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Article

Prosodic Skills and Reading Acquisition in Spanish Primary School Children: Analysis Using the PEPS-C Test

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Abstract

Background: Although previous studies have considered the relationship between prosody skills and the acquisition of reading skills, few have performed comprehensive, simultaneous assessments of different oral language prosody skills and, to our knowledge, none have been carried out in Spanish. Our study analyses the relationship between prosody and reading skills. **Method:** Sixty-one second-grade Spanish schoolchildren participated in this study. Prosodic skills were assessed using the Spanish version of the Profiling Elements of Prosody in Speech-Communication battery, available in different languages. Reading comprehension, word/non-word reading skills, phonological awareness and vocabulary were also evaluated. **Results:** The results show that prosody was significantly related to word and non-word reading, but phonological awareness was the only significant predictor of these reading outcomes. Prosodic skills contribute to explaining reading comprehension even after controlling for the effect of vocabulary and phonological awareness. **Conclusions:** The results highlight the role of prosodic skills in reading acquisition in Spanish. Comparison with previous studies in English-language populations demonstrates the existence of cross-linguistic differences.

Keywords: Prosodic skills, reading acquisition, primary education.

Resumen

***Habilidades Prosódicas y Adquisición de la Lectura en Niños Españoles de Primaria: Análisis con el Test PEPS-C*. Antecedentes:** aunque estudios anteriores han considerado la relación entre las habilidades prosódicas y la adquisición de habilidades lectoras, pocos han realizado una evaluación completa y simultánea de las diferentes habilidades prosódicas del lenguaje oral y, hasta donde sabemos, ninguno se ha llevado a cabo en español. Nuestro trabajo analiza la relación entre prosodia y habilidades lectoras. **Método:** participaron 61 niños españoles de segundo de Primaria. Las habilidades prosódicas se evaluaron mediante la versión española de la batería Profiling Elements of Prosody in Speech-Communication, disponible en diferentes idiomas. También se evaluaron la comprensión lectora, las habilidades de lectura de palabras/no palabras, la conciencia fonológica y el vocabulario. **Resultados:** los resultados muestran que la prosodia se relaciona significativamente con la lectura de palabras y no palabras, pero la conciencia fonológica es el único predictor significativo de estos resultados de lectura. Las habilidades prosódicas contribuyen a explicar la comprensión lectora incluso después de controlar el efecto del vocabulario y la conciencia fonológica. **Conclusiones:** los resultados destacan el papel de las habilidades prosódicas en la adquisición lectora en español. La comparación con estudios anteriores de poblaciones de habla inglesa revela la existencia de diferencias interlingüísticas.

Palabras clave: habilidades prosódicas, adquisición lectora, educación primaria.

Reading ability is one of the most important transversal skills for the achievement of academic success, and also makes an important contribution to personal and social development (National Early Literacy Panel, 2008). In primary education, reading is transformed from a goal to a learning tool (Chall, 1996), and is the main competence on which the correct acquisition of most curricular content in other subjects depends (Pimperton & Nation, 2010). Nevertheless, international reports such as the Progress in International Reading Literacy Study (2016) show that reading ability levels among Spanish children are below the OECD average (Mullis et al., 2017). For these reasons, the study of factors involved in reading acquisition is particularly important.

In this line, phonological skills are significant factors in reading development. Specifically, the role of phonological awareness (PA)—the ability to analyse and manipulate the sound structure of spoken words— and its connection to literacy development is well established (e.g., Caravolas et al., 2013; Goswami & Bryant, 1990). A growing number of studies have also shown that prosody, or suprasegmental phonology, i.e., the subsystem of phonology that refers to the rhythmic, dynamic and melodic features of language (Samuelsson et al., 2011), also has an important role in reading development (e.g., Cuadro et al., 2021; Defior et al., 2015; Goswami et al., 2002; Holliman et al., 2010).

