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Article

Rapid naming components and its relation to reading comprehension in spanish

Los componentes de la velocidad de denominación y su relación con la comprensión lectora en español

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Resumen

Rapid naming is one of the main reading predictors, especially in transparent orthographies such as Spanish. Although it has been consistently studied at the level of reading words, few works try to explain its relationship with reading comprehension. From the perspective of the analysis of the rapid naming components: pauses between items and articulation times; this research explored the relationship between rapid naming and reading comprehension in Chilean students from first to fourth grade. In addition, we evaluated whether this relationship is explained by accuracy of reading words and fluency. Results show that both components share a significant amount of variance with comprehension. However, the relation between pauses is the greatest with comprehension. In addition, word reading accuracy and fluency are variables that mediate the relationship between rapid naming and reading comprehension. Results are discussed in the context of rapid naming as a variable related to fluency in reading and the usefulness of its evaluation in school context.

Abstract

La velocidad de denominación es uno de los principales predictores de la lectura, especialmente en ortografías transparentes como el español. Si bien ha sido consistentemente estudiada al nivel de la lectura de palabras, pocos trabajos tratan de explicar su relación con la comprensión lectora. Desde la perspectiva del análisis de los componentes de la velocidad de denominación (pausas entre ítems y tiempos de articulación), esta investigación exploró la relación entre la velocidad de denominación y la comprensión lectora en estudiantes chilenos de primero a cuarto de educación básica. Además, se evaluó si esta relación se puede explicar por las habilidades en la precisión de lectura de palabras y fluidez lectora. Los resultados muestran que ambos componentes comparten una cantidad significativa de varianza con la comprensión. Sin embargo, comparativamente, es mayor la relación de las pausas entre ítems con la comprensión. Además, la precisión en la lectura de palabras y la fluidez son variables que median la relación entre la velocidad de denominación y la comprensión lectora. Los resultados se discuten en el contexto de la velocidad de denominación como una variable relacionada con la fluidez en la lectura y la utilidad de su evaluación en el contexto escolar.

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Introduction

Naming pace (hereinafter "NP") is the ability to sequentially name a series of familiar stimuli such as digits, letters, colours or figures as quickly and accurately as possible (Wolf, 1991). It is one of the major reading predictors, both in alphabetical orthographies (Furnes & Samuelsson, 2011; Gómez-Velázquez, González-Garrido, Zarabozo & Amano; 2010; Papadopoulos, Spanoudis & Georgiou, 2016; Powel, Stainthorp, Stuart, Garwood & Quinlan, 2007) and non-alphabetical orthographies such as the Chinese and Japanese orthographies (Kobayashi, Haynes, Macaruso, Hook & Kato, 2005; Shum & Au, 2017). Although most studies approach the link between NP and the fluency and accuracy when reading words (Di-Filippo *et al.*, 2005; Katzir *et al.*, 2006), a link between NP and reading comprehension has also been found (Ho *et al.*, 2017; Weng, Li y Li, 2016). In this sense, it is reported that NP explains between 3.1% and 16% of reading comprehension (Johnston & Kirby, 2006; Joshi & Aaron, 2000). Nevertheless, it is also known that certain variables such as vocabulary and fluency (Poulsen, Juul & Elbro, 2015), working memory and processing speed (Christopher *et al.*, 2012, Weng *et al.* 2016) have an impact on this link as well.

Attempts have been made to approach the link between NP and reading comprehension (hereinafter, RC) from three different perspectives: according to the first approach, NP has a direct impact on word recognition and fluency, which in turn have a direct impact on RC (Johnston & Kirby, 2006). The second approach proposes a mediation model between NP and RC through reading fluency. In this sense, Kirby, Parrila & Pfeiffer (2003) state that NP is a precursor of fluency and the latter is a key element of RC, which explains why it is necessary to understand what is read (Kim, Wagner & Foster, 2011; Lai, Benjamin, Schwanenflugel & Kuhn, 2014). In last place, the third approach suggests that the processes involved in NP, such as working memory and processing speed could also be linked to RC and hence the link between them (Arnell, Joanisse, Klein, Bussery & Tannock, 2009; Brooks, Berninger & Abbott, 2011).

Furthermore, the NP paradigm used to evaluate the link with RC is significant. Evidence show that alphanumerical paradigms (digits and letters) explain greater reading variance (Manis, Doi & Bhadha, 2000; Savage *et al.*, 2005). Therefore, it can be assumed that the nature of NP with reading of words is partly phonological and orthographical (Georgiou, Parrila & Kirby 2009; Torgessen, Wagner, Rashotte, Burgess & Hecht, 1997). Nevertheless, evidence is not conclusive in the case of the link with RC. It has also been found that non-alphanumerical NP paradigms (colours and figures) are more linked to RC because they involve a greater level of access to semantic information rather than to phonological information (Poulsen *et al.*, 2013). Furthermore, as far as Non-alphanumerical paradigms are free from the influence of reading literacy, they withdraw the effect of this variable when linking it to RC; therefore, they are an indicator of the automation of lexical-semantic retrieval (Johnston & Kirby, 2006; Nation, Marshall & Snowling, 2001; Perfetti, 2007).

