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Martínez, Naroa; Goikoetxea, Edurne
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Predictors of Reading and Spelling Words Change as a Function of Syllabic Structure in Spanish

Naroa Martínez and Edurne Goikoetxea

University of Deusto, Spain

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A B S T R A C T

We investigated the longitudinal predictors of reading and spelling of words and pseudowords with different syllabic structures in a shallow orthography. Participants were 47 Spanish-speaking children from kindergarten to second grade. Letter knowledge, phonological awareness, and rapid automatized naming were evaluated at the beginning and at the end of the school year, and reading and spelling skills were assessed at the beginning of the following year. Hierarchical multiple regression analysis revealed that letter knowledge was the strongest predictor of reading and spelling words and pseudowords with simple syllables after 6 and 12 months. Phonological awareness predicted reading and spelling stimuli with complex syllables. Mediation analysis confirmed the mediator role of phonological awareness in the relationship between letter knowledge and reading and spelling with complex syllabic stimuli. This research provides longitudinal evidence that the syllabic structure determines the role of letter knowledge and phonological awareness in reading and spelling skills in Spanish. Understanding the knowledge that is key to learning to read and write may lead to improving methods and materials for literacy in Spanish language.

Los predictores de la lectura y escritura de palabras varían en función de la estructura silábica en español

Palabras clave:
Desarrollo de la lectura
Conocimiento de las letras
Conocimiento fonológico
Estructura silábica
Ortografía transparente
Investigación longitudinal

R E S U M E N

Investigamos los predictores longitudinales de la lectura y escritura de palabras y pseudopalabras con diferente estructura silábica en una ortografía transparente. Participaron 47 menores de 3º de Educación Infantil a 2º de Educación Primaria cuya lengua materna era el español. Al principio y al final del año escolar se evaluó el conocimiento de las letras, el conocimiento fonológico y la denominación rápida automatizada y al principio del año siguiente se evaluaron las habilidades de lectura y escritura. Los análisis de regresión múltiple jerárquica revelaron que el conocimiento de las letras fue el predictor más fuerte de la lectura y la escritura de palabras y pseudopalabras con sílabas simples después de 6 y 12 meses. El conocimiento fonológico predijo la lectura y escritura de estímulos con sílabas complejas. El análisis de mediación confirmó el papel mediador del conocimiento fonológico en la relación entre el conocimiento de las letras y la lectura y escritura con estímulos silábicos complejos. Esta investigación proporciona evidencia longitudinal de que la estructura silábica determina el papel del conocimiento de las letras y el conocimiento fonológico en las habilidades de lectura y escritura en español. Comprender qué conocimientos son esenciales para aprender a leer y escribir puede conducir al perfeccionamiento de métodos y materiales de alfabetización en lengua española.

In the research on learning to read, it is fundamental to address the characteristics of the languages investigated, such as orthographic depth and syllabic structure. On the one hand, orthographic depth is understood as the reliability of print-to-speech correspondences (see Schmalz, Marinus, Coltheart, & Castles, 2015). Orthography is considered shallow when grapheme-phoneme correspondences are one-to-one 1:1 and deep when rules of correspondences are far from being one-to-one. Orthographic depth has been extensively investigated, and cross-language empirical research has pointed out the following facts: first, the rhythm of learning letter-sound relationships varies depending on orthographic depth, and it is easier to learn to read in shallow orthographies than in deep ones (e.g., Ellis & Hooper, 2001; Goswami, Gombert, & de Barrera, 1998); second, cognitive predictors of reading vary depending on orthographic

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depth, with phonological awareness being more important in deep orthographies than in shallow ones (Mann & Wimmer, 2002). Influential theories such as the Orthographic Depth Hypothesis (Katz & Frost, 1992; see Frost, 2012 for a recent extension of this hypothesis) and the Grain Size Theory (Ziegler & Goswami, 2005) highlight how orthographic depth affects reading acquisition.

On the other hand, syllabic structure is understood as the set of possible consonant and vowel sequences in the onset, nucleus, and coda, and their combinations. According to the World Atlas of Language Structures (WALS; Maddieson, 2013), some languages have a predominance of simple open CV syllables, whereas other languages have numerous syllabic patterns with an abundance of complex consonant clusters and closed syllables. Syllabic structure, one of the most noteworthy differences between languages (Coulmas, 2003), could be a decisive issue in cognitive predictors of reading, but it is a characteristic that has been neglected in the literature on learning to read.

Spanish, the language of the sample of this research, is considered a shallow orthography with an approximate 1:1 grapheme to phoneme ratio, where approximately 70% of syllables are open (Real Academia Española, 2010), presenting a mostly simple syllabic structure (Maddieson, 2013). Syllabic limits of Spanish are very salient, and the structure of the syllable has a maximum of two consonants in the onset and a maximum of two consonants in the coda (e.g., CCVCC in *trans-por-te* [transport]), which results in less than 20 frequent consonant clusters (RAE, 2010). English, by contrast, is considered a deep orthography with an approximate 1:24 grapheme to phoneme ratio (Coulmas, 2003), where 66% of syllables are closed (Dauer, 1983), presenting a complex syllabic structure (Maddieson, 2013). English has a stress-timed rhythm, and the structure of the syllable allows up to three consonants in the onset and four consonants in the coda (e.g., CCCVCCCC in strengths), which results in approximately 100 consonant clusters (Roach, 2009). The atypical position of English among other alphabetic orthographies has led to questioning the generalizability of results on learning to read because most of the research has been carried out with English speakers.

A criticism due to Anglocentric research carried out in reading (Share, 2008) is the over-estimated role of phonological awareness in learning to read. The causal relationship between phonological awareness and reading has been classified as one of the most important milestones in reading psychology in the last century (e.g., Stanovich, 1991). However, cross-language research has also shown that the predictive value of phonological awareness changes according to orthographic depth, with phonological awareness being a powerful predictor of reading in deep orthographies and a weak predictor in shallow orthographies (Georgiou, Parrila, & Papadopoulos, 2008; Landerl & Wimmer, 2008). Ziegler et al.'s (2010) study with 1,265 second grade students from five orthographies (Finnish, Hungarian, Dutch, Portuguese, and French) found that orthographic depth had a significant effect on the influence of phonological awareness on decoding and reading, with a greater impact in deep orthographies than in shallow ones. In English, phonemic knowledge has been described as a necessary prerequisite for reading (Liberman, 1973; see also Ehri, 2014 and Melby-Lervåg, Lyster, & Hulme, 2012). In contrast, in Spanish, Carrillo (1994) reported that Spanish-speaking first-grade children that were good decoders performed poorly in some of the phonological awareness tasks. Casillas and Goikoetxea (2007) reported that phonemic awareness was not a significant predictor of word reading for Spanish-speaking kindergarten and first-grade children. Castells & Solé (2013) showed that letter knowledge together with the ability to identify syllables phonologically was sufficient to begin to read for Catalan-speaking kindergarten children. Other longitudinal studies in Spanish have highlighted the predictive role of phonological skills and other variables such as rapid automatized naming (RAN) in word reading and spelling (Aguilar et al., 2010; Suárez-Coalla, García de Castro, & Cuetos, 2013). However, these studies did not

Table 1. Means (and Standard Deviations) for Demographic and Cognitive Variables by Grade

Variable	*n*	Kindergarten *n* (%)	Grade 1 *n* (%)	Grade 2 *n* (%)	Range
Sex (girls)	47	9 (50.00)	9 (60.00)	7 (50.00)	
Age	47	5.05 (0.31)	6.03 (0.33)	7.05 (0.40)	4-8
CI	47	84.37 (13.83)	85.64 (19.98)	90.07 (19.41)	55-120
WM					
Verbal	47	15.79 (2.42)	14.79 (2.94)	16.7 (2.73)	10-21
Non verbal	47	11.53 (1.84)	11.71 (3.24)	14.20 (3.33)	5-22
Predictors					
LK (T1)	47	10.26 (6.93)	15.89 (8.19)	20.11 (7.28)	0-27
LK (T2)	47	17.97 (7.53)	20.14 (7.18)	23.57 (5.43)	2-27
PA (T1)	47	4.53 (2.89)	5.86 (3.88)	8.14 (3.57)	0-12
PA (T2)	47	7.32 (4.18)	7.21 (3.56)	9.29 (2.92)	0-12
RAN (T1)	47	64.19 (15.80)	64.97 (19.29)	74.26 (16.68)	34-102
RAN (T2)	47	65.85 (17.74)	72.76 (24.76)	82.78 (13.65)	32-118
Reading					
Incipient Simple (T2)	47	6.49 (4.29)	8.29 (4.81)	10.04 (3.24)	0-12
Incipient Complex (T2)	47	1.49 (2.46)	1.94 (2.47)	5.14 (3.64)	0-8
Simple W (T3)	33	7.26 (7.81)	19.71 (17.74)	29.43 (15.74)	0-40
Simple PW (T3)	33	4.32 (5.00)	8.29 (7.69)	13.07 (7.65)	0-20
Complex W (T3)	33	2.74 (5.06)	7.36 (8.89)	13.14 (9.16)	0-20
Complex PW (T3)	33	0.68 (2.98)	5.21 (7.33)	11.93 (8.84)	0-20
Prolec-R W (T3)	33	0.95 (4.13)	10.86 (15.19)	25.29 (18.12)	0-40
Prolec-R PW (T3)	33	0.74 (3.21)	8.93 (12.58)	23.64 (16.96)	0-37
Spelling					
Simple W (T3)	33	4.74 (6.16)	15.79 (13.51)	25.79 (13.33)	0-38
Simple PW (T3)	33	3.89 (4.15)	8.93 (8.33)	13.57 (7.24)	0-20
Complex W (T3)	33	0.11 (0.46)	4.71 (6.37)	10.86 (8.27)	0-18
Complex PW (T3)	33	0.05 (0.23)	4.5 (6.07)	9.93 (7.76)	0-18

Note. LK = letter knowledge; PA = phonological awareness; RAN = rapid automatized naming; W = words; PW = pseudowords.