Research suggests that prosody is not only fundamental in the development of segmental phonological skills but also supports literacy skills (Goswami et al., 2002; Thomson & Jarmulowicz, 2016). In this respect, Wood et al. (2009) proposed a model in

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which prosodic skills are placed at the centre of reading acquisition. According to it, greater sensitivity to speech rhythm is associated with a higher capacity to identify parts of speech that are relevant for learning to read (e.g., phonemes, rhymes and words). In this model, later extended by Holliman et al. (2014), several possibilities are suggested to explain the relationship between prosody and literacy acquisition. Prosodic sensitivity helps children to segment the speech-chain into meaningful words (Cutler & Mehler, 1993), which is needed for vocabulary development. Since vocabulary is connected to PA, prosodic sensitivity may also be linked to reading acquisition through vocabulary and PA. A second link considers that prosodic sensitivity may directly affect PA, since phoneme perception is easier in stressed than unstressed syllables (Wood & Terrell, 1998). This model also suggests that prosodic sensitivity influences rhyme awareness by facilitating the detection of volume peaks associated with vowels, and vowel sound quality (Goswami, 2003). A fourth link identifies morphological awareness as an intermediate variable connecting prosodic sensitivity with reading development. In this regard, stress is associated with certain suffixes in complex words. In addition, Wood et al. (2009) considered the possibility that prosodic sensitivity may explain additional variance through word decoding. It should also be considered that prosodic skills help children to better understand different linguistic components, such as syntax and pragmatics (Cutler et al., 1997). Taking this into consideration, prosodic skills may also indirectly contribute to reading comprehension, through its effects on oral language comprehension (Whalley & Hansen, 2006).

Another aspect that should be considered is that prosody is not a unitary construct; the term encompasses different skills which may be differently related to reading outcomes (Holliman et al., 2013). Metrical and lexical stress skills have been analysed in this regard. For example, Wood & Terrell (1998) used a metrical stress task termed 'filtered sentences', given to English children aged 8-9 years, and concluded that poor readers were less sensitive to metrical stress than their age-matched controls. In the same line, Whalley & Hansen (2006) found that, for typically developing fourth-graders, the DEEdee task was the most relevant to comprehension whereas the compound nouns task was more closely related to word reading. In Spain, empirical evidence has been reported of a relationship between prosodic sensitivity and literacy acquisition. For instance, Gutiérrez-Palma et al. (2009) measured lexical stress discrimination among Spanish school children. After controlling for the effect of PA, the children who obtained higher results on the prosodic task also read more fluently. The association between prosody and reading skills has been further corroborated in longitudinal studies (Calet et al., 2015).

There have been other studies on prosody and reading in Spanish which have focused on the use of prosodic cues while reading and reading performance (Álvarez-Cañizo et al., 2018; Álvarez-Cañizo, Cueva et al., 2020; Álvarez-Cañizo, Martínez-García et al., 2020). Overall, these studies pointed out that prosodic reading is important for reading success. The authors also provide evidence on how expressive reading develops in primary and secondary school children. However, these studies did not consider oral prosodic skills and their relationship with reading acquisition.

Prosody studies have been carried out using a wide variety of in-house methods developed specifically for each study, a heterogeneous approach that makes inter-study comparisons difficult (Lochrin et al., 2015). Moreover, most such studies have only considered lexical/metrical stress sensitivity at the receptive level. However, other prosodic functions may contribute to reading outcomes. Lochrin et al. (2015) used the Profiling Elements of Prosody in Speech-Communication (PEPS-C) battery (Peppé & McCann, 2003) to study this question. The PEPS-C test analyses the skills needed to understand and express prosodic cues for turn-end, affect, chunking, and contrastive focus signalling. It also evaluates the discrimination and production of the prosodic forms involved in these functions (for a detailed description of the PEPC-S, see the Method section). Lochrin et al. (2015) analysed the relationships between the prosodic skills assessed in the PEPS-C and word reading, non-word reading and reading comprehension among English-speaking children aged 7 to 12 years. Many prosodic skills showed significant correlations with the reading measurements, and some significantly predicted both word/non-word reading accuracy, as well as reading comprehension, even after accounting for PA. Understanding of contrastive focus and prosody expression for phrasal chunking contributed to explaining word reading with a predictive power beyond that of PA. The same prosodic skills, together with the ability to use rising and falling intonation to establish conversational turns, most contributed to explaining the proportion of variance in non-word reading. Both PA and the use of prosody for phrasal chunking significantly predicted reading comprehension. The results obtained for the relationships between prosody and word and non-word reading were interpreted as supporting the view that prosody enhances phonological representations, which in turn facilitates decoding (Wood, 2006). The possibility that prosody could indirectly contribute to decoding via vocabulary enhancement was also taken into consideration. However, vocabulary was not measured in this study. The ability to produce prosodic cues to parse the speech chain was considered to contribute to explaining reading comprehension via oral language enhancement.

