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From cotenyou to continue: modeling the contributions of phonological and morphological awareness to spelling accuracy in young Spanish-English dual-language learners

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Purpose: This study evaluates a developmental model of predictive relationships between oral-language based metalinguistic skills in kindergarten and single-word reading and spelling in second grade for Dual-language Learning (DLL) children.
Methods: Seventy-one Spanish-speaking English-learning children participated in this longitudinal study. A partial-least squares path model investigated how cross-linguistic Phonological Awareness in kindergarten predicted English Morphological Awareness (MA) and later English literacy performance (single-word reading and spelling) in second grade.
Results: Spanish Phonological Awareness (S-PA) at the end of kindergarten predicted 2nd grade English MA (E-MA) development and indirectly facilitated spelling performance. English Phonological Awareness (E-PA) at the end of kindergarten uniquely supported 2nd grade word reading and spelling accuracy. Within the model, S-PA was the only significant longitudinal predictor of E-MA, and E-PA was the predictor most strongly associated with spelling skill, overall.
Conclusion: Children learning more than one language are able to leverage first language knowledge dynamically to support second language literacy outcomes over time. Study results suggest DLL children's phonological awareness in both languages should be assessed in kindergarten to more accurately estimate risk-status for poor literacy performance over time.

KEYWORDS

dual-language learners, phonological awareness, morphological awareness, reading, spelling

Introduction

Young Spanish-speaking Dual-language Learners (DLLs) in the United States, or approximately 1 in 4 students in public schools, often experience pronounced achievement gaps in reading and writing compared to their monolingual English-speaking peers (McFarland et al., 2019; Wang and Dinkes, 2020). One factor driving this disparity is an inadequate evidence-base for the task of supporting education decision making in diverse classrooms, such as assessing risk-status for poor literacy outcomes in early elementary

school for DLL children (Noguerón-Liu, 2020). By some estimates, Spanish-speaking children who are beginning to learn how to speak and read and write English at the beginning of kindergarten need 5–7 years to fully access the content of lessons taught in English language immersion classrooms (Cummins, 2021). The protracted timeline for DLLs to access the curriculum in the classroom is at odds with the often-abbreviated timeline clinicians are given to diagnose language-based literacy disorders. Many states require children at-risk for language-based reading disorders to be identified for special education services by 3rd grade, just 4 years after starting school (Acosta et al., 2020). This mismatch underscores the need for more effective early identification tools that can identify language-based learning disorders within language-learning differences.

This study aims to identify longitudinal cross-linguistic causal relationships between earlier emerging oral-based metalinguistic skills (i.e., phonological and morphological awareness) and later acquired literacy skills (i.e., word reading and spelling) for Spanish-speaking English-learning DLLs. By quantifying the predictive relationships between these skills, we provide concrete data to inform education progress monitoring and decision making. Both path analysis and regression models are used to evaluate developmental, predictive patterns. Study results can inform early elementary school education decision making by identifying how DLL children can leverage first language knowledge to support second language literacy growth over time.

Oral language foundations of metalinguistic skills

Oral language abilities provide the foundation for the extended development of experience-dependent literacy skills (Durant et al., 2022; Snowling and Hulme, 2021). Of particular importance to literacy development is metalinguistic awareness, or the ability to consciously reflect on and manipulate the structural units of language (Gillon, 2017a; Lee et al., 2023). In turn, the development of these metalinguistic skills (e.g., phonological and morphological awareness) depends on previously environmentally learned linguistic information stored in a memory network known as the mental lexicon. While accurately measuring the breadth of the mental lexicon in people who speak more than one language has been an area of considerable debate (e.g., Babayiğit et al., 2022; Monsrud et al., 2019; Pratt et al., 2024), there is an emerging consensus on the developmental sequence of PA and its importance to literacy development in DLL children.