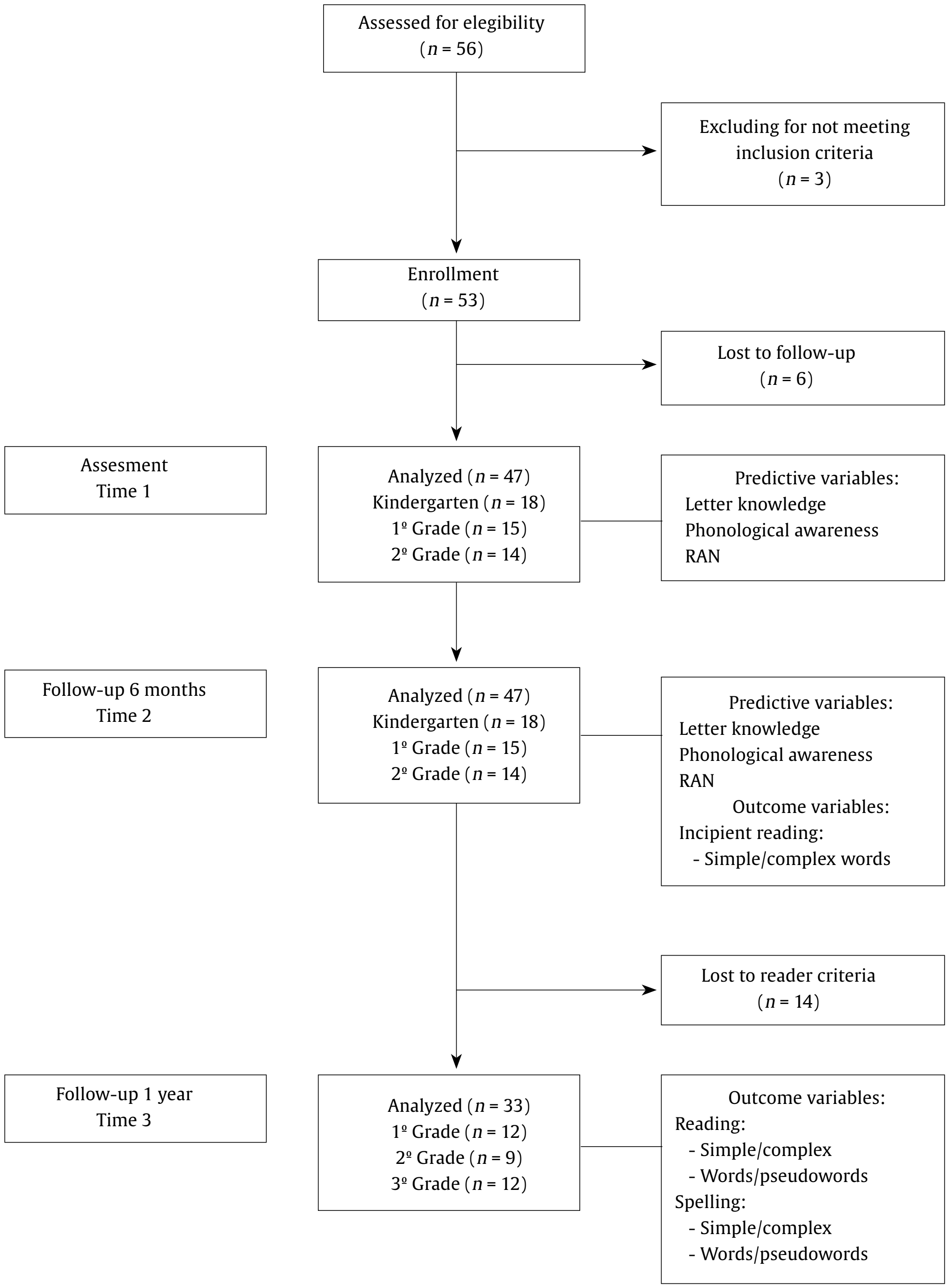

Figure 1. Sampling, Flow of Participant, and Variables Examined trough the Longitudinal Study

include a measure of letter knowledge. It should be noted that the RAN letter task is not considered a measure of letter knowledge because it only includes five supposedly known and frequent letters, whereas measures of letter knowledge use many or all of the letters of the alphabet (Speece, Mills, Ritchey, & Hillman, 2003). In sum, the evidence in Spanish seems to be consistent with the assertion that phonemic awareness takes place along with the process of learning to read (see Morais, Cary, Alegria, & Bertelson, 1979).

Cross-linguistic research has also shown that letter knowledge stands out as a more powerful preschool predictor of learning to read in shallow orthographies than in deep orthographies (e.g., Caravolas, Lervåg, Defior, Málková, & Hulme, 2013; Georgiou, Torppa, Manolitsis, Lyytinen, & Parrila, 2012). Research with Spanish-speaking children has highlighted letter knowledge as one of the most powerful and enduring predictors (Bravo-Valdivieso, Villalón, & Orellana, 2003, 2006; Kim & Pallante, 2012), even explaining more than 50% of the variance of reading and spelling words (Casillas & Goikoetxea, 2007). In Finnish, it has been reported that the most salient predictive measure to identify children at risk of having difficulties in learning to read is letter recognition (Lyytinen, Erskine, Hämäläinen, Torppa, & Ronimus, 2015).

The differences between predictors of reading could also be explained by the syllabic structure of languages, although it has gone unnoticed in cross-language research on predictors of reading. One exception is Seymour, Aro, Erskine, & COST Action A8's (2003) study, which included syllabic structure as an influential factor in reading achievement in 13 European orthographies. The results showed that there were more errors and slower speed in beginning readers in orthographies with complex syllables than in orthographies with simple syllables, even when children had equivalent letter knowledge and fluency in reading familiar words. The authors explained these results by indicating that grapheme-phoneme correspondences that are embedded in consonant groups impede their recovery and slow down their decoding, whereas a simple and repetitive CV structure facilitates it. English-speaking children who are beginning to read must deal with highly complex but frequent words (e.g., CV.CCVC.CCC letters sequence of butterfly), which requires early analysis of the so-called orthographical clusters (Adams, 1990) or higher-level orthographic representations (Grainger & Ziegler, 2011) formed by multi-consonant patterns (e.g., str-) or morphemes (e.g., -ing). Spanish-speaking children must deal with simple structure syllables in both frequent and infrequent words.

Longitudinal studies are required in Spanish to help clarify the role of different predictors in reading and spelling in shallow orthographies. Such research might be critical to understanding the importance of letter knowledge and phonological awareness in literacy, which can lead to the development and refinement of programs for teaching Spanish-speaking children to read. In addition, previous research could be improved in order to understand the impact of syllable structure on learning to read. To our knowledge, the longitudinal studies in Spanish cited above have not considered syllabic structure. Therefore, even studies that examined the role of phonological awareness and letter knowledge in reading did not evaluate simple and complex stimuli separately. The longitudinal research in Spanish also faces a difficulty that is typical of shallow and simple orthographic languages, that is, fast progress of children in learning to read. Thus, as soon as children know letters, it is relatively frequent for them to begin to decode.

This study was conducted in order to re-examine the predictive power of letter knowledge and phonological awareness in both reading and spelling. To overcome limitations of previous research, we included letter knowledge among predictor variables, and we separated simple and complex stimuli in reading and spelling tasks. In addition, this study was carried out with a sample of children whose literacy was undertaken mainly or exclusively by school, which allows better control of content and duration of literacy teaching. We hypothesized that the strongest predictor of reading and spelling of simple syllabic structure stimuli would be letter knowledge, but complex syllabic structure stimuli would also require phonological awareness as a mediator in the relationship between letter knowledge and reading and spelling.

Method

Design

A longitudinal panel study was used where participants were assessed three times (Time 1, Time 2 and Time 3) in one year, with 6-month intervals. This design increases internal and external validity, compared to cross-sectional designs, and makes it possible to establish predictive relationships between predictor variables and outcome. Moreover, the evaluation of the same group of children at three time points is particularly useful for understanding the underlying mechanisms of the predictive relationship through a possible mediating variable, and developmental changes. Data analysis of panel designs was performed with multiple regressions. The temporal sequence of the study is presented in Figure 1.