The PEPS-C battery, therefore, is useful for studying prosody and reading outcomes relationships. It has been translated and adapted to different languages (e.g., Peppé et al., 2010), including Spanish (Martínez-Castilla & Peppé, 2008). The Spanish PEPS-C is parallel to the English battery, and both versions are valuable tools for prosody assessment, both in typically developing children and those with language disorders (Marshall et al., 2009). PEPS-C has also been used in cross-linguistic studies (Martínez-Castilla et al., 2012). Given that prior studies of the relationship between prosody and reading ability in Spanish have only focused on the role of lexical/metrical stress (e.g., Calet et al., 2015; Gutiérrez-Palma et al., 2009) or on prosodic reading (Álvarez-Cañizo et al., 2018; Álvarez-Cañizo, Cueva et al., 2020; Álvarez-Cañizo, Martínez-García et al., 2020) and that PEPS-C evaluates other prosodic skills, this battery would provide an excellent means of determining whether different prosodic skills are associated with reading outcomes in Spanish-speaking children (Lochrin et al., 2015). In addition, since the English and Spanish versions of PEPS-C are parallel, this battery enables us to compare the results for each language. While English is characterised as being non-transparent and stress-timed, Spanish is transparent and syllable-timed (Dauer, 1983). Reading and prosody relationships in Spanish, therefore, may differ from those seen in English.

Considering the aforementioned, the specific objectives of our study were twofold: 1) to analyze the relationships between different prosodic skills and reading outcomes (word/non-word reading, and reading comprehension) among Spanish primary school children, using PEPS-C; 2) to determine the explanatory role

of prosodic skills on the variability in reading outcomes when also considering the effects of PA and vocabulary. To our knowledge, this is the first study to carry out a comprehensive examination of these relationships in Spanish-speaking children. Participants in the second grade of primary education were chosen because children at this age are still learning to read (Chall, 1996), but are gradually consolidating their reading skills to concentrate on the meaning of the text. We hypothesised there exists a positive association between the PEPS-C tasks and reading outcomes, beyond the effects of PA or vocabulary. Based on previous research conducted in English (e.g., Lochrin et al., 2015; Whalley & Hansen, 2006), prosody at the word level was expected to be more strongly related to word/non-word reading skills whereas prosody at the phrase level was expected to be associated with reading comprehension. However, taking into account the linguistic differences between English and Spanish, we also anticipated finding relationships between the PEPS-C subtests and reading measurements that differred from those previously reported in English (Lochrin et al., 2015).

Method

Participants

The original sample comprised 65 second graders children from a public-sector school in the South of Spain (M = 95.02 months, SD = 3.29 months; 33 boys and 32 girls). Participants had Spanish as their native language. The children attended a mainstream school, and presented reading levels according to their grade. All participants presented typical development and their intelligence scores were within the normal range (see Table 2). None had any known cognitive impairment, auditory, visual, or motor disorders. All had average socio-economic status and were in the school year that corresponded to their chronological age. Four children, who were unable to complete all the reading assessment tests, were excluded from the study.

Instruments

Non-verbal cognitive ability. The Matrices subtest of the Spanish version of the Kaufman Brief Intelligence Test (Kaufman et al., 2009) was used to measure non-verbal cognitive ability. Here, the participant is asked to identify the relationship among different visual stimuli in a multiple-choice task, thus assessing non-verbal reasoning and problem-solving strategies.

Vocabulary. The Expressive Vocabulary subtest of the Spanish version of the Kaufman Brief Intelligence Test (Kaufman et al., 2009) was used to measure vocabulary. Here, the participant is required to name different pictured objects.

Phonological awareness. The PA subtest of the Spanish Reading and Writing (LEE) battery was used (Defior et al., 2006). This test assesses the ability to manipulate and isolate the sounds of words. It is composed of 14 assessment items of increasing complexity.

Word reading. Word reading ability was measured using a subtest of the PROLEC-R Spanish standardised battery (Cuetos et al., 2010). Participants are asked to read a list of 40 words aloud as quickly and as accurately as they can. These words vary in frequency, length and syllabic structure. The measurement of words correctly read aloud per minute was computed, as the number of words read accurately divided by the total reading time (in seconds) and multiplied by 60.

