andar" [walk]; CVV as in "agua" [water]; CCV as in "plato" [plate]; CVVC as in "guante" [glove]. The other rest of syllables are less frequent (Guerra, 1983).

Although Spanish may be viewed as a consistent orthography, is considered an inflected language. The verbs are potentially marked for tense, aspect, mood, person, and number. The nouns and adjectives are inflected for number and gender. Pronouns can be inflected for person, number, gender, and case, including a residual neuter. Reading instruction proceeds usually from smaller to larger units. It usually starts at 5 to 6 years. Thereafter, a synthetic phonics method is used to encourage phonological recoding of simple CV syllables that form simple words. Once children have established good letter-sound knowledge and have built and initial sight vocabulary, grapheme-phoneme correspondences include more complex syllables like CCV. The basic reading process is typically well established by the end of the first grade (Defior, Martos & Cary, 2002; Seymour et al., 2003)

The outlined similitudes between the Spanish and Bulgarian orthographies take us to the following question: to what extent do these similitudes in the degree of consistency, between the two languages entail similitudes/differences in reading acquisition procedures?

Objetives and hypothesis

As novel aspects, the present study examines a language, Bulgarian, that has not yet been reported in previous cross-linguistic studies, and investigates the precursors of reading comprehension development in both scripts. The main purpose of this study was to expand our understanding of cross-linguistic research on the predictive validity of potential critical skills for reading acquisition and reading comprehension, using data from first and second grade students in Spain and Bulgaria.

Assuming that Bulgarian and Spanish adhere to the alphabetic principle and are consistent orthographies, we hypothesize that reading should rely on similar component skills (Caravolas, 2006; Ziegler et al. 2010). The following research questions (RQ) and hypothesis (H) were considered:

RQ1: Do the similitudes in consistency between the two orthographies entail similitudes in reading acquisition procedures?

RQ 2: To what extent do phonological segmentation (PS) and RAN differentially influence different measures of literacy acquisition (passage reading efficiency, reading speed, and reading comprehension) at the beginning of reading acquisition?

H 1: Given the outlined similitudes in consistency between Spanish and Bulgarian, we expected to find similar patterns of relationship of PS and RAN in reading in both languages. In line with previous studies we hypothesized that the relationship of RAN with passage reading efficiency and reading speed will be higher than the relationship of PS with these variables in both languages.

RQ 3: Are there potential differences in how the *simple view of reading* is enacted in Bulgarian and in Spanish based on the similitudes in the transparency of the two languages?

H 2: We predict that vocabulary and measures related to word decoding will be related to and will account for a relative amount of variance in reading comprehension in both languages.

Method

Participants

One hundred and fifty-seven normally developing children participated in the study. The Bulgarian children were recruited from one primary public school in Sofia, and the Spanish children were recruited from two primary public schools in Madrid. Bulgarian group consisted of 80 children in grades 1 and 2, ranging in age from 6 years 6 months to 9 years (M = 8 years 2 months, SD = 7.41 months). The Spanish group consisted in 77 children in grades 1 and 2, ranging in age from 6 years 3 months to 9 years 1 month (M = 7 years 7 months, SD = 6.75 months). The mean ages of the samples varied in line with national differences in the age of commencement of formal schooling. The Spanish first grade children entered school at 6 years, while the Bulgarian first grade children entered school at 7 years. The samples were matched by grade, PS, and IQ (see Tables 1 and 2). In both countries schools followed a phonic approach to teaching reading in the early grades, that means that children learned the

sound of letters early in the school year and completed practiced letter-sound decoding. All participants were from predominantly a middle-class background, being their native languages Bulgarian or Spanish, with no documented cognitive, uncorrected sensory, or behavioral difficulties. All had nonverbal IQ scores in the normal range or higher (80 or above) for their grade on the KBIT test. Written informed consent was obtained from parents before testing.