Participants

Participants were 47 native Spanish-speaking children – 18 kindergartens, 15 first graders, and 14 second graders – who attended a public school in Bilbao that serves mostly Romani families with a low socio-economic level. The International Socio-Economic Index (ISEI) of the school was -1.98 on the evaluation of the school in 2015, which classifies it at a "very low level" (OECD, 2016). Teaching language at the school is Spanish. Nine additional children were excluded from the sample for not completing the tasks at any of the three assessment points, mainly in Time 3 because they attended another school. Informed consents of the adults responsible for all the children who participated in the study were collected.

Demographic and cognitive characteristics of the participants by grade are presented in Table 1. Mean IQ scores, as estimated from their performance on the Peabody Picture Vocabulary Test-Third Edition (Dunn & Dunn, 1997), were situated approximately one standard deviation below the mean, according to normative data for the test in all the grades. Mean scores for working memory, estimated from their performance on the Stanford-Binet Intelligence Scales–Fifth Edition (Roid, 2003), were near the mean, based on normative data for the test in all the grades. To consider children readers, the criterion was established of having read at least three words correctly. At the beginning of the study, 79% (18 kindergartens, 13 first graders, and 6 second graders) were prereaders considering the mentioned criteria, that is, they were not able to correctly read three or more words with a simple structure and three or more words with a complex structure. Specifically, in Time 1, none of the kindergarten children were able to read simple or complex words; 40% of first graders were readers of simple words, but only 13% could read complex words; and 71% of second graders were readers of simple words, whereas 57% could read complex words. In all, 33 children were readers at the end of the study one year later (12 kindergartens, 9 first graders, and 12 second graders).

For a better description of the sample, we include some details about the teaching method. The method for teaching reading and spelling begins in Kindergarten using a commercial program and continues in first and second-grade using an alphabetic type program created by the school. The letter used was lowercase with Masallera font, as well as Arial upper- and lowercase in classroom material. The linguistic tasks and units are presented in the following sequence: writing and identifying the letter, joining letters to form syllables in order to read and write them, reading and spelling words, and reading and writing sentences.

Instruments

Three tests were used for the assessment: the standardized Rapid Automatized Naming and Rapid Alternating Stimulus Tests (RAN-RAS; Wolf & Denckla, 2005), the standardized Reading Processes Assessment Battery-Revised (PROLEC-R; Cuetos, Rodríguez, Ruano, & Arribas, 2007), and the Reading and Writing Test 1 (RW1; Goikoetxea & Martínez, 2014). The first two batteries are widely used to evaluate RAN and reading, respectively. However, there is not much consensus about the instruments and tasks used to evaluate letter knowledge and phonological knowledge in Spanish. Moreover, separation of stimuli according to their syllabic structure was required for the evaluation of reading and spelling in order to answer our research question. Therefore, the RW1 test was used because it allows us to evaluate both predictor variables such as letter knowledge and phonological awareness as word reading and spelling, controlling lexicality of stimuli (words and pseudowords), and syllabic structure (simple and complex). In addition, this test offers two parallel forms, which reduce memory effects in repeated measures and are optimal for longitudinal studies. Reliability indices for this sample were adequate (α > .80) at different assessment times. The RW1 also showed convergent validity due to moderate to high correlations with standardized test scores (mean r = .86). Subtests used and their psychometric properties are described in detail below.

Predictor variables

Letter knowledge (RW1). In this task the child read and then wrote the 27 Spanish alphabet letters by hand in upper- and lowercase. The instructions were the following. For letter identification, "Point to each letter and tell me the name of the letter", and for letter writing by hand, "Let's write the letters I'm going to dictate. There are many letters, so you may not know them all. If you don't know any of the letters, draw an '=' symbol. If you know how to make the letter uppercase or large and lowercase or small, write it both ways". The order of items was random but the same for all participants. The name or sound of the letter was considered a correct answer, and the examiner dictated each letter by saying its name and its sound. Productions that included the correct formation of all parts of the letter were considered correct answers. Reversals in orientation were not considered incorrect for the scoring. The average number of correctly named and handwritten upper- and lowercase letters constituted the total score for letter knowledge. The reliability coefficient for scores in this sample was .97 in Time 1 and 2. Correlation coefficient of scores on this test for this sample with the letter-naming fluency subtest of the IDEL (Baker, Cummings, Good, & Smolkowski, 2007) was .86 in Times 1 and 2.

Phonological awareness (RW1). This task required the child to detect pairs of words that start with the same syllable and pairs of words that start with the same phoneme. It contains two lists of 12 pairs of words, half were "yes" pairs, sharing the same initial syllable (e.g., *mano-mapa*) or phoneme (e.g., *mesa-moto*), and the other half were "no" pairs, sharing no phoneme at all (e.g., *seta-mono*). All the words were chosen from LEXIN, the printed vocabulary for beginning readers (Corral, Ferrero, & Goikoetxea, 2009) and were represented by a normalized drawing. Instructions were the following: "Here we have two drawings. I am going to name them. Repeat them with me. Do they sound the same at the beginning?" Pairs of words in each list were distributed in random order, but were the same for all participants, with the only restriction of not including four consecutive "yes" or four consecutive "no" pairs. The average number of correctly identified syllable and phoneme pairs constituted total score for phonological awareness. Reliability coefficient for the scores in this sample was .84 in Time 1 and .83 in Time 2. Correlation coefficient of scores on this test for this sample with the phoneme-segmentation fluency subtest of the IDEL (Baker et al., 2007) was .54 in Time 1 and .40 in Time 2.

Rapid Automatized Naming (RAN-RAS). This test evaluates ability to recognize visual symbols quickly. Rapid color and object naming subtests were administered. Each subtest consists of 50 items corresponding to five frequent stimuli that are repeated in random order. On these tasks, the child had to name colors and objects as quickly as possible. Test-retest reliability in this sample was r = .80 for colors test and r = .63 for objects test.

Reading variables

Incipient reading words with a simple structure (RW1). This task is designed to evaluate an initial reading level and makes it possible to approach the incipient knowledge used to identify common words. The test consisted of 12 items in all, and target words had two to four syllables with a simple V or CV structure (e.g., *conejo* [rabbit]). The task required the child to identify the word that corresponded to the one represented by a drawing and named by the examiner, from a list of five stimuli based on Spanish writing development models (Ferreiro & Teberosky, 1979). The five options always included: a target word (e.g, *conejo*), an incorrect word with same syllable structure (e.g., *casita*), an incorrect orthographic structure with correct letters (e.g., *cnjoeo*), syllabic correct letters (e.g., *cnj*), and syllabic incorrect letters (e.g., *aia*). The instructions were the following: "Here we have a drawing. I am going to name it. Repeat it with me. Point out where this word is written correctly." This task does not require reading aloud, but in order to respond correctly, an initial level of decoding is required because they need to identify at least segments of written words. The number of items answered correctly constituted the total score. Reliability coefficient for scores in this sample was .80 in Time 2.

Incipient reading words with a complex structure (RW1). This task required the child to identify the word that corresponded to the one represented by a drawing and named by the examiner from a list of stimuli, as in the previous task. The test consisted of eight items in all. Target words had two to four syllables with a complex CCV or CCVC syllabic structure (e.g., *profesora* [teacher]). Instructions and scoring were the same as in the previous task. Reliability coefficient for scores in this sample (n = 47) was .95 in Time 2.

Reading words with a simple structure RW1). On this task the child read aloud 40 frequent words with a two to four syllable simple V or CV structure (e.g., *tomate*). All the words were chosen from LEXIN (Corral et al., 2009). Instructions given to the child were the same as the PROLEC-R word-reading subtest "Read these words aloud." Hesitations were considered correct as long as articulation was correct. The number of stimuli the child read correctly determined the total score. The score was the same for the following reading tasks. Reliability coefficient for scores in this sample was .98 in Time 3.

Reading pseudowords with a simple structure (RW1). On this task the child read aloud 20 pseudowords with two to four syllables and a simple V or CV syllabic structure and created from the words on the reading task (e.g., *tovate*). One consonant was substituted in each two-syllable or three-syllable word and two consonants in four-syllable words. Instructions given to the child were the same as on the PROLEC-R pseudoword-reading subtest, "These words are invented. Read them aloud." Reliability coefficient for scores in this sample was .93 in Time 3.

Reading words with a complex structure (RW1). On this task the child read aloud 20 frequent words with one to four syllables and at least one syllable with a CCV, CVC, or CCVC structure (e.g., *plátano* [banana]). Reliability coefficient for scores in this sample was .98 in Time 3.

Reading pseudowords with a complex structure (RW1). On this task the child read aloud 20 pseudowords with one to four syllables and at least one syllable with a CCV, CVC, or CCVC structure and created from the words on the reading task (e.g., *plámano*). One consonant was substituted in each two-syllable or three-syllable word and two consonants in four-syllable words, as in the simple pseudowords task. Reliability coefficient for scores in this sample was .98 in Time 3.