Non-word reading. The ability to read non-words was measured using the PROLEC-R subtest (Cuetos et al., 2010). Participants are required to read aloud 40 non-words as quickly and as accurately as possible. The measurement of non-words correctly read aloud per minute was calculated as in the previous task.

Reading comprehension. The Assessment of Reading Comprehension (ACL) test (Català et al., 2001) was used to measure reading comprehension. Here, the participant is asked to silently read seven short texts and answer 24 multiple-choice questions.

Prosodic skills. Prosodic skills were measured using the Spanish version of the PEPS-C battery (Martínez-Castilla & Peppé, 2008), consisting of twelve tasks, eight of which assess prosody function and four, prosody form. Prosody function involves higher-level processing and relates phonetic form to meaning; prosody form, on the other hand, refers to lower-level phonetic processing, in which meaning is not involved. Each subtest has both an expressive (output/imitation) and a receptive (input/discrimination) dimension and the different subtests evaluate prosody skills at either the word or the phrase level. Each subtest has a maximum score of 16 points (see Table 1 for task description).

Procedure

The assessment took place in three sessions lasting no longer than 50 min each. Reading comprehension was evaluated in a group session and all other tests were individually administered, by trained examiners. The tasks were administered to all participants in the same order, only the word and non-word reading reading tasks were counterbalanced to control for undue effects of presentation order. All tests included practice items.

The study was approved by the Ethical Human Research Committee of the University of Granada (Spain) and consent forms were signed by participants' parents.

Data analysis

The analyses were carried out using the statistical package SPSS 25. Descriptive statistics were first calculated for all the measurements obtained in the study. For the PEPS-C output and imitation tasks, inter-rater reliability was calculated on 20% of the items. Mean agreement was good ($\varkappa$ = .71, p < .001) (Pardo & Ruiz, 2002). Pearson correlations were conducted to analyze the relationships between PA, vocabulary, prosody and reading outcomes. Partial correlations between prosody and reading, controlling for either PA or vocabulary, were also calculated. Finally, hierarchical regression analyses were carried out to study predictors of reading outcomes.

Results

Descriptive results for the tasks included in the study can be seen in Table 2.

Table 3 shows the relationships observed between PA, vocabulary, prosody and reading outcomes. PA was significantly correlated with the three reading outcomes and vocabulary was significantly correlated with reading comprehension. As to prosody, while word reading and non-word reading were significantly correlated with only two PEPS-C tasks, reading comprehension was significantly correlated with nine of the twelve PEPS-C tasks.

Table 1
Description of the Spanish PEPS-C Test

PEPS-C tasks		Level	Prosodic skill assessed	Brief description and examples
Function tasks				
Turn-end	Input	Word	Understanding rising or falling intonation for signalling conversational turns	Words of food items are presented with rising or falling intonation (e.g., cake). By choosing the appropriate picture, participants must decide whether the item has been offered or stated
	Output	Word	Producing rising or falling intonation for signalling conversational turns	Pictures of food items being offered or stated are shown. Participants have to offer or state the name of the food item with the appropriate intonation contour
Affect	Input	Word	Understanding intonation cues for the expression of liking and disliking	Words of food items are presented with the intonation contours linked to 'liking' (rise–fall pitch contour) or 'disliking' (flat melodic contour with a slight fall). By choosing the appropriate picture, participants must decide whether what they heard expresses liking or disliking
	Output	Word	Producing intonation cues for the expression of liking and disliking	Participants have to use the right intonation contours to express liking or disliking towards different food items shown in pictures
Chunking	Input	Phrase	Understanding prosodic cues for the segmentation of syntactically ambiguous phrases	Participants are presented with two pictures representing two different meanings of the same segmental information [e.g., /pez/ espada/ y limón/ (/fish/ sword/ and lemon/) vs. /pez-espada/ y limón/ (/sword-fish/ and lemon/)]. After hearing an auditory input, participants must choose the picture corresponding to what they heard
	Output	Phrase	Producing prosodic cues for the segmentation of syntactically ambiguous phrases	Participants must produce the appropriate prosodic cues for the disambiguation of phrases as shown in different pictures
Focus	Input	Phrase	Understanding prefinal narrow accent	Participants are presented with two pictures of food items and hear a sentence. By choosing the appropriate picture, they have to decide which of the two food items is being asked for in the sentence [e.g., "Quería paella y YOGUR para comer" vs. "quería PAELLA y yogur para comer" (I wanted paella and YOGURT to eat/I wanted PAELLA and yogurt to eat]
	Output	Phrase	Producing prefinal narrow focus	Participants are shown with a picture of a child with two desired food items and hear a sentence about the eating wishes of the child. The sentence always contains an error over one of the two food items. Participants have to correct what they heard by saying what the child actually wants to eat
Form tasks				
Short-item	Discrimination	Word	Discrimination of the intonation cues involved in the turn-end and affect functions	Minimal pairs of laryngograph recordings (which preserve prosodic information but have no segmental information) are presented and participants have to decide whether the two sounds are the same or different
	Imitation	Word	Imitation of the intonation cues involved in the turn-end and affect functions	Participants have to repeat words as they hear them and thus imitate their intonation contour
Long-item	Discrimination	Phrase	Discrimination of the prosodic cues involved in the chunking and focus functions	Same procedure as in short-item discrimination
	Imitation	Phrase	Imitation of the prosodic cues involved in the chunking and focus functions	Participants have to repeat a set of phrases as they hear them and thus imitate their prosodic cues