According to some authors, the key to understand the link between NP and reading does not lie in the total time assigned to it but in its two main components: pauses between items and the time to articulate them (Georgiou, *et al,* 2014; Georgiou, Papadopoulos & Kaizer, 2014). Articulation times reflect the level of familiarity with the stimulus that is to be named, whilst pauses represent the information retrieval process through long-term memory (Neuhaus, Foorman, Francis & Carlson, 2001). Research has shown that pauses are the component that is more frequently linked to reading compared to articulation times in the early stages of reading (Georgiou *et al.*, 2014; Georgiou, Parrila & Kirby, 2009). The link between the components of NP and RC is hardly addressed in this field. Li, Kirby & Georgiou (2011) report that

pauses of NP-digits explain around 15% of RC only in year 6 of primary education, but no effect was found among students of year 2 and 4 of primary education. On their part, Neuhaus *et al.*, (2001) report that pauses of NP-letters explain 49% of variance in RC among students of year 1 of primary education and 34 % in the case of students of year 2 of primary education. In this same study, articulation times were not linked to RC in any of the school years under study. Likewise, in a study conducted with children aged between 8 and 14, Li *et al.* (2009) report that pauses of NP-letters and NP-digits explain 12% and 14% of RC, respectively, whilst articulation times are not linked.

Although the results show that pauses are a component of NP that is better linked to RC, there are three limitations regarding these results that should be noted. The first limitation is that only the direct link between the components of NP and RC has been explored and that the mediating effect of fluency and reading accuracy has not been considered. In second place, although it is known that the NP-type paradigm (Alphanumerical, Non-alphanumerical) affects the scale of the impact on RC (Johnston & Kirby, 2006; Poulsen *et al.*, 2013), there is no verification as to whether this happens at the level of components, pauses and articulation levels. The foregoing was only addressed in the study conducted by Li *et al.* (2009), but only in English. In this sense, the third limitation, i.e. the link between NP and RC, has not been analysed in a transparent orthography such as the Spanish orthography. Given the impact of orthographic depth, this is important to explain reading development (Share, 2008). The depth of orthographic systems is defined by the consistency of the grapheme-phoneme link; for this reason, those orthographic systems where this link is poorly consistent and more than one phoneme corresponds to each grapheme, are defined as opaque, while those systems where this link is more consistent are classified as transparent orthographic systems (Katz & Frost, 1992). In this continuum, English is at the very end of the opacity spectrum, while Finish and Spanish are at the end of orthographic transparency (Bravo-Valdivieso & Escobar, 2014; Katz & Frost, 1992). The depth of orthographic systems is important because it explains the learning speed of reading and the cognitive processes involved in its development (Seymour, Aro & Erskine, 2003; Ziegler *et al.*, 2010). Prior research was also conducted in opaque orthographies such as English orthography (Neuhaus, Foorman, Francis & Carlson, 2001; Li *et al.*, 2011) and non-alphabetical orthographies, such as Chinese orthography (Li *et al.*, 2009). As far as NP is concerned, it is shown that it is a variable that depends on the orthographic system (Araújo, Reis, Petersson & Faísca, 2015; López-Escribano, Sánchez-Hípola, Suro-Sánchez & Leal-Carretero, 2014), which also happens to RC (Florit & Cain, 2011; Tobia & Bonifacci, 2015).

This study explores the link between the components of NP, pauses between items and articulation times, and RC in Chilean students of the first cycle of primary education. Additionally, it aims at determining whether the link between the components of NP and RC varies depending on the type of NP task used: Alphanumerical (letters) or Non-alphanumerical (figures). This study is important as there are no precedents in Spanish that deal with this link, just as there are no previous studies on the impact of fluency and reading accuracy to explain this link.

On the basis of the theoretical background presented, we assume that: a) NP will be correlated to RC, including both the task of letters and figures, NP-letters being the task that reports a higher level of correlation; b) the component that will share a higher level of variance with RC will be the pauses above articulation times; c) pauses in alphanumerical tasks (letters) will better explain the link with RC, and; d) the level of variance that explains the pauses of NP and RC will decrease after controlling the impact of accuracy when reading words and fluency, as these two variables play a mediating role in this link.

Method

Participants

This study has a non-selected sample of 110 children studying the first cycle of primary education: 23 children from year 1 (*N*= 82.66, *SD*= 4.59), 28 from year 2 (*N*= 94.24, *SD*= 4.21), 28 from year 3 (N= 106.17, *SD*= 3.87) and 31 from year 3 (*N*= 117.77, SD= 5.08). They all attend working-class schools in the city of Santiago de Chile. The school has a mixed approach to teach reading, in other words, the teachers combine aspects of the synthetic approaches, such as highlighting the phonic components of language, and global methods such as presenting words at the beginning of the reading learning process (Lebrero & Lebrero, 1996). The participants showed an appropriate emotional, sensorial and cognitive development, as reported by the teachers and verified by the evaluator and conducting the tests. All the participants speak Spanish and no one of them repeated any school year. The supervising teachers signed the informed consent and the participants gave their consent to this study.

Instruments

Naming pace. It was evaluated by adapting the paradigm of Denckla and Rudel (1974). This task consists in naming stimuli as quickly and accurately as possible from left to right and from top to bottom. The participants were evaluated using the tasks of letters (a,o,s,p,d) and figures (ball, pencil, fish, car, house). The paradigms were presented on a sheet where the 5 stimuli were repeated 10 times randomly, creating a 5x10 grill. Before starting the test, the stimuli were presented to ensure that the participants were familiar with them. The time used to perform the task was quantified in seconds.