Reading words (PROLEC-R). On this task the child read aloud 40 words varying in lexical frequency, with one to four syllables and at least one syllable with a VC, CCV, CVC, CVVC, or CCVC structure. Reliability coefficient for scores in this sample was .99 in Time 3.

Reading pseudowords (PROLEC-R). On this task the child read aloud 40 pseudowords created from the words on the reading task. Reliability coefficient for scores in this sample was .98 in Time 3.

Spelling variables

Spelling words with a simple structure (RW1). On this task the child spelled 40 words with a simple syllabic structure from the reading test. A normalized drawing represented each word.

Instructions were the following: "Here we have a drawing. I am going to name it. Spell the word as best as you can." The instructions were the same for the following word spelling tasks. Written productions made in upper or lower case as well as punctuation marks were ignored in scoring. The score was the same for the following spelling tasks. The number of stimuli written orthographically correctly constituted the total score. Reliability coefficient for scores in this sample was .98 in Time 3.

Spelling pseudowords with a simple structure (RW1). On this task the child spelled the 20 dictated pseudowords with a simple syllabic structure from the reading test. Instructions were the following: "I'm going to dictate some invented words that don't exist. Spell them as best you can." The instructions were the same for the following pseudoword spelling tasks. Reliability coefficient for the scores in this sample was .93 in Time 3.

Spelling words with a complex structure (RW1). On this task the child spelled the 20 words with a complex syllabic structure from the reading test. Reliability coefficient for the scores in this sample was .98 in Time 3.

Spelling pseudowords with a complex structure (RW1). On this task, the child spelled the 20 dictated pseudowords with a complex syllabic structure from the reading test. Reliability coefficient for scores in this sample was .98 in Time 3.

Procedure

The study included three assessment times, carried out during 15 months, from October 2014 to December 2015. In Time 1, all the participants were assessed at the beginning of the school year (October to December); in Time 2, at the end of the school year (May to June); and in Time 3, at the beginning of the next school year (October to December). Prediction measures were taken in Times 1 and 2 and the reading and spelling measures in Time 3. The order of administration of prediction measures was the following: rapid naming, phonological awareness, and letter knowledge. Reading and spelling tasks were counter-balanced and the order of stimuli type was the following: simple words, complex words, simple pseudowords, complex pseudowords, PROLEC-R words, and PROLEC-R pseudowords. To avoid memory effects from the reading task to the spelling task (or vice versa), the two tasks were carried out on different days, with an interval of three or four days. All the children were evaluated individually by the two authors and another evaluator who received training in the administration of tasks. The evaluation was carried out in a quiet room in the school.

Results

All statistical analyses were conducted with a level of significance set at .05. The analyses were performed using SPSS software, version 18.0.0.

Table 1 shows the achievement of children in test of time 1, 2 and 3 according to grade. An ANOVA showed that sex was no significant, except for letter knowledge in Time 1, $F(1, 45) = 4.79$, $p = .034$, letter knowledge in Time 2, $F(1, 45) = 4.39$, $p = .042$, and incipient reading with simple structure, $F(1, 45) = 4.28$, $p = .044$, but grade had a significant effect, except for the CI, $F(2, 44) = 0.45$, $p = .642$, non-verbal memory, $F(2, 44) = 1.82$, $p = .173$, letter knowledge in Time 2, $F(2, 44) = 2.68$, $p = .079$, phonological awareness in Time 2 $F(2, 44) = 1.49$, $p = .237$, and RAN in Time 1, $F(2, 44) = 1.59$, $p = .215$, and Time 2, $F(2, 44) = 3.17$, $p = .052$, and incipient reading with simple structure, $F(1, 104) = 2.93$, $p = .064$.

Table 2 shows the correlations between predictive measures in Times 1 and 2 with the incipient reading measures in Time 2 and reading and spelling measures in Time 3, according to syllabic structure. Age presented moderate coefficients with all the reading and spelling measures, and high correlations with spelling simple words. Letter knowledge presented moderate to high correlations in both Time 1 and Time 2, reaching higher coefficients with reading and spelling simple than complex structure stimuli. Regarding phonological awareness in Time 1, correlation coefficients were moderate for all the measures, although higher on words with a complex structure. In Time 2, correlations were low, decreasing compared to Time 1, showing somewhat higher coefficients for reading and spelling complex stimuli and simple pseudowords, except with incipient reading, that phonological awareness presented moderate correlation coefficients with both types of stimuli. In Time 1, rapid naming showed low and non-significant correlation coefficients with the majority of reading and spelling variables. In Time 2, correlations range from low to moderate, increasing compared to Time 1, especially with stimuli with a complex structure.

Table 2. Correlation Analyses among Predictor Measures and Reading and Spelling according to the Syllabic Structure

Incipient reading in Time 2 (n = 47)							
Variable	T	Simple	Complex				
Age	T1	.411**	.467**				
LK	T1	.828***	.683***				
	T2	.891***	.588***				
PA	T1	.614***	.631***				
	T2	.661***	.578***				
RAN	T1	.361*	.399**				
	T2	.427**	.461**				
Reading in Time 3 (n = 33)							
		Simple		Complex		Complex (standardized test)	
Variable	T	Words	Pseudowords	Words	Pseudowords	Words	Pseudowords
Age	T1	.690***	.586***	.518***	.636***	.654***	.671***
LK	T1	.838***	.816***	.764***	.701***	.699***	.695***
	T2	.735***	.711***	.716***	.647***	.632***	.626***
PA	T1	.620***	.669***	.729***	.664***	.654***	.636***
	T2	.284	.390*	.520**	.375*	.422*	.417*
RAN	T1	.336	.318	.316	.391*	.333	.336
	T2	.485**	.418*	.526**	.515*	.493**	.473**
Spelling in Time 3 (n = 33)							
		Simple		Complex			
Variable	T	Words	Pseudowords	Words	Pseudowords		
Age	T1	.780***	.649***	.639***	.626***		
LK	T1	.840***	.822***	.694***	.707***		
	T2	.729***	.734***	.635***	.661***		
PA	T1	.615***	.649***	.659***	.687***		
	T2	.302	.479**	.453**	.457**		
RAN	T1	.324	.318	.374*	.398*		
	T2	.439*	.490**	.527**	.555**		

Note. T = time; LK = letter knowledge; PA = phonological awareness; RAN = rapid automatized naming.
$^{*}p < .05$., $^{**}p < .01$., $^{***}p < .001$.

Hierarchical multiple regression analyses were carried out to examine the specific and unique contribution of predictors in the variations in performance on reading and spelling words and pseudowords with simple and complex structures 6 and 12 months later. Independent variables, in order, were: age, letter knowledge, and phonological awareness. RAN was excluded from these analyses because of the non-significant contribution to the variance in reading and spelling performance in Time 3 in any type of stimulus. Predictive variables measured in Time 1 and Time 2 were taken to explain results in incipient reading in Time 2 and literacy in Time 3. Variables were introduced in separate stages with each independent variable. The order in which predictors

Table 3. Hierarchical Regression Analyses for the Measures in Time 1 Predicting Incipient Reading in Time 2 and Reading and Spelling in Time 3 according to the Syllabic Structure

Incipient Reading (n = 47)

Step	Simple			Complex		
	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF
1 Age	.17	.17	9.16**	.22	.22	12.54**
2 LK	.69	.52	75.29***	.47	.26	21.47***
3 PA	.69	.00	0.46	.52	.05	4.09*

Reading (n = 33)

Step	Simple						Complex						Complex (standardized test)					
	Words			Pseudowords			Words			Pseudowords			Words			Pseudowords		
	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF
1 Age	.48	.48	28.21***	.34	.34	16.21***	.27	.27	11.38**	.40	.40	21.04***	.43	.43	23.19***	.45	.45	23.37***
2 LK	.77	.30	39.37***	.69	.35	33.49***	.60	.33	24.24***	.58	.17	12.36**	.59	.16	11.75**	.60	.15	11.10**
3 PA	.78	.01	1.32	.72	.03	3.48	.69	.09	8.75**	.65	.08	6.29*	.66	.07	5.84*	.66	.06	4.98*

Spelling (n = 33)

Step	Simple						Complex					
	Words			Pseudowords			Words			Pseudowords		
	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF
1 Age	.61	.61	48.12***	.42	.42	22.61***	.41	.41	21.44***	.39	.39	19.96***
2 LK	.85	.24	45.90***	.73	.31	33.70***	.57	.16	11.53**	.58	.19	13.15**
3 PA	.85	.01	1.63	.75	.02	2.66	.65	.08	6.18*	.67	.09	7.81**

Note. LK = letter knowledge; PA = phonological awareness.
*p < .05, **p < .01, ***p < .001.