PA was not only significantly correlated with reading outcomes but also with seven PEPS-C tasks (Table 3). Accordingly, partial correlations controlling for the effect of PA were also calculated (Table 4). While the previous correlations between the different PEPS-C tasks and reading comprehension remained significant, those between word and non-word reading with chunking input and focus output lost their statistical significance.

Vocabulary was significantly correlated not only with reading comprehension but also with seven PEPS-C tasks. Partial correlations controlling for vocabulary were then conducted. As shown in Table 5, the correlations between the PEPS-C tasks and word and non-word reading remained significant. Except for short-item imitation, the previous correlations between PEPS-C tasks and reading comprehension all remained significant.

Hierarchical regression analyses were conducted to identify possible predictors of reading outcomes, such as PA and vocabulary (Cain, 2016; Wood et al., 2009), which were included in the first block of the regression model. The possible effect of the prosodic skills evaluated in PEPS-C as predictors of reading outcomes has not yet been established for a Spanish-language population. Consequently, these tasks were included, using a stepwise method, in the second block of the regression model. Neither of these models presented multicollinearity or influential cases. The standard assumptions of homoscedasticity, linearity, normality and error independence were fulfilled in all analyses.

The results of the final word and non-word reading models are shown in Table 6. Only PA significantly predicted word reading. Vocabulary was not a significant predictor. All the PEPS-C tasks

were excluded from the model. The same pattern of results was found for non-word reading.

For reading comprehension, vocabulary was a significant predictor, explaining a unique variance of 22.09%. Unlike word and non-word reading, PA did not significantly predict reading comprehension. The final regression model also included three PEPS-C predictors (Table 7): short-item discrimination (unique variance of 4.84%), focus output (unique variance of 4.84%) and chunking input (unique variance of 2.56%).

Table 2
Descriptive Results Obtained in Every Task

	M	SD
Non-verbal intelligence	106.57	9.43
Vocabulary	34.03	3.82
Phonological awareness	11.07	2.95
Word reading	43.93	14.19
Non-word reading	26.05	7.27
Reading comprehension	16.18	4.65
Turn-end input	14.77	2.14
Turn-end output	15.11	1.74
Affect input	15.75	0.62
Affect output	15.49	1.15
Chunking input	13.21	2.15
Chunking output	12.92	2.24
Focus input	13.48	2.81
Focus output	11.36	3.41
Short-item discrimination	14.00	2.32
Short-item imitation	15.49	0.78
Long-item discrimination	13.46	2.00
Long-item imitation	14.67	1.23

Note: N = 61. For non-verbal intelligence, standard scores are reported. For all other measurements, raw scores are shown