Reading comprehension. It was evaluated using the Comprehension test of the *Batería III Woodcock-Muñoz*, standardised to the Spanish language (Muñoz, Woodcock, McGrew & Mather, 2005). It is a typically *cloze* task, where paragraphs with one key word missing marked with a blank are read out loud. The texts become more difficult in terms of length and vocabulary as the test progresses. The score ranges from 0 to 47 points. The authors report an alpha amounting to .83 for the ages under study.

Reading fluency. The Fluency test of the *Batería III Woodcock-Muñoz* (Muñoz *et al.*, 2005) was used. The participants had 180 seconds to read definitions out loud and determine whether they were true or false by circling the right answer (example: cows are green). The final score is obtained by deducting the wrong answers from the correct answers. The scores range from 0 to 115 points. An alpha amounting to .90 regarding the participants' age is reported.

Reading words. The Word identification test of the *Batería III Woodcock-Muñoz* (Muñoz *et al.*, 2005) was used. The participants read out loud a list of 76 words; after 6 consecutive errors, the test is suspended. Difficulty is determined by the frequency and the length of the words used. Reading accuracy is awarded points. The authors report an alpha of .94.

Vocabulary. The expressive aspect of language was evaluated at the level of single words using the Vocabulary on pictures test of *Batería III Woodcock-Muñoz* (Muñoz *et al.*, 2005). Some pictures are presented in a booklet and are identified by naming the objects shown in the pictures. Difficulty is determined by familiarity with the pictures. The scores range from 0 to 46 points. An alpha amounting to .77 was reported.

Proceeding and handling of the audio files

The participants were evaluated individually in a quiet room, lit and free of distraction, located in their own school. The evaluations were performed during the second half of the school year. The tests were administered by a team of 6 evaluators, with a background in psychology, who had been previously trained to

Table 1.

Descriptive statistics and partial correlations between variables

		N (SD)	1	2	3	4	5	6	7	8
1	NP-L	41.04 (17.18)								
2	PT-L	20.14 (11.36)	.906***							
3	AT-L	17.42 (3.45)	.586***	.443***						
4	NP-F	59.18 (14.33)	.634***	.638***	.379***					
5	PT-F	26.56 (9.64)	.548***	.583***	.223*	.864***				
6	AT-F	28.67 (4.73)	.345**	.322**	.620***	.449***	.203*			
7	Word	63.74 (14.59)	-.704***	-.639***	-.472***	-.366***	-.317**	-.155		
8	Comp	22.61 (6.57)	-.658***	-.625***	-.413***	-.383***	-.311*	-.151	.765***	
9	Fluency	27.81 (12.98)	-.679***	-.666***	-.424***	-.496***	-.396***	-.370***	.659***	.705***

Note. NP-L= NP-Letters; PT-L= Pauses Letters; AT-L= Articulation Letters; NP-F= NP-Figures; PT-F= Pauses Figures; AT-F= Articulation Figures; Word= word reading accuracy; Comp= Reading comprehension
[a]Measured in seconds
*p < .05; **p <.01, ***p <.001

administer the tests in a standardised way. Each participant was evaluated only once in one-hour sessions. The tests were applied in a counterbalanced way to control fatigue as they were being performed.

The audio files of the NP tasks were recorded using Audacity©. Environmental noise was reduced thanks to this software and the audio files were converted to monaural format. The audio files were handled using the PRAAT software (Boersma & Weenink, 2014) to identify articulation times and pauses between items. The audio files underwent four types of clean-ups, described in detail by Georgiou *et al*. (2008): a) Errors, when an error was made, the pause before it was removed, as well as the stimulus incorrectly named and the pause after it; b) Self-corrections, if the children corrected their error spontaneously, the pauses between the two correct articulations were removed; c) Omitting stimuli, the articulation time between two correct articulations and the following pause were removed; d) Behaviours alien to the task, such as sneezing, talking to the evaluator or cheering up between two articulations were removed.

Results

What is the scale of the link between NP and RC?

Prior to the analysis, both the task NP-Letters and the task NP-Figures and their respective components were positively skewed and transformed using the logarithm with the base of 10, whose proceeding was described by Tabachink & Fidell (2007). The descriptive statistics of the variables under study are shown in table 1, as well as the partial correlations between the variables upon being controlled by the vocabulary.

The results show that NP-Letters is moderately and negatively correlated to the measurement of RC and share around 43% of variance. This correlation is negative, as NP is an assigned measured in seconds whereby the less time the better performance. On the other hand, NP-Figures is also moderately correlated to RC, the variables sharing around 15% of variance. These results suggest that NP is correlated to RC, regardless of the type of task used (letters or figures). Nevertheless, the scale of the correlation between the task NP-Letters and RC is greater than the task NP-Figures.

Table 2.

Analysis of the commonalities components of NP to explain Reading comprehension

	Comprehension			
		NP-L		NP-F
	β	*Coefficients*	β	*Coefficients*
Single contributions				
Vocabulary	.269***	.0631 (11.50%)	.389***	.1358 (40.99%)
Pauses	-.510***	.1865 (33.96%)	-.251**	.0567 (17.10%)
Articulation	-.155*	.0176 (3.20%)	-.145	.0190 (5.73%)
Common contributions				
Common to 1& 2		.0637 (11.61%)		.0501 (15.12%)
Common to 1 & 3		.0125 (2.28%)		.0259 (7.83%)
Common to 2 & 3		.1045 (19.04%)		.0153 (4.61%)
Common to 1, 2 & 3		.1011 (18.41%)		.0286 (8.62%)
Total (R^2)		.5490		.3314

*p < .05; **p <.01, ***p <.000

What is the component of the NP task that is more related to RC?