Phonological awareness

Phonological Awareness is defined as a set of interrelated skills encompassing both the understanding of how oral language can be split into smaller components of sound as well as the reasoning skills to judge and manipulate sound patterns (Anthony and Francis, 2005; Stahl and Murray, 1994). The progression of PA skill development, where children are capable of reflecting on smaller units of sound (e.g., syllables and phonemes), is dependent on larger vocabularies pressuring implicitly learned phonological representations to become increasingly precise (Ziegler and Goswami, 2005) and is similar across languages (Anthony et al., 2011). For instance, children must be able to discriminate between similar sounding words, such as *hit* and *bit* in English, in order to retrieve the correct conceptual information from memory to build meaning during language use (Walley et al., 2003). In English, the existing holistic representation of /hɪt/ would be restructured into syllable onset and rhyme, e.g. /h/ and /ɪt/, when pressured by a similar newly learned word such as /bɪt/ that varies a single feature. Children with robust lexicons consequently have more detailed representations of sound patterns, making them better prepared for the challenges of early literacy development. Mapping mental representations of transient units of sound to static visual symbols, like letters in Spanish and English, is one of the core challenges in both early single-word reading and writing (Míguez-Álvarez et al., 2022). The dynamic interplay of language-specific structures and domain-general awareness of patterns is not constrained to just the sounds of language, however. It also extends to how languages encode patterns of meaning in words.

Morphological awareness

The awareness and skill of manipulating the units of meaning that combine to make words in languages is referred to as Morphological Awareness (MA) and is a major driver of literacy success over time in both English and Spanish (Lee et al., 2023). For example, adding the suffix *–ful* to the noun *fear* produces a new adjective, *fearful* defined as "frightening, feeling afraid, or showing fear," that shares both similar phonological structure and meaning. This is different from the minimal phonological pair of /hɪt/ and /bɪt/ which have similar phonological representations but unrelated meanings. In contrast, the minimal morphological pair of *fear* and *fearful* have similar phonological structure and related meanings.

MA has been observed to expand rapidly throughout elementary school in both monolingual and bilingual students (Berninger et al., 2010), presumably due to the dramatic increase of derived morphologically complex vocabulary that children encounter in the classroom. Vocabulary growth in school-aged children is positively affected by derivational morphological problem solving, in which children analyze unknown derived vocabulary and infer meaning through knowledge of the component morphemes (Levesque et al., 2021). While children are expanding their repertoire of morphologically derived vocabulary in the classroom, they are also becoming literate.

Metalinguistics is a promising area of research for assessment of children in the process of transitioning from monolingual to second language speakers in early elementary school. Metalinguistic skills are not only predictive of reading comprehension outcomes in monolinguals and bilinguals in later elementary school (Míguez-Álvarez et al., 2022), but they are also teachable and transferable across languages (Oshchepkova et al., 2023). Moreover, metalinguistic performance has been identified as an area of relative strength for children learning more than one language compared to their monolingual peers, dependent on both task, age, and environment (Adesope et al., 2010; Bailey et al., 2020; Oller and Jarmulowicz, 2007; Ware et al., 2020). Therefore, it is necessary

to identify the types of elicitation tasks sensitive to developmental changes in oral-language based metalinguistic skills for children learning to listen and speak one language at home but read and write in another at school across early elementary school to accurately predict early literacy outcomes.