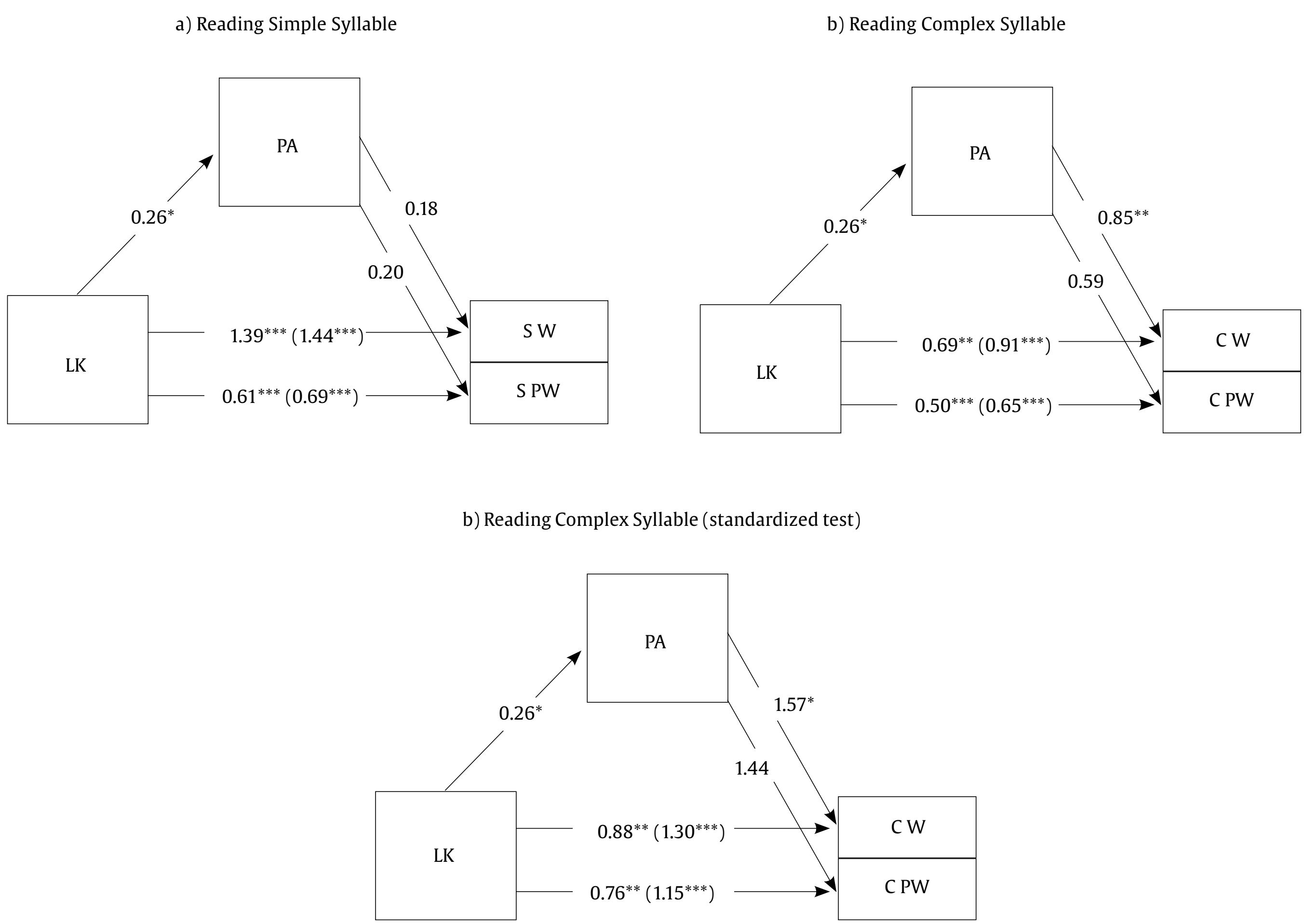

Figure 2. Mediation Analyses Displaying both a Direct Effect of Letter Knowledge in Time 1 on Reading Measures in Time 3 and Indirect Effect via Phonological Awareness in Time 2.
Note. LK = letter knowledge; PA = phonological awareness; S = simple; C = complex; W = words; PW = pseudowords; Age was controlled in the analysis.
*p < .05, **p < .01, ***p < .001.

Table 4. Hierarchical Regression Analyses for the Measures in Time 2 Predicting Reading and Spelling in Time 3 according to the Syllabic Structure (*n* = 33)

Reading

	Simple						Complex						Complex (standardized test)					
	Words			Pseudowords			Words			Pseudowords			Words			Pseudowords		
Step	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF
1 Age	.48	.48	28.21***	.34	.34	16.21***	.27	.27	11.37***	.40	.40	21.04***	.428	.428	23.19***	.450	.450	25.37***
2 LK	.68	.21	19.75***	.58	.24	17.01***	.55	.28	18.72***	.55	.15	10.00**	.557	.129	8.73**	.567	.117	8.12**
3 PA	.70	.01	1.38	.63	.05	3.93	.67	.12	10.60**	.61	.06	4.48*	.650	.093	7.70*	.661	.094	8.00*

Spelling

	Simple						Complex					
	Words			Pseudowords			Words			Pseudowords		
Step	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF	R^2	ΔR^2	ΔF
1 Age	.61	.61	48.12***	.42	.42	22.61***	.41	.41	21.44***	.39	.39	19.96***
2 LK	.77	.16	20.53***	.65	.23	19.52***	.55	.14	9.02**	.56	.17	11.27**
3 PA	.79	.03	3.53	.75	.10	12.15**	.66	.11	9.44*	.66	.11	9.05**

Note. LK = letter knowledge; PA = phonological awareness.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

were introduced into the regression equation was determined by correlation coefficients obtained and previous literature. Variance inflation values were all lower than 10, and condition indices were lower than 30. Regression analyses for the final model are described.

Regression Analyses for Predictive Variables in Time 1 to Explain Results in Time 2 and Time 3

Table 3 shows regression analyses for predictive variables taken in Time 1 to explain results in incipient reading in Time 2 and literacy one year later, in Time 3.

Incipient reading. Performance on incipient reading words with a simple structure was predicted by letter knowledge (β = .84, *p* = .000). Both, age (β = -.11, *p* = .304) and phonological awareness (β = .08, *p* = .501) were not significant. Together, these variables contributed to approximately 70% of variance.

Performance on incipient reading words with a complex structure was predicted by letter knowledge (β = .42, *p* = .013) and phonological awareness (β = .30, *p* = .049). Age (β = .09, *p* = .470) was not significant. Together, these variables contributed to approximately 52% of variance.

Reading. Performance on reading words with a simple structure was predicted by letter knowledge (β = .57, *p* = .000) and by age (β = .32, *p* = .004). Phonological awareness (β = .13, *p* = .260) was not significant. Together, these variables contributed to approximately 78% of the variance. Performance on reading simple pseudowords was predicted by letter knowledge (β = .55, *p* = .001). Phonological awareness (β = .24, *p* = .072) and age (β = .19, *p* = .120) were not significant. Together, these variables contributed to approximately 72% of variance.

Performance on reading words with a complex structure was predicted by letter knowledge (β = .43, *p* = .009) and phonological awareness (β = .40, *p* = .006). Age (β = .13, *p* = .297) was not significant. Together, these variables contributed to approximately 69% of variance. Performance on reading complex pseudowords was predicted by phonological awareness (β = .36, *p* = .018) and by age (β = .35, *p* = .012). Letter knowledge (β = .27, *p* = .109) was not significant. Together, these variables contributed to approximately 65% of variance.

Performance on reading complex words on the standardized test PROLEC-R was predicted by age (β = .38, *p* = .007) and phonological awareness (β = .35, *p* = .022). Letter knowledge (β = .26, *p* = .119) was not significant. Together, these variables contributed to approximately 66% of variance. Performance on reading pseudowords on PROLEC-R was predicted by age (β = .41, *p* = .004) and phonological awareness (β = .32, *p* = .034). Letter knowledge (β = .26, *p* = .121) was not significant. Together, these variables contributed to approximately 66% of variance.

Spelling. Performance on spelling words with a simple structure was predicted by letter knowledge (β = .51, *p* = .000) and age (β = .45, *p* = .000). Phonological awareness (β = .12, *p* = .221) was not significant. Together, these variables contributed to approximately 85% of variance. Performance on spelling pseudowords with a simple structure was predicted by letter knowledge (β = .54, *p* = .001) and age (β = .28, *p* = .020). Phonological awareness (β = .20, *p* = .114) was not significant. Together, these variables contributed to approximately 75% of variance.

Performance on spelling words with a complex structure was predicted by age (β = .37, *p* = .010) and phonological awareness (β = .36, *p* = .019). Letter knowledge (β = .25, *p* = .131) was not significant. Together, these variables contributed to approximately 65% of variance. Performance on spelling pseudowords with a complex structure was predicted by phonological awareness (β = .39, *p* = .009) and age (β = .34, *p* = .015). Letter knowledge (β = .26, *p* = .109) was not significant. Together, these variables contributed to approximately 75% of variance.

Regression Analyses for Predictive Variables in Time 2 to Explain Results in Time 3

Table 4 shows regression analyses for predictive variables taken in Time 2 to explain results in literacy six months later, in Time 3.