An analysis of the commonalities was performed to identify which components of the NP tasks explain a greater proportion of RC variance and to determine whether there are any differences regarding the type of task. This analysis identifies the proportion of single and shared variance that an independent variable provides to a dependent variable in the presence of multicollinearity (Nimon, 2010). The total amount of the single and common contributions is R^2 of the model. The analysis of the commonalities of the components of the tasks NP-Letters and NP-Figures is shown after controlling the impact of vocabulary to explain RC.

As far as the components of task NP-Letters is concerned, the analysis of the commonalities shows that pauses and articulation times jointly explain 19.4% of RC variance. In the case of the task NP-Figures, pauses and articulation times jointly explain 4.6% of RC. Upon analysing the single contributions of the components of NP-Letters, pauses between items provide a greater proportion of variance to the model -33.96%- while articulation times amount to 3.2%. The analysis of the components of NP-Figures shows that pauses explain 17.1% while articulation times explain 5.7% of RC. In short, while pauses and articulation times of NP-Letters and NP-Figures are linked to RC, pauses explain a greater variance proportion, especially pauses of NP-Letters, around 33% of variance. Therefore, these results suggest that although pauses are the component that is more linked to RC, there is also an impact of the type of task, pauses of NP-Letters being the component that is more linked to RC.

Do fluency and reading accuracy of variable words play a mediating role in the link between NP and RC?

Given that the components of NP-Letters are more linked to RC, the other analysis will focus on this variable in order to present the results sparingly. Commonalities were once again

analysed to determine whether the components of NP-Letters still explain CL variance upon controlling reading of words and reading fluency. The results obtained upon analysis commonalities are shown in Table 3.

Table 3.

Analysis of the commonalities components of NP-Letters about comprehension controlling word reading accuracy.

	β	*p*	Coefficient	Percentage
Single contributions				
Vocabulary	.236	.000	.0481	6.82%
Words	.561	.000	.1563	22.16%
Pauses	-.208	.006	.0218	3.09%
Articulation	-.023	.720	.0004	0.05%
Common contributions				
Common to 1 & 2			.015	2.13%
Common to 1 & 3			.0109	1.55%
Common to 2 & 3			.1647	23.35%
Common to 1 & 4			.0019	0.26%
Common to 1 & 4			.0172	2.44%
Common to 3 & 4			-.0493	-6.99%
Common to 1, 2 & 3			.0528	7.49%
Common to 1, 2 & 4			.0106	1.51%
Common to 1, 3 & 4			-.0176	-2.49%
Common to 2, 3 & 4			.1538	21.81%
Common to 1, 2, 3 & 4			.1187	16.82%
Total			.7054	

The results show that the variance proportion of pauses of NP-Letters decreases notably, although they still explain 3.09% of total R^2, upon controlling the impact of word reading accuracy. In this model, word reading accuracy makes a greater proportion to the model, amounting to 22.16%. Articulation times are not taken into account as they do not provide any additional variance. The proportion of variance shared between word reading accuracy and pauses jointly explains 23% of RC. Upon replicating the analysis controlled by the impact of fluency (table 4), the proportion of CL variance explained by pauses decreases, but it still explains 4% of variance. Pauses and fluency jointly explain 24% of comprehension. These results suggest that both fluency and word reading accuracy partially play a mediating role between the components of NP and RC, as the proportion of shared variance between the NP component and RC decreases as reading accuracy and fluency are included in the model.

Table 4.

Analysis of the commonalities components of NP-Letters about comprehension controlling Reading fluency.

	β	*p*	Coefficient	Percentage
Single contributions				
Vocabulary	.198	.002	0.0329	5.05%
Fluency	.474	.000	0.1027	15.76%
Pauses	-.235	.006	0.0258	3.96%
Articulations	-.081	.238	0.0047	0.72%
Common contributions				
Common to 1& 2			0.0302	4.64%
Common to 1& 3			0.0036	0.54%
Common to 2 & 3			0.1606	24.65%
Common to 1 & 4			0.0032	0.49%
Common to 2 & 4			0.0129	1.98%
Common to 3 & 4			-0.0438	-6.72%
Common to 1, 2 & 3			0.0602	9.24%
Common to 1, 2 & 4			0.0093	1.43%
Common to 1, 3 & 4			-0.0063	-0.96%
Common to 2, 3 & 4			0.1483	22.75%
Common to 1, 2, 3 & 4			0.1074	16.47%
Total			0.6517	

Discussion

This study explored the link between the components of NP, pauses between items and articulation times, and RC in Chilean students of the first cycle of primary education. It also evaluated the mediating role played by reading fluency and accuracy in this link. In first place, it is found that both the task NP-Letters and NP-Figures are correlated to RC. Nevertheless, upon comparing the scale of these links, it was found that the task NP-Letters is more strongly correlated to RC. Therefore, it seems that the

nature of the NP task has an impact on the scale of the link between the variables. This finding is in line with other studies that also report that alphanumerical paradigms such as letters and digits have stronger correlations with reading measurements compared to Non-alphanumerical paradigms (Misra, Katzir, Wolf & Poldrack, 2004; Tannock, Martinussen & Frijters, 2000).