Table 1. Number of children in each grade for each language group

Language	*First Grade*	*Second Grade*
Bulgarian		
N	24	56
Girls	16	25
Boys	8	31
Age (months)	88.9	102.2
SD	4.2	4.2
Spanish		
N	22	55
Girls	12	30
Boys	10	25
Age (months)	81.9	93
SD	4.7	4.6

Instruments

Rapid Automatized Naming (Letters and Objects) (RAN-L & RAN-O). This task was selected from the RAN /RAS test (Wolf & Denckla, 2005). The task is to, as quickly as possible, read or name 5 letter, or 5 objects that are repeated 10 times. These letters or objects are distributed across a page consisting of five rows and ten columns. It has 50 letters/50 objects in total. The test-retest reliability standard reported for this test is .90.

Phonological Segmentation (PS), is one of the task in the DST-J (Dyslexia Screening Test) by Fawcett & Nicolson (2011). It is administered to children between 6 and 11 years of age. This test assesses the ability to break down a word into its constituent sounds (syllables or phonemes) and to manipulate those sounds (for example "*say rosa* [rose] *without the s*").

There are 3 examples and 12 items (3 of them phonological segmentation of syllables and 9 phonological segmentation of phonemes – 3 at the end of the word- 3 beginning – 3 middle). Testing was discontinued after four consecutive errors were made. The participant's score was the number of correctly answered items. In Bulgarian the task was modelled after the Spanish version with comparable items and difficulty levels in both orthographies. The test-retest reliability standard reported for this test in Spanish is .76.

Passage Reading Efficiency (PRE) is one of the task in the DST-J (Dyslexia Screening Test) by Fawcett & Nicolson (2011). This test assesses *passage reading efficiency* by mixing nonsense words with real words in a passage (similar to Lewis Carroll's 'Jabberwock' poem). The text is 38 words long, 28 are words and 10 pseudowords. Time and errors are measured. The total score is made out of words read correctly 28 points (1 point per word), plus pseudowords read correctly (2 points per pseudoword) 20 points, plus 10 points if time of reading was less than 55 seconds. If time of reading was more than one minute, one point per every two seconds must be subtracted, to a total of 10 points. In Bulgarian the task was modelled after the Spanish version, with the same number and difficulty levels of words and pseudowords in both orthographies. The test-retest reliability standard reported for this test in Spanish is .90.

Picture Vocabulary (V) is one of the task of the Language Survey-Revised Woodcock-Muñoz Test by Alvarado, Ruef, & Schrank (2005). This test measures aspects of oral language, including language development and lexical knowledge. The task requires the subject to identify pictured objects. The test contains a few receptive vocabulary items at lower levels of difficulty, but it is primarily an expressive semantic task at the single word-level. The items become increasingly difficult as the objects pictured appear less and less frequently in the environment. It is administered to people between the ages of 2 years and 90+ years. The same pictures were used in Bulgarian and Spanish. Picture Vocabulary has a median reliability of .91 in the age 5 to 19 range.

Per-word oral reading time in connected text (RS). (*LEE, Reading and Writing Test in Spanish)* (Defior et al., 2006). To assess per-word oral reading time in connected text, we used LEE Reading Time in Connected Text. This task consisted of reading a text. The participants were asked to read aloud as fast and as accurately as possible a short text that consisted of 72 words. The text used in the experiment, "*Pupi"*, was taken from the "Test de

lectura y escritura en español" (LEE) [Reading and Writing Test in Spanish] (Defior et al., 2006). The text was meant for first and second grade students. Children's scores were the total time taken to read the story in seconds divided by the number of words, *words per second*. The Spanish version text was adapted to Bulgarian with the same topic, number of words and difficulty level.

Reading comprehension of connected text (RC) (*LEE, Reading and Writing Test in Spanish)* (Defior et al., 2006). To assess reading comprehension, we used the LEE Reading Comprehension Narrative Text. The text was read by the participants followed by a total of eight questions: three literal, three inferential, and two questions related to the structure of the text: identifying main ideas and the title of the text. This test was meant for children from Grade 1 to Grade 4. The Spanish version of this test was adapted to Bulgarian with the same number of words and topic. The test-retest reliability standard reported for this test in Spanish is .51.