Reading. Performance on reading words with a simple structure was predicted by letter knowledge (β = .47, *p* = .001) and age (β = .46, *p* = .001). Phonological awareness (β = .13, *p* = .249) was not significant. Together, these variables contributed to approximately 70% of variance. Performance on reading simple pseudowords was predicted by letter knowledge (β = .46, *p* = .002) and age (β = .36, *p* = .011). Phonological awareness (β = .24, *p* = .057) was not significant. Together, these variables contributed to approximately 63% of variance.

Performance on reading words with a complex structure was predicted by letter knowledge (β = .46, *p* = .002), phonological awareness (β = .37, *p* = .003), and age (β = .29, *p* = .027). Together, these variables contributed to approximately 67% of variance. Performance on reading complex pseudowords was predicted by age (β = .47, *p* = .002), letter knowledge (β = .34, *p* = .024), and phonological awareness (β = .26, *p* = .043). Together, these variables contributed to approximately 61% of variance.

Performance on reading complex words on the standardized test PROLEC-R was predicted by age (β = .51, *p* = .001), phonological

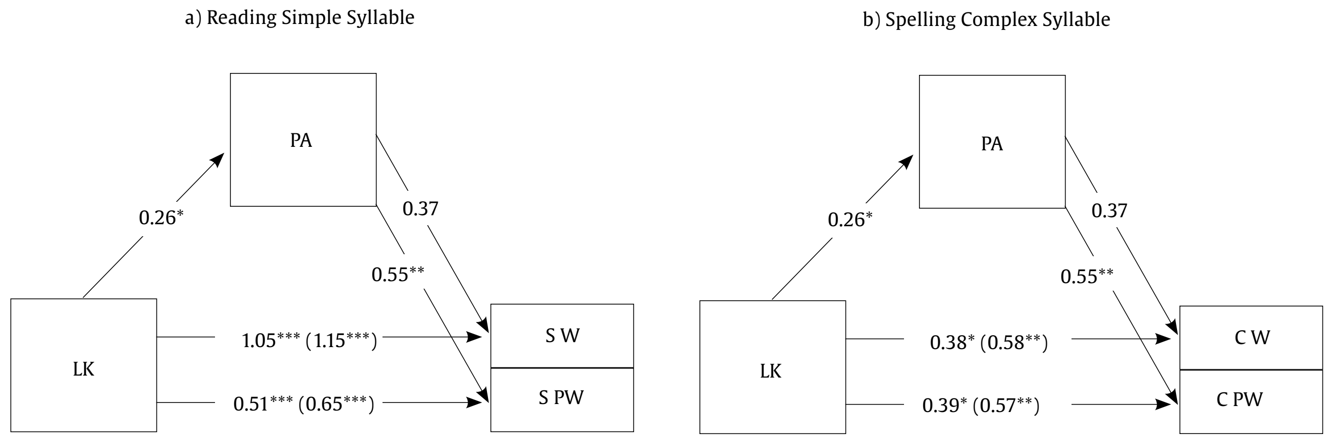

Figure 3. Mediation Analyses Displaying both a Direct Effect of Letter Knowledge in Time 1 on Spelling Measures in Time 3 and an Idirect Effect via Phonological Awareness in Time 2.
Note. LK = letter knowledge; PA = phonological awareness; S = simple; C = complex; W = words; PW = pseudowords; Age was controlled in the analysis.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

awareness (β = .33, *p* = .010), and letter knowledge (β = .28, *p* = .047). Together, these variables contributed to approximately 65% of variance. Performance on reading pseudowords on the PROLEC-R was predicted by age (β = .54, *p* = .000) and phonological awareness (β = .33, *p* = .008). Letter knowledge (β = .26, *p* = .059) was not significant. Together, these variables contributed to approximately 66% of variance.

Spelling. Performance on spelling words with a simple structure was predicted by age (β = .59, *p* = .000) and letter knowledge (β = .39, *p* = .001). Phonological awareness (β = .17, *p* = .070) was not significant. Together, these variables contributed to approximately 79% of variance. Performance on spelling pseudowords with a simple structure was predicted by age (β = .44, *p* = .000), letter knowledge (β = .41, *p* = .001), and phonological awareness (β = .34, *p* = .002). Together, these variables contributed to approximately 75% of variance.

Performance on spelling words with a complex structure was predicted by age variable (β = .50, *p* = .000), phonological awareness (β = .36, *p* = .005), and letter knowledge (β = .28, *p* = .045). Together, these variables contributed to approximately 66% of variance. Performance on spelling pseudowords with a complex structure was predicted by age (β = .46, *p* = .001), phonological awareness (β = .35, *p* = .005), and letter knowledge (β = .33, *p* = .019). Together, these variables contributed to approximately 66% of variance.

Mediation Analyses

To test whether the letter knowledge variable influences reading and spelling through a mediator, phonological awareness, depending on syllabic structure, we conducted mediation analyses using PROCESS (Hayes, 2013). Letter knowledge at Time 1 was considered the independent variable, phonological awareness at Time 2 was considered the mediator variable, age was introduced as a covariate, and each of the reading and spelling measures at Time 3 (reading and spelling, words and pseudowords; simple structure and complex structure) was considered an outcome variable. Mediation analyses were tested using the bootstrapping method with bias-corrected confidence estimates, and 95% confidence interval of the indirect effect was obtained with 5,000 bootstrap samples (Preacher & Hayes, 2008). To report effect size, we selected standardized *b* for the indirect effect or index of mediation (Preacher & Kelley, 2011).

Figures 2 and 3 display standardized regression coefficients for the relationship between letter knowledge and reading or spelling outcomes as mediated by phonological awareness. Letter knowledge at Time 1 was found to be positively associated with phonological awareness at Time 2, *B* = 0.26, *t*(2, 30) = 2.68, *p* = .012. However, age as a covariate was not found to be significantly associated with phonological awareness at Time 2, *B* = -0.99, *t*(2, 30) = -1.42, *p* = .165. Finally, in general results indicated that the mediator, phonological awareness at Time 2, was not significantly associated with reading or spelling, except on stimuli with complex syllabic structures.

In cases where both the association between the independent variable and mediator awareness (*a*-path) and the association between mediator and outcomes (*b*-path) were significant, mediation analyses confirmed the mediator role (significant indirect effect, *ab*) of phonological awareness in the relationship between letter knowledge and reading or spelling with complex stimuli (except on reading complex pseudowords with the non-standardized measure), representing a small effect (β < .30).

On reading measures, phonological awareness was a significant mediator in reading complex words (*B* = 0.23, 95% BCa CI [0.05, 0.55]; β = .17, 95% BCa CI [0.03, 0.39]), complex words from PROLEC-R (*B* = 0.42, 95% BCa CI [0.07, 1.18]; β =.17, 95% BCa CI [0.03, 0.44]) standardized test, and complex pseudowords from PROLEC-R (*B* = 0.38, 95% BCa CI [0.07, 1.06]; β =.17, 95% BCa CI [0.03, 0.44]).

On the spelling measures, phonological awareness was a significant mediator in spelling complex words (*B* = 0.21, 95% BCa CI [0.06, 0.48]; β = .19, 95% BCa CI [0.05, 0.40]), spelling simple pseudowords (*B* = 0.15, 95% BCa CI [0.02, 0.33]; β = .16, 95% BCa CI [0.02, 0. 38]), and spelling complex pseudowords (*B* = 0.19, 95% BCa CI [0.05, 0.43]; β = .18, 95% BCa CI [0.05, 0.38]).

In addition, in all cases, the results indicated that the direct effect of letter knowledge continued to be significant when controlling for phonological awareness.

Discussion

In this study, we investigated the predictive value of letter knowledge and phonological awareness in incipient reading, reading, and spelling simple (V and CV) and complex (CCV, CVC, CCVC) stimuli in Spanish-speaking children. The results revealed that predictors of reading and spelling differed between simple and complex syllabic structure stimuli after six and 12 months, in Spanish, a shallow orthography.

Next, we will discuss the results according to the syllabic structure of stimuli.

First, letter knowledge was the strongest predictor of reading-spelling words and pseudowords with a simple structure, and phonological awareness did not mediate in this relationship.

The phonological awareness measure was a syllable and phoneme identification measure. We observed that this measure showed the characteristic performance of children at these ages. However, on letter task we found a low performance, characteristic of disadvantaged children which made it possible to predict how well they learned to read one year later. In addition, the magnitude of the predictive relationship between letter knowledge and phonological awareness and reading was similar to magnitude for spelling.

Our results suggest that knowing letters seems to be necessary, and decisive in learning to begin to read and spell consistent and simple words. In fact, nine of the 33 readers (27% of the sample) who were able to read simple words showed low levels of phoneme awareness (unable to correctly identify initial phonemes in more than half of the stimuli), but all knew 16 or more letters at the end of previous school year. This finding concurs with those found by previous studies in Spanish and Catalan indicating that letter knowledge enables children to read some words, regardless of whether they show a deep level of phonological awareness (Carrillo, 1994; Casillas & Goikoetxea, 2007; Castells & Solé, 2013), as well as the question of whether phonological awareness is universally necessary to learn to read (e.g., Castles & Coltheart, 2004; Morais et al., 1979). Knowledge of the alphabet seems to be the necessary element in getting ready to read words, at least in some shallow and simple orthographies where letter-sound correspondence is predictable and unambiguous in decoding.