Upon analysing the link between NP and RC at a component level, it was found that pauses between items are more strongly linked to RC, especially pauses of alphanumerical tasks (NP-Letters). The results showed that the pauses of NP-Letters share around 34% of RC variance, whilst the pauses between items of NP-Figures share around 17%. This result is in line with other studies that also report that pauses of alphanumerical tasks share greater variance with RC (Li *et al.*, 2009; Neuhaus, Foorman, Francis & Carlson, 2001). Pauses are the component of NP that is more strongly related to RC because they "lump together" the process related to the retrieval of information from long-term memory, while articulation times only refer to stimulus identification (Cobbold, Passenger & Terrel, 2003; Neuhaus, Foorman, Francis & Carlson, 2001). In this sense, the pauses between items are an indicator of automation in the retrieval of the orthographic and phonological representations required to read (Georgiou *et al.*, 2009; Li *et al.*, 2011); therefore, the faster and more fluent this process is, the more cognitive resources are released to make reading comprehension easier (Logan, 1997; Perfetti, 2007).

The possible link explaining the connection between pauses and reading comprehension can be better explained through the mediating role of reading fluency and word reading. The analysis of the commonalities showed that, on controlling word reading accuracy, the variance shared between pauses and comprehension decreases from 34% to 3%, which suggest that, as a matter of fact, the link partially exists. The link between word reading accuracy and RC has been thoroughly analysed (Perfetti & Stafura, 2014; Kendeou, Van-den-Broek, White & Lynch, 2009). Studies suggest that it would be necessary to automate word decoding, so that it does not entail greater effort and makes comprehension easier as cognitive resources are released (García & Cain, 2014; Gutiérrez-Fresneda, 2017; Perfetti & Hogaboam, 1975). Word reading accuracy and pauses of NP-Letters are linked as both tasks have important phonological components and involve letter recognition. Hence the mediating role of word reading accuracy in the link between NP and RC entails the rapid recognition of letters and longer orthographic units, such as words, and this rapid recognition makes RC easier as this process becomes more fluent (Fumagalli, Barreyro & Jaichenco, 2017; Johnson & Kirby, 2006). Therefore, in the link between NP and RC there is an important component related to access and information recognition speed.

When the analysis is replicated with reading fluency, the significant decrease of the pauses between items to explain RC can be found once again. Therefore, the pauses between items of NP-Letters explain 4% of comprehension, whilst fluency explains 16%. On analysing the common contributions to the model, pauses and fluency share 25% of comprehension variance; in other words, they jointly explain 25% of variance, which means that fluency is a mediating variable in the link between pauses and RC. In this sense, NP is more than a task linked to information processing speed (Vaessen, Gerretsen & Blomert, 2009). Research show that NP still explains reading upon controlling processing speed (Powell *et al.*, 2007). Therefore, NP rather than speed as a general process, is an indicator of processing speed linked to a specific orthography that explains fluency and automation in word recognition (Li *et al.*, 2011, Neuhaus & Post, 2003). Provided that the recognition of lexical and sublexical units is rapid, the reading process is automated and cognitive resources that promote RC are released. In this context, the pauses of NP-Letters are an indicator of the automation when retrieving these

units; therefore, they share this mechanism with word reading accuracy and fluency linked to RC. This link is significant in the orthographic context of Spanish language, where fluency measurements predicts reading performance to a greater extent than accuracy-based measurements (Share, 2008). Therefore, some variables such as naming pace, which entail a significant component of fluency, are important in the case of orthography in Spanish.

It should be noted that there have been some limitations. Subsequent studies should take a larger sample into account from each one of the school grades for a clearer transversal perspective of the role played by the components of NP to explain RC. Likewise, the measurement of fluency used has an important component of comprehension, unlike other measurements that only consider the decoding speed at the level of words, which may also explain the high correlation existing between this variable and RC. Finally, the measurement of word reading used is based on accuracy. Nevertheless, variance was found in the participants' reading accuracy despite this limitation. Future research should analyse the link between executive functions, the components of NP and RC, because it has been found that executive functions are linked to comprehension and performance in NP tasks (Altani, Protopapas & Georgiou, 2017; Kieffer, Vukovic & Berry, 2013).

In short, pauses of NP-Letters are the component that shares a greater proportion of variance with RC. Upon controlling reading accuracy and fluency, the pauses of the task NP-Letters still provide variance; nevertheless, it decreases, which means that the link between NP and RC can be explained based on the mediating role played by word reading accuracy and fluency. In the educational sphere, these results highlight the importance of evaluating both longitudinal and concurrent important precursors of RC. Evaluating naming pace is a quick and easy way of early identification of those students at risk of having reading difficulties, especially those whose skills are compromised in terms of reading accuracy or automation. Therefore, it is important to consider NP measurements in those evaluation batteries aimed at identifying those students at risk of having reading difficulties.