KBIT (IQ) (the Brief Intelligence Test) (Kaufman & Kaufman, 2000). The nonverbal scale (matrices subtest) was used in this experiment. This test assesses the nonverbal, manipulative intelligence to obtain a nonverbal IQ. It is administered to people between 4 and 90 years of age. Studies of validity and reliability show that the reliability coefficient of this test varies by age range, but in no case is below that of .76.

Procedure

Children were tested by a native speaker (graduate students trained by the authors) of their respective languages in a quite room within the school over one session lasting an hour. Testing was performed individually and every task was preceded by verbal instructions, together with examples. Analysis was conducted on raw scores.

Datal Analysis

Descriptive statistics (mean and standard deviation) for all dependent variables were calculated. A t-test analysis was used to test the differences of the two populations means in the studied variables. For research questions 1 and 2 we employed correlation and regression analyses to examine the influence of several variables on the passage reading efficiency, reading speed, and reading comprehension. For question 2, a regression model was constructed. We explore mediators of reading comprehension by examining separately in each language

the unique contributions of oral vocabulary, phoneme segmentation, reading speed and RAN. All statistical analyses were perfomed using the SPSS Version 22 for Windows IBM® SPSS® Statistics).

Results

Descriptive Statistics

The descriptive statistics for IQ and literacy measures skills are presented in Table 2. Scores on most measures were normally distributed, and none of the test produced ceiling or floor effects (see Table 2). In both language groups, skewed distributions were found for the RAN-L task (positive skew). In the Bulgarian group a skewed distribution was found for the PS task (nonsignificant negative skew), and in the Spanish group for the PRE (negative skew). Although logarithmic transformations normalized the RAN-Letters distribution, the transformed values had no effect on any subsequent analyses; therefore, analyses on untransformed scores are reported.

To examine whether similar proficiencies in reading in the two examined orthographies were achieved, "*t*-test" were carried out for examining significant differences between the reading measures in the two samples. The *t*-test on the KBIT's manipulative IQ, and PS, confirmed that the two samples of children were indistinguishable in nonverbal ability and PS. The Bulgarian readers performance in RAN-O and RAN-L were significantly higher than the Spanish readers performance. However, the Spanish group tended to have significantly higher scores than did the Bulgarian group in PRE, RS, V, and RC.

The present study was not primarily designed to test for reliable mean comparisons and any differences in mean performance between countries should be interpreted with caution. The learning context is a factor adding complexity to the cross-linguistic relationship in literacy development and must be taken into account. These differences are probably due to different level of linguistic knowledge by the influence of the ways of teaching reading in the two countries.

Table 2. Means, standard deviations, ranges, and t-scores for non-verbal IQ, and literacy skills for Bulgarian- and Spanish-speaking children (N=80 & N=77 respectively)

	Bulgarian-speaking children		*Spanish-speaking children*		
	Mean (SD)	*Min-Max*	*Mean (SD)*	*Min-Max*	*t-statistics t (p)*
K-BIT (Non-verbal IQ) (standard score)	97 (7.8)	80 - 126	97 (8.9)	80 - 139	.60 (.490)
RAN-Letters (seconds)	29.62 (5.73)	18 - 56	38.93 (12.1)	21 - 82	6.2** (.000)
RAN-Objects (seconds)	54.41 (10.47)	35 - 85	58.22 (13.43)	34 - 104	1.9* (.050)
Phonological Segmentation (raw score, maximum = 12)	9.30 (2.14)	2 - 12	8.66 (2.86)	1 - 12	-1.6 (.116)
Passage Reading Efficiency (raw score, maximum = 58)	47.41 (10.1)	19 - 58	52.75 (9.36)	13 - 58	3.4** (.001)
Vocabulary (standard score)	111 (8.2)	91 - 139	127 (7.5)	107 - 160	6.1** (.000)
Reading speed (words per second)	1.01 (.48)	.10 - 2.24	1.17 (.46)	.12 - 2.08	2.2** (.026)
Reading comprehension (raw score, maximum = 16)	10.83 (2.47)	5 - 16	12.32 (2.52)	6 -16	3.7** (.000)

Correlation Analysis

To examine the relationship of RAN and PS to reading, correlations were computed separately for each language (see Table 3). A similar pattern of correlations was obtained across languages for most variables.