The reason is that letter name refers to its sound, and this iconicity of letters is used by children in their first efforts to read and spell (Adams, 1990; Treiman & Kessler, 2003, 2014). The simplicity of syllabic structure plays a key role in facilitating reading and spelling based on letter recognition, without a need for precise phonemic awareness, even in incipient reading. In Spanish, knowing letters makes it possible to begin to read simple syllables immediately because possibilities for co-articulation are quite low; for each consonant, there are only five possible unions with another phoneme, one for each vowel (e.g., ma, me, mi, mo, mu). Thus, it is easier to access an orthographic mapping at the level of what Ehri (2014) called grapho-syllabic patterns, in which a reader knows the orthography of a syllable as a grapheme-phoneme unit. This would help beginning readers to develop what Share (1995) called self-learning, with a reliable mechanism to identify new sequences of letters that follow the same pattern (in this case, CV) and strategies to begin decoding words (CV-CV) by themselves. That is, when children see the word *mapa* [map], they need to perform only two connections between orthographic units ma and pa and corresponding sounds /ma/ and /pa/, without having to manipulate phonemes in isolation.

Second, regression analyses showed that when stimuli had a complex structure, phonological awareness played a role in reading and spelling and mediated its relationship with letter knowledge. However, this mediation represented a small effect, and letter knowledge continued to be significant in all cases. Therefore, the importance of letter knowledge as a predictor of reading and spelling a year later was maintained, even when we controlled the effect of phonological awareness.

Some linguistic considerations explain the predictive and mediation role of phonological awareness in complex-syllables stimuli. Complex syllables include a larger number of consonant phonemes in the onset or coda than simple syllables. Consonant phonemes are less perceptible than vowels according to the universal scale of sonority, and in Spanish, consonants adhere to vowels, forming margins with a decreasing sonority pattern, which makes it more difficult to manipulate consonant phonemes than vowel phonemes. This could present a decoding challenge for beginning readers, who have to segment the syllable into its phonemes because these new letter sequences do not fit the syllabic CV pattern. For example, necessary decoding skills for reading or spelling the word *trompeta* [trumpet] are more difficult and take longer to acquire than those needed to read or spell t*omate* [tomato]. The union or segmentation of phonemes becomes much more complicated because the initial syllable of trom.pe.ta has a CCVC structure with a beginning or onset tr-, a core -o-, and a coda -m. The effect of syllabic structure on phonological awareness in six orthographies (English, French, Greek, Islandic, Portuguese, and Spanish) is offered by Duncan et al. (2013). Their results show that English-speaking children (frequently exposed to complex structures and a non-syllabic or stress-timed rhythm) did not present differences in their pattern of performance on identification of syllables and phonemes, whereas Spanish-speaking children (frequently exposed to simple structures and a syllable-timed rhythm) presented better performance on the syllable than on the phoneme. In Spanish, there is already evidence showing that pre-literate children and illiterate adults have a great ability to identify the syllable, but great difficulty in developing pre-reading phonemic skills (Goikoetxea, 2005; Morais & Kolinsky, 2005). Our results suggest that in complex syllables, it is no longer sufficient to know letters, and a more sophisticated strategy is required, such as phonemic manipulation.

The findings from this study add to existing research showing that, in Spanish, the predictive power of phonological awareness seems to be stronger in the decoding skills of complex syllables. In fact, children take longer to acquire them, as has been found in research on Spanish spelling (Defior, Jiménez-Fernández, & Serrano, 2009), but mastery of phonological awareness tasks did not significantly influence reading-spelling when stimuli had a simple structure. Our results reveal a direct effect of letter knowledge on learning to read and spell simple words, mediated by phonological awareness in complex stimuli and preceded by experience with decoding simple stimuli. Letter knowledge favors phonological awareness (e.g., Carroll, 2004), and in Spanish there are data showing that learning to read (the creation of orthographic memory of words) facilitates discrimination of phonemes (Goikoetxea, 2005).

Although the present study should be replicated in larger samples, the results invite discussion of some issues. In a language where letter knowledge is a strong predictor of beginning to read, it would be desirable to reexamine the main causes for initial reading problems using simple and complex syllabic structure stimuli. However, different authors agree on pointing out the imbalance between the importance of letter knowledge in learning to read and the scarcity of studies dedicated to better understanding its development, its effect on literacy (e.g., Foulin, 2005; Phillips, Piasta, Anthony, Lonigan & Francis, 2012), and the elements that characterize effective teaching of the alphabet. The results of this investigation indicate that research on reading must pay attention to the orthography depth and syllabic structure of each language before making any generalizations.

Despite the limitations noted, this study has clear educational implications for the design of effective preventive and remedial interventions. In shallow orthographies with a predominance of simple syllabic structures, explicit teaching of the alphabet seems to be fundamental in early literacy. In addition, it is important to develop phonological skills through easy tasks and training in grapheme-phoneme correspondences and grapho-syllabic patterns using simple stimuli. For example, the explicit teaching of the union of a consonant phoneme with the five vowels would facilitate understanding of the decoding system for many words in Spanish. Once a mastery of the alphabet and its functioning in reading and spelling of simple words is achieved, more advanced training in phonemic awareness could be more effective, allowing successful reading and spelling of complex stimuli.

Conflict of Interest

The authors of this article declare no conflict of interest.

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References

Adams, M. J. (1990). *Beginning to read: Thinking and learning about print.* Cambridge, MA: MIT press.

Aguilar, M., Guzmán, J. I. N., Jiménez, I. M., Cuevas, C. A., Consejero, E. M., & Olivier, P. R. (2010). Velocidad de nombrar y conciencia fonológica en el aprendizaje inicial de la lectura. *Psicothema, 22*, 436-442.

Baker, D. L., Cummings, K. D., Good, R. H., & Smolkowski, K. (2007). *Indicadores dinámicos del éxito en la lectura (IDEL®): Summary of decision rules for intensive, strategic, and benchmark instructional recommendations in kindergarten through third grade* (Technical Report No. 1). Eugene, OR: Dynamic Measurement Group.

Bravo-Valdivieso, L., Villalón, M., & Orellana, E. (2003). Predictividad del rendimiento de la lectura: el segundo año básico. *Psykhé, 12*, 29-36.

Bravo-Valdivieso, L., Villalón, M., & Orellana, E. (2006). Predictibilidad del rendimiento en la lectura: una investigación de seguimiento entre primer y tercer año. *Revista Latinoamericana de Psicología, 38*, 9-20.

Caravolas, M., Lervåg, A., Defior, S., Málková, G. S., & Hulme, C. (2013). Different patterns, but equivalent predictors, of growth in reading in consistent and inconsistent orthographies. *Psychological Science, 24*, 1398-1407. https://doi.org/10.1177/0956797612473122

Carrillo, M. (1994). Development of phonological awareness and reading acquisition. *Reading and Writing, 6*, 279-298. https://doi.org/10.1007/BF01027086

Carroll, J. M. (2004). Letter knowledge precipitates phoneme segmentation, but not phoneme invariance. *Journal of Research in Reading, 27*, 212-225. https://doi.org/10.1111/j.1467-9817.2004.00228.x

Casillas, Á., & Goikoetxea, E. (2007). Sílaba, principio-rima y fonema como predictores de la lectura y la escritura tempranas. *Infancia y Aprendizaje, 30*, 245-259. https://doi.org/10.1174/021037007780705184

Castells, N. & Solé, I. (2013). Early literacy development in Catalan: Characteristics and instructional influence. *Da Investigação às Práticas, 3*(1), 3-23. https://doi.org/10.25757/invep.v3i1.25

Castles, A., & Coltheart, M. (2004). Is there a causal link from phonological awareness to success in learning to read? *Cognition, 91*, 77-111. https://doi.org/10.1016/S0010-0277(03)00164-1

Corral, S., Ferrero, M., & Goikoetxea, E. (2009). LEXIN: A lexical database from Spanish kindergarten and first-grade readers. *Behavior Research Methods, Instruments & Computers, 41*, 1009-1017. https://doi.org/10.3758/BRM.41.4.1009

Coulmas, F. (2003). *Writing systems: An introduction to their linguistic analysis.* Cambridge, MA: Cambridge University Press.

Cuetos, F., Rodríguez, B., Ruano, E., & Arribas, D. (2007). *PROLEC-R: batería de evaluación de los procesos lectores de los niños de educación primaria revisada* [Reading processes assessment battery of children in primary education reviewed]. Madrid, Spain: TEA.

Dauer, R. M. (1983). Stress-timing and syllable-timing reanalyzed. *Journal of Phonetics, 11*, 51-62.