References

Altani, A., Protopapas, A., & Georgiou, G. K. (2017). The contribution of executive functions to naming digits, objects, and words. *Reading and Writing*, *30*(1), 121-141. doi: https://doi.org/10.1007/s11145-016-9666-4

Araújo, S., Reis, A., Petersson, K. M., & Faísca, L. (2015). Rapid automatized naming and reading performance: A meta-analysis. *Journal of Educational Psychology, 107*(3), 868-883. doi: http://dx.doi.org/10.1037/edu0000006

Arnell, K. M., Joanisse, M. F., Klein, R. M., Busseri, M. A., & Tannock, R. (2009). Decomposing the relation between Rapid Automatized Naming (RAN) and reading ability. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, *63*(3), 173. doi: http://dx.doi.org/10.1037/a0015721

Boersma, P., & Weenink, D. (2014). *Praat: doing phonetics by computer* [Computer program]. Version 5.4.06, retrieved 08 september 2014 from http://www.praat.org/

Bravo-Valdivieso, L., & Escobar, J. P. (2014). How transparent is Spanish orthography?/¿ Cuán transparente es nuestra ortografía castellana? *Estudios de Psicología, 35*(3), 442-449. doi: https://doi.org/10.1080/02109395.2014.965455

Brooks, A. D., Berninger, V. W., & Abbott, R. D. (2011). Letter naming and letter writing reversals in children with dyslexia: momentary inefficiency in the phonological and orthographic loops of working memory. *Developmental Neuropsychology*, *36*(7), 847-868. doi: https://doi.org/10.1080/87565641.2011.606401

Christopher, M. E., Miyake, A., Keenan, J. M., Pennington, B., DeFries, J. C., Wadsworth, S. J. ... Olson, R. K. (2012). Predicting word reading and comprehension with executive function and speed measures across development: a latent variable analysis. *Journal of Experimental*

Psychology, *141*(3), 470. doi: https://doi.org//10.1037/a0027375

Cobbold, S., Passenger, T., & Terrell, C. (2003). Serial naming speed and the component elements of speech time and pause time: Relationships with the development of word-level reading in children aged four to five years. *Journal of Research in Reading*, 26, 165–176. doi: https://doi.org/10.1111/1467-9817.00194

Denckla, M. B., & Rudel, R. (1974). Rapid "automatized" naming of pictured objects, colors, letters and numbers by normal children. *Cortex, 10*(2), 186-202. doi: https://doi.org/10.1016/S0010-9452(74)80009-2

Di Filippo, G., Brizzolara, D., Chilosi, A., De-Luca, M., Judica, A., Pecini, C. ... Zoccolotti, P. (2005). Rapid naming, not cancellation speed or articulation rate, predicts reading in an orthographically regular language (Italian). *Child Neuropsychology*, *11*(4), 349-361. doi: https://doi.org/10.1080/09297040490916947

Florit, E., y Cain K. (2011). The simple view of reading: Is it valid for different types of alphabetic orthographies? *Educational Psychology Review*, *23*(4), 553-576. doi: https://doi.org/10.1007/s10648-011-9175-6

Fumagalli, J. C., Barreyro, J. P., & Jaichenco, V. I. (2017). Fluidez lectora en niños: cuáles son las habilidades subyacentes. *Ocnos: Revista de estudios sobre lectura*, *16*(1), 50-61. doi: http://dx.doi.org/10.18239/ocnos_2017.16.1.1332

Furnes, B., & Samuelsson, S. (2011). Phonological awareness and rapid automatized naming predicting early development in reading and spelling: Results from a cross-linguistic longitudinal study. *Learning and Individual Differences*, *21*(1), 85-95. doi: https://doi.org/10.1016/j.lindif.2010.10.005

García, J. R., & Cain, K. (2014). Decoding and reading comprehension: A meta-analysis to identify which reader and assessment characteristics influence the strength of the relationship in English. *Review of Educational Research*, *84*(1), 74-111. doi: https://doi.org/10.3102/0034654313499616

Georgiou, G. K., Aro, M., Liao, C. H., & Parrila, R. (2014). The Contribution of RAN Pause Time and Articulation Time to Reading Across Languages: Evidence From a More Representative Sample of Children. *Scientific Studies of Reading*, 1-10. doi: https://doi.org/10.1080/10888438.2014.956927

Georgiou, G., Papadopoulos, T., & Kaizer, E. (2014). Different RAN components relate to reading at different points in time. *Reading and Writing*, 27, 1379- 1394. doi: https://doi.org/10.1007/s11145-014-9496-1

Georgiou, G., Parrila, R., & Kirby, J. (2009). Ran components and reading development from grade 3 to grade 5: What underlies their relationship? *Scientific Studies of Reading*, *13*(6), 508- 534. doi: https://doi.org/10.1080/10888430903034796

Gómez-Velázquez, F. R., González-Garrido, A. A., Zarabozo, D., & Amano, M. (2010). La velocidad de denominación de letras: el mejor predictor temprano del desarrollo lector en español. *Revista mexicana de investigación educativa*, *15*(46), 823-847.