Discussion

The aim of this study was to examine relationships between prosodic skills and reading outcomes among Spanish-speaking primary school children. Although previous works analysed these relations in Spanish (e.g., Cuetos et al., 2018; Gutiérrez-Palma et al., 2009), in this study, for the first time, a wide range of prosodic skills were evaluated using a complete prosody assessment battery. Thus, prosodic functions and forms at the word and phrase levels were assessed in the receptive and expressive dimensions. The possible effects of PA and vocabulary on reading outcomes were also assessed. The results obtained in the correlation and partial correlation analyses suggest that, in Spanish, the relationships between prosody skills and word/non-word reading are accounted for by the association between prosody and PA. Our study also shows that, although there is an association between prosody and word/non-word reading, only PA predicts these reading skills. We concur with previous studies that suprasegmental phonology may support the development of PA, thus impacting on word/non-word reading skills (Goswami et al., 2002; Thomson & Jarmulowicz, 2016). Therefore, prosodic skills would indirectly impact on reading outcomes through their role in PA. The fact that phoneme perception is easier in stressed syllables illustrates this role (Wood & Terrell, 1998). Some prosodic skills could even have a direct relationship with word/non-word reading. In Spanish, this has been shown to be the case for lexical stress (e.g., Gutiérrez-Palma et al., 2009).

According to the model proposed by Wood et al. (2009), reading skills and prosody could also be linked in other ways. Thus, prosody enhances vocabulary and therefore may indirectly

Table 3
Correlations Between Reading, Phonological Awareness, Vocabulary and Prosody

	NWR	RC	PA	Voc	TI	TO	AI	AO	CI	CO	FI	FO	SD	SI	LD	LI
WR	.80***	.25	.45***	.13	.18	.23	.14	.09	.34**	.18	.17	.30*	.25	.08	.20	.09
NWR		.10	.30*	.03	.10	.18	.15	-.02	.30*	.17	.17	.30*	.18	-.03	.22	.25
RC			.43**	.71***	.48***	.47***	.08	.34**	.40**	.19	.53***	.54***	.51***	.33**	.30*	.24
PA				.36**	.40**	.31*	.05	.22	.40**	.19	.44***	.41**	.35**	.17	.15	.29*
Voc					.34**	.31*	-.09	.17	.22	.26*	.32*	.33**	.28*	.26*	.17	.13

Note: WR = Word reading, NWR = Non-word reading, RC = Reading comprehension, PA = Phonological awareness, Voc = Vocabulary, TI = Turn-end input, TO = Turn-end output, AI = Affect input, AO = Affect output, CI = Chunking input, CO = Chunking output, FI = Focus input, FO = Focus output, SD = Short-item discrimination, SI = Short-item imitation, LD = Long-item discrimination, LI = Long-item imitation, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4
Partial Correlations Between Reading, Vocabulary and Prosody, After Controlling for Phonological Awareness

	NWR	RC	Voc	TI	TO	AI	AO	CI	CO	FI	FO	SD	SI	LD	LI
WR	.78***	.07	-.03	.00	.11	.13	-.01	.19	.10	-.04	.14	.11	.00	.15	-.05
NWR		-.03	-.09	-.02	.10	.15	-.09	.20	.12	.04	.20	.08	-.08	.19	.18
RC			.66***	.37**	.39**	.07	.28*	.27*	.12	.42**	.44***	.43**	.29*	.26*	.13
Voc				.23	.23	-.11	.11	.09	.21	.19	.22	.18	.21	.12	.02

Note: WR = Word reading, NWR = Non-word reading, RC = Reading comprehension, Voc = Vocabulary, TI = Turn-end input, TO = Turn-end output, AI = Affect input, AO = Affect output, CI = Chunking input, CO = Chunking output, FI = Focus input, FO = Focus output, SD = Short-item discrimination, SI = Short-item imitation, LD = Long-item discrimination, LI = Long-item imitation, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5
Partial Correlations Between Reading, Phonological Awareness and Prosody, After Controlling for Vocabulary

	NWR	RC	PA	TI	TO	AI	AO	CI	CO	FI	FO	SD	SI	LD	LI
WR	.80***	.22	.44***	.15	.20	.15	.07	.32*	.15	.13	.27*	.22	.05	.18	.07
NWR		.11	.31**	.10	.18	.16	-.02	.30*	.17	.16	.30*	.18	-.04	.22	.25
RC			.27*	.36**	.37**	.20	.32*	.35**	.00	.46***	.46***	.46***	.22	.26	.22
PA				.32*	.22	.08	.17	.35**	.11	.37**	.33**	.27*	.09	.10	.27*