Developmental relationships between metalinguistic awareness and literacy skills

Literacy encompasses a set of interrelated skills that develop over a prolonged time span. Children must first learn to read before they use reading to acquire new knowledge. Acquiring the alphabetic principle, or the awareness that letters represent sounds, requires children to consciously reflect on their implicitly learned phonological knowledge and make the individual sounds of language objects of abstract thought (Apel et al., 2022). In the early stages of reading, when students are learning to associate sounds with letters, PA makes the largest contribution to word learning (Gillon, 2017b). Children first leverage PA to learn these associations via decoding before the more cognitive taxing task of encoding (Furnes and Samuelsson, 2009). As children become more familiar decoding and encoding increasingly complex patterns of language, the demands of reading and spelling change. During this transition, children are increasingly confronted with more morphologically derived vocabulary that carry much of the content of academic subjects, particularly in written text (Anglin et al., 1993). MA then emerges as a significant unique predictor of literacy development, overtaking PA and vocabulary (Apel et al., 2022; Fumero and Tibi, 2020). Increased awareness of morphological patterns leads to more accurate production of phonologically opaque orthographic representations (Masterson and Apel, 2010). Children learning English who recognize that the <ph> for /f/ in *physic* is related to the spelling of *physical* education and *physician*'s note is more likely to read and spell all three more accurately (Deacon et al., 2014).

Developmental relationships between metalinguistics and literacy skills in DLLs

For Spanish-English bilinguals who are developing early pre-literacy skills in both languages, recognizing letters as symbols for sounds and PA are similarly predictive of reading and spelling performance in both Spanish and English (Furnes and Samuelsson, 2009). Spanish PA has reliably been shown to predict literacy achievement in English for Spanish-speaking DLLs (Míguez-Álvarez et al., 2022). While both Spanish and English PA significantly support orthographic-based MA for DLL second graders, English PA is uniquely predictive (Durant et al., 2022). However, Spanish-speaking DLLs' ability to leverage metalinguistic awareness grows instead of decreases with time in the classroom. English and Spanish MA not only directly supports reading comprehension in older elementary Spanish-English DLLs but also indirectly through contributions to academic vocabulary knowledge and fluent word reading (Gilbert et al., 2014; Kieffer et al., 2013; Kieffer and Box, 2013). How DLL children leverage MA to support writing development is not as well-described despite the importance of writing to academic and vocational outcomes (Fumero and Tibi, 2020).

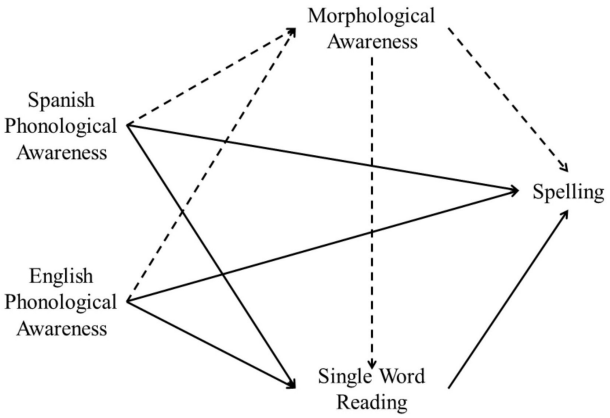

FIGURE 1
Proposed developmental model of relationship between phonological awareness, morphological awareness, single word reading and spelling in Spanish-English DLLs. The solid lines represent relationships demonstrated by experimental studies with DLLs. The dashed lines represent relationships observed in monolinguals and hypothesized for DLLs.

The model in Figure 1 illustrates developmental relationships between metalinguistic skills (i.e., PA and MA) and literacy skills (i.e., single-word reading and spelling) that are described in the literature for children receiving literacy instruction in English at school (Goodwin et al., 2017; Kieffer et al., 2013; Kieffer and Box, 2013). The solid lines represent relationships demonstrated by experimental studies with DLLs. The dashed lines represent relationships observed in English monolinguals and theoretically hypothesized for DLLs learning English. In other words, the dashed lines illustrate relationships that to the best of our knowledge have not yet substantiated in the evidence-base for approximately 1 in 4 children in American schools who are Spanish-speaking and English-learning. This study aims to explore the size, direction, and significance of relationships between these variables of interest during the relatively less documented developmental window between kindergarten and 2nd grade for DLL students.

The current study

The present study uses an exploratory model of structured equations to:

1) Identify the relative contributions of Spanish and English oral language based metalinguistic skills to English single-word reading and spelling.
2) Look for significant cross-linguistic relationships between Spanish and English PA in kindergarten and English MA in 2nd grade for Spanish-speaking DLLs.