Gutiérrez-Fresneda, R. (2017). Efecto de la lectura compartida y las habilidades prelectoras en el aprendizaje lector. *Ocnos: Revista de estudios sobre lectura*, *16*(2), 17-26. doi: http://dx.doi.org/10.18239/ocnos_2017.16.2.1356

Ho, C. S. H., Zheng, M., McBride, C., Hsu, L. S. J., Waye, M. M., & Kwok, J. C. Y. (2017). Examining an extended simple view of reading in Chinese: The role of naming efficiency for reading comprehension. *Contemporary Educational Psychology*, 51, 293-302. doi: https://doi.org/10.1016/j.cedpsych.2017.08.009

Johnston, T. C., & Kirby, J. R. (2006). The contribution of naming speed to the simple view of reading. *Reading and Writing*, *19*(4), 339-361. doi: https://doi.org/10.1007/s11145-005-4644-2

Joshi, R. M., & Aaron, P. G. (2000). The component model of reading: Simple view of reading made a little more complex. *Reading Psychology*, *21*(2), 85-97. doi: https://doi.org/10.1080/02702710050084428

Katz, L., & Frost, R. (1992). The reading process is different for different orthographies: The orthographic depth hypothesis. *Advances in psychology*, 94, 67-84. doi: https://doi.org/10.1016/S0166-4115(08)62789-2

Katzir, T., Kim, Y., Wolf, M., O'Brien, B., Kennedy, B., Lovett, M., & Morris, R. (2006). Reading fluency: The whole is more than the parts. *Annals*

of dyslexia, 51-82. doi: https://doi.org/10.1007/s11881-006-0003-5

Kendeou, P., Van-den-Broek, P., White, M. J., & Lynch, J. S. (2009). Predicting reading comprehension in early elementary school: The independent contributions of oral language and decoding skills. *Journal of Educational Psychology*, *101*(4), 765. doi: http://dx.doi.org/10.1037/a0015956

Kieffer, M. J., Vukovic, R. K., & Berry, D. (2013). Roles of attention shifting and inhibitory control in fourth grade reading comprehension. *Reading Research Quarterly*, *48*(4), 333-348. doi: https://doi.org/10.1002/rrq.54

Kim, Y. S., Wagner, R. K., & Foster, E. (2011). Relations among oral reading fluency, silent reading fluency, and reading comprehension: A latent variable study of first-grade readers. *Scientific Studies of Reading*, *15*(4), 338-362. doi: https://doi.org/10.1080/10888438.2010.493964

Kirby, J. R., Parrila, R. K., & Pfeiffer, S. L. (2003). Naming speed and phonological awareness as predictors of reading development. *Journal of Educational Psychology*, *95*(3), 453. doi: http://dx.doi.org/10.1037/0022-0663.95.3.453

Kobayashi, M. S., Haynes, C. W., Macaruso, P., Hook, P. E., & Kato, J. (2005). Effects of mora deletion, nonword repetition, rapid naming, and visual search performance on beginning reading in Japanese. *Annals of Dyslexia*, *55*(1), 105-128. doi: https://doi.org/10.1007/s11881-005-0006-7

Lai, S. A., Benjamin, R., Schwanenflugel, P. J., & Kuhn, M. R. (2014). The Longitudinal Relationship Between Reading Fluency and Reading Comprehension Skills in Second-Grade Children. *Reading & Writing Quarterly*, *30*(2), 116-138. doi: https://doi.org/10.1080/10573569.2013.789785

Lebrero, M. P., & Lebrero, T. (1996). *Cómo y cuándo enseñar a leer y a escribir.* Síntesis: Madrid.

Li, J. J., Cutting, L. E., Ryan, M., Zilioli, M., Denckla, M. B., & Mahone, E. M. (2009). Response variability in rapid automatized naming predicts reading comprehension. *Journal of Clinical and Experimental Neuropsychology*, *31*(7), 877-888. doi: https://doi.org/10.1080/13803390802646973

Li, M., Kirby, J., & Georgiou, G. K. (2011). Rapid naming speed components and reading comprehension in bilingual children. *Journal of Research in Reading*, *34*(1), 6-22. doi: https://doi.org/10.1111/j.1467-9817.2010.01476.x

Logan, G. (1997). Automaticity and reading: perspectives from the instance theory of automatization. *Reading and Writing Quarterly*, 13, 123- 146. doi: https://doi.org/10.1080/1057356970130203

López-Escribano, C., Sánchez-Hípola, P., Suro-Sánchez, J., & Leal-Carretero, F. (2014). Análisis comparativo de estudios sobre la velocidad de nombrar en español y su relación con la adquisición de la lectura y sus dificultades. *Universitas Psychologica*, *13*(2). doi: https://doi.org/10.11144/Javeriana.UPSY13-2.aces

Manis, F. R., Doi, L. M., & Bhadha, B. (2000). Naming speed, phonological awareness, and orthographic knowledge in second graders. *Journal of learning disabilities*, *33*(4), 325-333. doi: https://doi.org/10.1177/002221940003300405

Misra, M., Katzir, T., Wolf, M., & Poldrack, R. A. (2004). Neural systems for rapid automatized naming in skilled readers: Unraveling the RAN-reading relationship. *Scientific Studies of Reading*, *8*(3), 241-256. doi: https://doi.org/10.1207/s1532799xssr0803_4

Muñoz, A. F, Woodcock, R. W., McGrew, K. S., & Mather, N. (2005). *Batería III Woodcock-Muñoz: pruebas de habilidades cognitivas*. Illinois: Riverside Publishing Company.