Note: WR = Word reading, NWR = Non-word reading, RC = Reading comprehension, PA = Phonological awareness, Voc = Vocabulary, TI = Turn-end input, TO = Turn-end output, AI = Affect input, AO = Affect output, CI = Chunking input, CO = Chunking output, FI = Focus input, FO = Focus output, SD = Short-item discrimination, SI = Short-item imitation, LD = Long-item discrimination, LI = Long-item imitation, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 6
Final Models of Predictors of Word and Non-Word Reading

Predictors	B	SE B	β	t	p	Unique variance (%)
Word reading						
PA	2.23	.60	.46	3.69	<.001	19
Vocabulary	-.12	.47	-.03	-0.25	.80	.09
Non-word reading						
PA	.81	.33	.33	2.45	.017	9.61
Vocabulary	-.17	.26	-.09	-0.65	.52	0

Note: Final word reading model, reached after Step 1. $R^2 = .21$, $F(2,58) = 7.46$, $p = .001$. Final non-word reading model, reached after Step 1. $R^2 = .10$, $F(2,58) = 3.04$, $p = .056$. Unique variance refers to the percentage of variance explained by the predictor after controlling for the remaining predictors included in the model. PA: phonological awareness

Table 7
Final Model of Predictors of Reading Comprehension

Predictors	B	SE B	β	t	p	Unique variance (%)
Phonological awareness	-.02	.14	-.01	-0.14	.89	.01
Vocabulary	.64	.10	.52	6.33	<.001	22.09
Short-item discrimination	.50	.17	.25	3.00	.004	4.84
Focus output	0.33	0.12	0.24	2.84	.006	4.84
Chunking input	0.38	0.18	0.18	2.14	.037	2.56

Note: Final model, reached in Step 4. $R^2 = .70$, $F(5,55) = 25.02$, $p < .001$. Unique variance refers to the percentage of variance explained by the predictor after controlling for the remaining predictors included in the model

improve reading skills. In our study, significant relationships were found between vocabulary and some prosodic skills. Nevertheless, vocabulary was not significantly related to word/non-word reading and did not predict these reading outcomes once PA was entered in a first step. It could be that at these ages the role of PA is more relevant than that of vocabulary for word/non-word reading. This hypothesis is in line with Holliman et al. (2014), who pointed out that the connections identified in the model of Wood et al. (2009) could vary depending on the participants' reading level and the characteristics of their native language. To account for these results, the two routes to word processing while reading should also be considered (Coltheart et al., 2001). Non-word reading is only possible by using the phonological route, which would explain the relevance of PA for non-word reading found in our study. Moreover, both unknown and known words can be read by using the same route. Yet, the latter words can also be read more quickly by using the lexical route, by which sublexical orthographic information directly activates the whole-word orthographic representation and then word meaning. According to this, a predictive role of vocabulary on word reading could have been expected. Yet, as previously mentioned, only PA was here a significant predictor. This may suggest that the children did not know all the words that had to be read. Nevertheless, this was not measured in our research. Another possible explanation may be that the method of learning to read that these children followed was phonetic, perhaps that is why at this age PA has a greater weight in the reading of words than vocabulary.

However, vocabulary was significantly correlated to reading comprehension. PA and many prosodic skills were also significantly related to the same reading outcome. Yet, when controlling for the effects of PA or vocabulary, the relationships between prosodic skills and comprehension remained significant, in every case except one. Therefore, most prosody skills were significantly related to reading comprehension beyond PA and vocabulary. Furthermore, although vocabulary explained the highest percentage of variance in reading comprehension, short-item discrimination, focus output and chunking input also predicted variance in reading comprehension even after accounting for the role of vocabulary (or PA). Of these prosodic skills, the importance of chunking and focus for comprehension has been highlighted in prior research (Whalley & Hansen, 2006). Thus, expressing focus by prosodic cues contributes to the expression of salient information (Martínez-Castilla & Peppé, 2008) which, in turn, facilitates understanding (Cutler et al., 1997). Moreover, chunking by prosodic means is known to help children parse phrases and sentences and ascertain syntactic structure (Cutler et al., 1997). In turn, higher syntactic awareness relates to better reading comprehension (Álvarez-Cañizo, Cueva et al., 2020). In the PEPS-C, the chunking input task requires the understanding of prosodic cues such as pauses, lenghthening and phrase-ending pitch (Martínez-Castilla & Peppé, 2008). The use of these prosodic devices while reading has also been related to reading comprehension (e.g., Álvarez-Cañizo, Cueva et al., 2020). The short-item discrimination task, which assesses melodic contour sensitivity, also appear to capture prosodic skills relevant to reading comprehension. This finding corroborates previous studies, according to which rising/falling intonation skills are a key variable in the prediction of reading comprehension (Calet et

al., 2015; Miller & Schwanenflugel, 2006). Future research should study the relationships between prosodic skills, reading prosody and reading comprehension.