Defior, S., Jiménez-Fernández, G., & Serrano, F. (2009). Complexity and lexicality effects on the acquisition of Spanish spelling. *Learning and Instruction, 19*, 55-65. https://doi.org/10.1016/j.learninstruc.2008.01.005

Duncan, L. G., Castro, S. L., Defior, S., Seymour, P. H., Baillie, S., Leybaert, J., ... Lund, R. (2013). Phonological development in relation to native language and literacy: Variations on a theme in six alphabetic orthographies. *Cognition, 127*, 398-419. https://doi.org/10.1016/j.cognition.2013.02.009

Dunn, L. M., & Dunn, L. M. (1997). *PPVT-III PEABODY Test de vocabulario en imágenes* [Picture Vocabulary Test]. Madrid, Spain: TEA.

Ehri, L. C. (2014). Orthographic mapping in the acquisition of sight word reading, spelling memory, and vocabulary learning. *Scientific Studies of Reading, 18*, 5-21. https://doi.org/10.1080/10888438.2013.819356

Ellis, N. C., & Hooper, A. M. (2001). Why learning to read is easier in Welsh than in English: Orthographic transparency effects evinced with frequency-matched tests. *Applied Psycholinguistics, 22*, 571-599. https://doi.org/10.1017/S0142716401004052

Ferreiro, E., & Teberosky, A. (1979) *Los sistemas de escritura en el desarrollo del niño.* México, DF: Siglo XXI.

Foulin, J. N. (2005). Why is letter-name knowledge such a good predictor of learning to read? *Reading and Writing, 18*, 129-155. https://doi.org/10.1007/s11145-004-5892-2

Frost, R. (2012). A universal approach to modeling visual word recognition and reading: Not only possible, but also inevitable. *Behavioral and Brain Sciences, 35*, 310-329. https://doi.org/10.1017/S0140525X12000635

Georgiou, G., Parrila, R., & Papadopoulos, T. C. (2008). Predictors of word decoding and reading fluency across languages varying in orthographic consistency. *Journal of Educational Psychology, 100*, 566-580. https://doi.org/10.1037/0022-0663.100.3.566

Georgiou, G. K., Torppa, M., Manolitsis, G., Lyytinen, H., & Parrila, R. (2012). Longitudinal predictors of reading and spelling across languages varying in orthographic consistency. *Reading and Writing, 25*, 321-346. https://doi.org/10.1007/s11145-010-9271-x

Goikoetxea, E. (2005). Levels of phonological awareness in preliterate and literate Spanish-speaking children. *Reading and Writing, 18*, 51-79. https://doi.org/10.1007/s11145-004-1955-7

Goikoetxea, E., & Martínez, N. (2014). *PRELEO test de lectura y escritura para prelectores y lectores principiantes en español y euskera* (pre-published version).

Goswami, U., Gombert, J. E., & de Barrera, L. F. (1998). Children's orthographic representations and linguistic transparency: Nonsense word reading in English, French, and Spanish. *Applied Psycholinguistics, 19*, 19-52. https://doi.org/10.1017/S0142716400010560

Grainger, J., & Ziegler, J. (2011). A dual-route approach to orthographic processing. *Frontiers in Psychology, 2*, 54. https://doi.org/10.3389/fpsyg.2011.00054

Hayes, A. F. (2013). *An introduction to mediation, moderation, and conditional process analysis: A regression-based approach.* New York, NY: Guilford Press

Katz, L., & Frost, R. (1992). The reading process is different for different orthographies: The orthographic depth hypothesis. In R. Frost & L. Katz (Eds.), *Orthography, phonology, morphology, and meaning* (pp. 45-66). Amsterdam, NL: Elsevier.

Kim, Y. S., & Pallante D. (2012). Predictors of reading skills for kindergartners and first grade students in Spanish: A longitudinal study. *Reading and Writing, 25*, 1-22. https://doi.org/10.1007/s11145-010-9244-0

Landerl, K., & Wimmer, H. (2008). Development of word reading fluency and spelling in a consistent orthography: An 8-year follow-up. *Journal of Educational Psychology, 100*, 150-161. https://doi.org/10.1037/0022-0663.100.1.150

Liberman, I. Y. (1973). Segmentation of the spoken word and reading acquisition. *Annals of Dyslexia, 23*, 64-77. https://doi.org/10.1007/BF02653842

Lyytinen, H., Erskine, J., Hämäläinen, J., Torppa, M., & Ronimus, M. (2015). Dyslexia—early identification and prevention: Highlights from the Jyväskylä longitudinal study of dyslexia. *Current Developmental Disorders Reports, 2*, 330-338. https://doi.org/10.1007/s40474-015-0067-1

Maddieson, I. (2013). Syllable structure. In M. S. Dryer & M. Haspelmath (Eds.), *The world atlas of language structures online.* Leipzig, Germany: Max Planck Institute for Evolutionary Anthropology. Retrieved from http://wals.info/chapter/12

Mann, V., & Wimmer, H. (2002). Phoneme awareness and pathways into literacy: A comparison of German and American children. *Reading and Writing, 15*, 653-682. https://doi.org/10.1023/A:1020984704781

Melby-Lervåg, M., Lyster, S. A. H., & Hulme, C. (2012). Phonological skills and their role in learning to read: A meta-analytic review. *Psychological Bulletin, 138*, 322-352. https://doi.org/10.1037/a0026744

Morais, J., Cary, L., Alegria, J., & Bertelson, P. (1979). Does awareness of speech as a sequence of phones arise spontaneously? *Cognition, 7*, 323-331. https://doi.org/10.1016/0010-0277(79)90020-9

Morais, J., & Kolinsky, R. (2005). Literacy and cognitive change. In M. J. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 188-203). Malden, MA: Blackwell Publishing.

OECD. (2016). *PISA 2015 Results (Volume I): Excellence and equity in education.* Paris, France: OECD Publishing. Retrieved from https://www.oecd-ilibrary.org/education/pisa-2015-results-volume-v_9789264285521-en

Phillips, B. M., Piasta, S. B., Anthony, J. L., Lonigan, C. J., & Francis, D. J. (2012). IRTs of the ABCs: Children's letter name acquisition. *Journal of School Psychology, 50*, 461-481. https://doi.org/10.1016/j.jsp.2012.05.002

Preacher, K. J., & Hayes, A. F. (2008). Contemporary approaches to assessing mediation in communication research. In A. F. Hayes, M. D. Slater, & L. B. Snyder (Eds.), *The Sage sourcebook of advanced data analysis methods for communication research* (pp. 13-54). Thousand Oaks, CA: Sage.

Preacher, K. J., & Kelley, K. (2011). Effect size measures for mediation models: quantitative strategies for communicating indirect effects. *Psychological Methods, 16*, 93-115. https://doi.org/10.1037/a0022658

Real Academia Española - RAE. (2010). *Ortografía de la lengua española* [Orthography of the Spanish language]. Madrid, Spain: Espasa.

Roach, P. (2009). *English phonetics and phonology: A practical course* (4th ed.). Cambridge, MA: Cambridge University Press.

Roid, G. H. (2003). *Stanford-Binet Intelligence Scales* (5th ed.). Itasca, IL: Riverside.

Schmalz, X., Marinus, E., Coltheart, M., & Castles, A. (2015). Getting to the bottom of orthographic depth. *Psychonomic Bulletin & Review, 22*, 1614-1629. https://doi.org/10.3758/s13423-015-0835-2

Seymour, P. H., Aro, M., Erskine, J. M., & COST Action A8 (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology, 94*, 143-174. https://doi.org/10.1348/000712603321661859

Share, D. L. (1995). Phonological recoding and self-teaching: Sine qua non of reading acquisition. *Cognition, 55,* 151-218. https://doi.org/10.1016/0010-0277(94)00645-2

Share, D. L. (2008). On the Anglocentricities of current reading research and practice: The perils of overreliance on an "outlier" orthography. *Psychological Bulletin, 134,* 584-615. https://doi.org/10.1037/0033-2909.134.4.584

Speece, D. L., Mills, C., Ritchey, K. D., & Hillman, E. (2003). Initial evidence that letter fluency tasks are valid indicators of early reading skill. *Journal of Special Education, 36,* 223-233. https://doi.org/10.1177/002246690303600403

Stanovich, K. E. (1991). Cognitive science meets beginning reading. *Psychological Science, 2,* 70-81. https://doi.org/10.1111/j.1467-9280.1991.tb00103.x

Suárez-Coalla, P., García de Castro, M., & Cuetos, F. (2013). Variables predictoras de la lectura y la escritura en castellano. *Infancia y Aprendizaje, 36,* 77-89. https://doi.org/10.1174/021037013804826537

Treiman, R., & Kessler, B. (2003). The role of letter names in the acquisition of literacy. In H. W. Reese & R. Kail (Eds.), *Advances in child development and behavior* (Vol. 31, pp. 105-135). San Diego, CA: Academic Press.

Treiman, R., & Kessler, B. (2014). *How children learn to write words.* New York, NY: Oxford University Press.

Wolf, M., & Denckla, M. B. (2005). *RAN/RAS: Rapid automatized naming and rapid alternating stimulus tests.* Austin, TX: Pro-ed.

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

Ziegler, J. C., & Goswami, U. (2005). Reading acquisition, developmental dislexia, and skilled reading across languages: A psycholinguistic grain size theory. *Psychological Bulletin, 131,* 3-29. https://doi.org/10.1037/0033-2909.131.1.3