Age correlated significantly with PRE, V, RS and RC in Bulgarian, and with RAN-L and RAN-O, PRE, and RS in Spanish. Of primary interest were the correlates of RAN-L and PS with PRE and RS. RAN-L showed the highest associations with PRE and RS in both languages. RAN-O and PS also correlated moderately with PRE and RS in both languages. RC correlated significantly with all the reading variables in the Bulgarian language and with RAN-O, PS, V and RS in Spanish. The relationship between RC and V was the highest in both languages. Interesting to note is that the correlation between RAN-O and RC was stronger in both languages than the correlations between RAN-L and RC.

Regression Analysis

A series of hierarchical regression models were constructed to examine RQ1 and RQ2. Separate models were constructed with PRE, RS, and RC as the dependent variables. We first assessed PRE, a basic reading skill, then, we examined RS that it is argued to play a particularly important role in reading in consistent orthographies. RAN-L, RAN-O, and Phonological Segmentation were entered into these analyses as independent variables (see Table 4, Models A and B and Table 5, Models D and E). Finally, we assessed reading comprehension, to answer RQ2. RAN-L, RAN-O, and PS, V, and RS, were entered into these analyses as independent variables (See Table 4, Model C, and Table 5, Model F)

Models A and D evaluated the role of RAN-L, RAN-O and PE as predictors of PRE. There were just two unique predictors of PRE, in both scripts, (RAN-L and PS) with RAN-L being higher and to an equal degree in both Bulgarian and Spanish. Models B and E evaluated the role of RAN-L, RAN-O and PS as predictors of RS. There were just two unique predictors of RS, in both scripts, (RAN-L and PS) with RAN-L being higher and to an equal degree in both Bulgarian and Spanish. Models C and F evaluated the role of RAN-O, PS, V, and, RS, as predictors of RC. There were just three unique predictors of RC, in Bulgarian, (V, PS, and RAN-O), and just one unique predictor of reading comprehension, in Spanish (V) with V being higher and to an equal degree in both Bulgarian and Spanish.

Table 3. Correlations between the different measures in each language for Bulgarian-speaking children (N=80) and Spanish-speaking children (N=77)

Bulgarian (n=80)

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Age	__	.03	-.22	-.09	.02	.41**	.37**	.37**	.24*
2. K-BIT (Non-verbal IQ)		__	-.21	-.09	.02	.41**	.37**	.37**	.23*
3. RAN-Letters			__	.61**	-.31**	-.61**	.01	-.56**	-.24*
4. RAN-Objects				__	-.21	-.49**	-.04	-.43**	-.27*
5. Phonological Segmentation					__	.44*	.27*	.45**	.44**
6. Passage Reading Efficiency						__	.24*	.76**	.41**
7. Vocabulary							__	.30**	.57**
8. Reading Speed								__	.44**
9. Reading Comprehension									__

Spanish (n=77)

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Age	__	-.13	-.48**	-.42**	.14	.45**	.17	.37**	.17
2. K-BIT (Non-verbal IQ)		__	.04	.07	-.27*	.09	.52**	.02	-.15
3. RAN-Letters			__	.57**	-.40**	-.69**	-.24*	-.62**	-.11
4. RAN-Objects				__	-.55**	-.53**	-.45**	-.51**	-.40**
5. Phonological Segmentation					__	.01	.35**	.11	.41**
6. Passage Reading Efficiency						__	.32**	.66**	.22
7. Vocabulary							__	.29**	.55**
8. Reading Speed								__	.26**
9. Reading Comprehension									__