Another finding of our study was that PA was not a predictive variable of reading comprehension. In agreement with this, other authors claim that the contribution of segmental phonology to literacy may be developmentally limited (Caravolas et al., 2013). A possible reason for this may be that, for transparent orthographies, the role of PA in reading comprehension is not critical, which increases the significance of other processes, such as prosodic skills. Thus, while, in English, among the prosodic skills included in PEPS-C, the expression of chunking is the only significant predictor of reading comprehension (Lochrin et al., 2015), our results show that, in Spanish, focus expression and the discrimination of prosodic forms also contribute significantly to this reading outcome.

Taking into account prior research in English (e.g., Lochrin et al., 2015; Whalley & Hansen, 2006), we had hypothesised that word level prosody would be related to word/non-word reading, while prosody at the phrase level would be mainly related to reading comprehension. However, the results obtained did not support this hypothesis, since word and non-word reading skills were significantly related to tasks tapping prosody at the phrase level (i.e., chunking input, focus output), whereas comprehension was significantly related to prosodic tasks at both word and phrase levels. The crosslinguistic differences between English and Spanish, both in terms of rhythm and written transparency, may account for these results. These differences may also account for other differences between our results, concerning in Spanish and using the PEPS-C, and those obtained in English using the same prosody test. Thus, while, in English, PEPS-C prosodic skills predict both word and non-word reading (Lochrin et al., 2015), this is not the case with Spanish-speaking children. These factors could also account for the different results found in reading comprehension, as previously suggested.

Other variables could also contribute to explaining the differing results between the studies conducted with the PEPS-C battery. As previously noted, in our study, several prosodic skills predicted reading comprehension but only one had the same effect in English (Lochrin et al., 2015). However, in English, the amount of variance explained by prosody was higher. In contrast to Lochrin et al. (2015), we also analysed the possible effect of vocabulary as a predictor for reading outcomes. When this variable is controlled for, the unique variance of prosodic skills may be lower. Differences in sample characteristics (8-year-old children in our study, but an age range of 7 to 12 in the English study) could also contribute to explaining the results differences.

The present study contributes to the literature on the relationships between prosodic skills and reading outcomes, with a focus on the Spanish language. Although we offer new insights in this regard, further studies should also be conducted, including a measurement of language comprehension to help clarify the relationships between prosody and reading comprehension. Morphological awareness is another important variable to be considered (Wood et al., 2009). It should also be noted that the Spanish PEPS-C battery does not evaluate lexical stress, although it is related to reading development (Gutiérrez-Palma et al., 2009). Studies of these questions, together with the prosodic skills included in PEPS-C, would further contribute to clarifying the impact of prosody on reading acquisition in Spanish. A limitation of the present study is the sample size. Further increasing the number of participants would allow path analyses to be performed, which could also help clarify the complex pattern of relationships between the different factors contributing to reading acquisition. Since both prosody and reading skills develop along the school years (e.g., Álvarez-Cañizo, Martínez-García et al., 2020; Calet et al., 2015; Martínez-Castilla & Peppé, 2008), future studies should focus not only on second-grade children but also include participants from other school levels.

To conclude, the prosodic skills included in the PEPS-C relate to word/non-word reading and to reading comprehension in Spanish primary school children. However, when accounting for the effects of PA and vocabulary, prosodic skills are significant predictors only for reading comprehension. Our results differ from those obtained in prior research conducted in English and highlight the importance of studying the relationships between prosody and reading acquisition in different languages, using prosody tests for crosslinguistic comparison. The results of the present study may have practical implications. Among others, the PEPS-C could be a useful instrument in schools to detect possible prosodic difficulties. Given the associations between prosody and reading skills, in addition to the assessment of segmental phonology, this instrument could also be used to analyse suprasegmental phonology and to provide guidance for intervention. Given the results found in this study, intervention programs focused on improving prosodic skills may have a positive impact on reading.

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