Nation, K., Marshall, C. M., & Snowling, M. J. (2001). Phonological and semantic contributions to children's picture naming skill: Evidence from children with developmental reading disorders. *Language and Cognitive Processes*, *16*(2-3), 241-259. doi: https://doi.org/10.1080/01690960042000003

Neuhaus, G. F., & Post, Y. (2003). Aye, aye, aye, aye: Orthography enhances rapid word reading in an exploratory study. *Journal of Research in Reading*, *26*(2), 141-150. doi: https://doi.org/10.1111/1467-9817.00192

Neuhaus, G., Foorman, B. R., Francis, D. J., & Carlson, C. D. (2001). Measures of information processing in rapid automatized naming (RAN) and their relation to reading. *Journal of exper-*

imental child psychology, *78*(4), 359-373. doi: https://doi.org/10.1006/jecp.2000.2576

Nimon, K. (2010). Regression commonality analysis: demonstration of an SPSS solution. *Multiple Linear Regression Viewpoints*, *36*(1), 10- 17.

Papadopoulos, T. C., Spanoudis, G. C., & Georgiou, G. K. (2016). How is RAN related to reading fluency? A comprehensive examination of the prominent theoretical accounts. *Frontiers in psychology*, 7. doi: https://doi.org/10.3389/fpsyg.2016.01217

Perfetti, C. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading*, *11*(4), 357-383. doi: https://doi.org/10.1080/10888430701530730

Perfetti, C., & Hogaboam, T. (1975). Relationship between single word decoding and reading comprehension skill. *Journal of Educational Psychology, 67*(4), 461-469. doi: http://dx.doi.org/10.1037/h0077013

Perfetti, C., & Stafura, J. (2014). Word knowledge in a theory of reading comprehension. *Scientific Studies of Reading*, *18*(1), 22-37. doi: https://doi.org/10.1080/10888438.2013.827687

Poulsen, M., Juul, H., & Elbro, C. (2015). Multiple mediation analysis of the relationship between rapid naming and reading. *Journal of Research in Reading*, *38*(2), 124-140. doi: https://doi.org/10.1111/j.1467-9817.2012.01547.x

Powell, D., Stainthorp, R., Stuart, M., Garwood, H., & Quinlan, P. (2007). An experimental comparison between rival theories of rapid automatized naming performance and its relationship to reading. *Journal of Experimental Child Psychology*, *98*(1), 46-68. doi: https://doi.org/10.1016/j.jecp.2007.04.003

Savage, R. S., Frederickson, N., Goodwin, R., Patni, U., Smith, N., & Tuersley, L. (2005). Relationships among rapid digit naming, phonological processing, motor automaticity, and speech perception in poor, average, and good readers and spellers. *Journal of learning disabilities*, *38*(1), 12-28. doi: https://doi.org/10.1177/00222194050380010201

Seymour, P. H., Aro, M., & Erskine, J. M. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology*, 94, 143–174. doi: https://doi.org/10.1348/000712603321661859

Share, D. (2008). On the anglocentricities of current reading research and practice: The perils of overreliance on an outlier orthography. *Psychologycal Bulletin, 134*(4), 584- 615. doi: http://dx.doi.org/10.1037/0033-2909.134.4.584

Shum, K. K. M., & Au, T. K. F. (2017). Why Does Rapid Naming Predict Chinese Word Reading?. *Language Learning and Development*, *13*(1), 127-142. doi: https://doi.org/10.1080/15475441.2016.1232651

Tabachnick, B. G. & Fidell, L. S. (2007). *Using Multivariate Statistics* (5a ed.). New York, USA: Allyn and Bacon.

Tannock, R., Martinussen, R., & Frijters, J. (2000). Naming speed performance and stimulant effects indicate effortful, semantic processing deficits in attention-deficit/hyperactivity disorder. *Journal of abnormal child psychology*, *28*(3), 237-252. doi: https://doi.org/10.1023/A:1005192220001

Tobia, V., & Bonifacci, P. (2015). The simple view of reading in a transparent orthography: the stronger role of oral comprehension. *Reading and Writing*, *28* (7), 1-19. doi: https://doi.org/10.1007/s11145-015-9556-1

Torgesen, J. K., Wagner, R. K., Rashotte, C. A., Burgess, S., & Hecht, S. (1997). Contributions of phonological awareness and rapid automatic naming ability to the growth of word-reading skills in second-to fifth-grade children. *Scientific Studies of Reading*, *1*(2), 161-185. doi: https://doi.org/10.1207/s1532799xssr0102_4

Vaessen, A., Gerretsen, P., & Blomert, L. (2009). Naming problems do not reflect a second independent core deficit in dyslexia: Double deficits explored. *Journal of Experimental Child Psychology, 103*(2), 202-221. doi: https://doi.org/10.1016/j.jecp.2008.12.004

Weng, X., Li, G., & Li, R. (2016). Mediating effects of working memory in the relation between rapid automatized naming and Chinese reading comprehension. *Journal of psycholinguistic research*, *45*(4), 945-959. doi: https://doi.org/10.1007/s10936-015-9385-z

Wolf, M. (1991). Naming speed and reading: The contribution of the cognitive neurosciences. *Reading*

Research Quarterly, 123-141. doi: https://doi.org/10.2307/747978

Ziegler, J., Bertrand, D., Tóth, D., Csépe, V., Reis, A., Faísca, L. ... Blomert, L. (2010). Ortographic depth and its impact on universal predictors of reading: A cross language investigation. *Psychological Science*, *21*(4), 551- 559. doi: https://doi.org/10.1177/0956797610363406