Table 4. Summary of Multiple Hierarchical Regression Results for Three Models for Bulgarian-speaking children (N = 80)

Step	*R*	*ΔR²*	*ΔF*
MODEL A			
(Unique variance in Passage Reading Efficiency predicted by RAN-Letters, RAN-Objects, and Segmentation)			
1. RAN-Letters	.62	.39	50.21**
2. Phonological Segmentation	.68	.07	32.62**
Excluded: RAN-Objects			
MODEL B			
(Unique variance in Reading Speed predicted by y RAN-Letters, RAN-Objects, and Phonologica Segmentation)			
1. RAN-Letters	.56	.32	36.66**
2. Phonological Segmentation	.64	.09	26.34**
Excluded: RAN-O			
MODEL C			
(Unique variance in Reading Comprehension predicted by RAN-O, Phonological Segmentation, Vocabulary, and Reading Speed)			
1. Vocabulary	.57	.32	38.02**
2. Phonological Segmentation	.64	.08	27.36**
3. RAN-Objects	.77	.03	20.85**
Excluded: RAN-Letters and Reading Speed			

Table 5. Summary of Multiple Hierarchical Regression Results for Three Models for Spanish-speaking children (N = 77)

Step	*R*	*ΔR²*	*ΔF*
MODEL D			
(Unique variance in Passage Reading Efficiency predicted by RAN-Letters, RAN-Objects, Segmentation, and Reading Speed			
1. RAN-L	.69	.48	69.95**
2. Phonological Segmentation	.75	.09	48.95**
Excluded: RAN-O			
MODEL E			
(Unique variance in Reading Speed predicted by y RAN-Letters, RAN-Objects, and Segmentation)			
1. RAN-L	.63	.39	48.09**
2. Phonological Segmentation	.68	.07	31.63**
Excluded: RAN-O			
MODEL F			
(Unique variance in Reading Comprehension predicted by RAN-Objects, Phonological Segmentation, Vocabulary, and Reading Speed)			
1. Vocabulary	.55	.30	32.22**
Excluded: RAN-L, RAN-O, phonological segmentation and reading speed.			

Discussion and Conclusions

The question at the center of this study was whether there were similitudes in the underlying skills of reading orthographies of similar consistency. This question was examined by testing readers of two consistent orthographies, Bulgarian and Spanish. Findings suggest that, readers in the Bulgarian and the Spanish language, approach reading similarly and rely on similar component skills in PRE, RS, and RC. RAN-L was the most important underlying skill for PRE and RS in both languages. The role of PS was also similar across the two forms of script. Notably, the relations between PS and PRE and RS in reading were somewhat weaker than those of RAN-L and reading.

These results stand well in line with previous studies indicating a significant role of RAN in reading in different languages (e.g., Chinese: Pan et al., 2011; Dutch: de Jong, 2011; Greek: Georgiou, Parrilla, & Papadopoulos, 2016; German: Landerl & Wimmer, 2008; English: Compton, 2003; Parrilla, Kirby, & McQuarrie, 2004; Norwegian: Lervåg & Hulme, 2009; Spanish: Lopez-Escribano, et al. 2012; Rodriguez et al., 2015).

Nevertheless, the interpretation of RAN and reading relationship remains controversial. The phonological processing, the orthographic processing, and the speed of processing accounts have been the most prominent theoretical accounts of the RAN-reading relationship (Georgiou et al, 2016; Lervåg & Hulme, 2009) However, recent studies that have investigated the nature of RAN with the goal of building better models of reading development, have pointed out that: (1) operationalizing orthographic processing and phonological processing measures with speeded measures strengthens their relationship with RAN, but does not reduce RAN's effects on reading fluency, suggesting that shared method variance is not the reason why RAN predicts reading fluency (Georgiou et al. 2016) (2) Preschool children with poor-auditory-neurophysiological responses to speech in noise showed significantly poorer RAN-Colors and RAN-O skills than their average peers (White-Schwoch et al. 2016) (3) RAN, measured with non-alphanumeric stimuli, before reading instruction begins, is a predictor of later growth in reading fluency in Norwegian children, but, there is no evidence of a reciprocal influence of reading fluency on the growth of RAN skill. The authors of this study suggested that RAN could tap neural circuits critical for the child's developing visual word-recognition system (Lervåg & Hulme, 2009).

According to the above previous recent findings, and the present study findings, on RAN and reading, our view is that RAN could tap critical neural circuits involved in the precise synchronization of auditory and visual reading stimulus that are critical for the development of accurate and fluent word recognition. In fact, brain-imaging studies of adult readers suggest that reading and object naming involve very closely relates sets of neural circuits (Price et al., 2006; Price & McCrory, 2005).

The overall results for RC for first and second grade students support the simple view of reading in the two transparent orthographies, as both V (a component of oral language comprehension) and PS (a word reading skill) were positively and simultaneously related to RC in both languages. Similarly, the relations of V with RC of the two languages did not differ significantly at this stage. The regression analyses showed that V explained a significant amount of variance in RC in both languages. However, PS and RAN-O seem to play more a role when reading in Bulgarian than in Spanish.

In the present study, such as in previous ones (Seymour et al., 2003), reading accuracy was close to ceiling by Grade 1 and 2 for Spanish-speakers, such that RC was not heavily influenced by differences in PRE and V was the most significant predictor of RC in Spanish. Previous studies have noted that as word reading becomes more efficient, oral language skills become the most significant predictor of reading comprehension (Catts, Adlof, & Weismer, 2006; Florit and Cain, 2011; Gough, Hoover, & Peterson, 1996).

Interesting to note, it is the relationship of RAN-O and RC. Although alphanumeric RAN does appear to be a better predictor of later reading than nonalphanumeric RAN (Compton, 2003; Bar-Kochva & Breznitz, 2014), nonalphanumeric RAN measured in prereaders, or/and in the first school years, has nevertheless, been shown to predict later reading (English: Parrilla et al., 2004; German: Landerl & Wimmer, 2008; Greek: Georgiou et al, 2016; Norwegian: Lervåg & Hulme, 2009; Spanish: Aguilar et al., 2010; Caravolas et al., 2012; Rodriguez et al. 2015).

As previous mentioned literature have shown, there is enough evidence that RAN alphanumeric, as well as, non-alphanumeric measures are good predictors of reading in transparent orthographies. It is our view that RAN nonalphanumeric measures could provide additional information, to RAN alphanumeric measures, in the early prediction of reading in con-

sistent orthographies, as the present study have shown. The findings of our study have possible implications for assessment and instruction, but it is important to note all recommendations are made with caution as our study is correlational in nature.

The main findings in our study were that, whether in consistent orthographies, RAN-L, RAN-O, and V played a key role in PRE, RS, and RC. According to these findings, our recommendations for assessment and instruction are: (1) RAN is assessed by very simple tasks where children name aloud objects, colors, or symbols (letters or digits) as quickly as they can. Being very easy to test, RAN is thus the great use in the diagnosis and prevention of reading disorders in consistent orthographies, and (2). The acquisition of vocabulary should be emphasized in kindergarten and first school years, using all type of printed material and text, to help students to acquire listening and written comprehension skills.

One of the limitations of the present study was the absence of comparable measures across languages. Normative data was not available for most of the test used in the study for the Bulgarian population and the results were likely to be influenced by language-specific linguistic variables. Nevertheless, the current study provides support for the view that consistent writing systems, place a critical demand on RAN and vocabulary skills, throughout the first primary school year.

It is also important to consider that international differences in wealth, health, education, educational practices, as they affect children's literacy attainments point to limitations of this research that must be borne in mind in its interpretation. It will be important to extent the current crossliguistic studies to: 1) a longitudinal design to asses the causal relations among different cognitive skills and component processes in becoming literate in the studied languages, and 2) the study of children learning to read coming from different socio economical backgrounds in both countries.

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