3) Determine if English MA predicted single-word reading and spelling accuracy in English for 2nd grade Spanish-speaking DLLs.
4) Describe how Spanish PA, English PA, and English MA uniquely and collectively support single-word reading and spelling in English across early elementary school for Spanish-speaking DLLs.

This model seeks to identify individual and cumulative cross-linguistic predictors of single-word spelling in early elementary school to inform the early identification of DLL children who are at-risk for poor literacy outcomes. The current study was designed longitudinally to permit model results to be interpreted in terms of pre-literacy school readiness for sequential Spanish-speaking DLLs. English was selected as the language for the longitudinal dependent measure variables due to the expectation that DLLs demonstrate literacy knowledge exclusively in English on standardized measures of academic proficiency in the United States (Acosta et al., 2020; Cummins, 2021). The period of 2nd grade was selected as time 2 for the current model, because children are expected to "…demonstrate command of the conventions of Standard English…spelling when writing" by the end of 2nd grade (Common Core State Standards Initiative – Preparing America's Students for College and Career, 2010).

Methods

Participants

The participants consisted of 45 boys and 26 girls (n = 71) sampled from two public schools in an area with a high concentration of Spanish-speakers in Memphis, Tennessee. The present analysis draws on data from a larger longitudinal project examining language and literacy development in Spanish-speaking English-learning DLLs. While the current study focuses on cross-linguistic relationships among phonological awareness, morphological awareness, and single-word reading and writing in English, related components of the broader study are reported elsewhere (e.g., Burrows et al., 2019; Durant et al., 2024; Gibson et al., 2012; McMillen et al., 2020; Oller et al., 2007). Following IRB approval and informed consent to participate in the study collected during the child's kindergarten year, each child's caregiver completed a questionnaire that had been translated into Spanish. According to parents' reports, Spanish was the primary language in the home. Demographic information collected during kindergarten, are reported in Table 1. Testing was conducted at two points in time, first in the last 3 months of kindergarten (M_{age} = 5 years and 8 months), and again in the middle of 2nd grade (M_{age} = 7 years and 6 months). Chi-square calculations revealed that there were significantly more boys than girls in the study, χ^2 (1, N = 71) = 5.09, p = 0.02, and more children in the sample had siblings than did not have siblings, χ^2 (1, N = 71) = 36.63, $p < 0.001$.

All participants passed a bilateral hearing screening at 25 dB for tones at 1,000, 2,000, and 4,000 Hz. Children were excluded from the study if the child asked to discontinue testing (n = 2) or if technical difficulties occurred during testing (n = 1). The remaining 68 participants completed the entire testing battery in the study design and described below.

TABLE 1 Means and (in parentheses) standard deviations for demographic variables.

Variable	Total
Age average in months	66.66 (3.76)[a]
First exposure average age in months	2.82 (1.68)[b]
Sex	
Boys	61.4%[a]
Girls	38.6%[a]
Birth country	
USA	73.5%[c]
Other	26.5%[c]
Preschool in English	
Yes	57.2%[a]
No	36.8%[a]
Mothers' stay in USA average in years	10.7 (3.9)[b]
Mothers' English proficiency	
None	87.1%[d]
Some	12.9%[d]
Mothers' education average in years	8.2 (2.7)[c]
Adults in home average	1.57 (1.28)[d]
Children in home average	2.99 (1.37)[a]
Birth order	
First- or only-born	48.6%[d]
Later-born	51.5%[d]

The sample sizes for each group were as follows:
[a]71.
[b]70.
[c]69.
[d]68.

Measures

Phonological awareness

English phonological awareness (E-PA) was operationalized as the composite of two subtests, elision and sound matching, from the *Comprehensive Test of Phonological Processing* (CTOPP; Wagner et al., 1999), as shown in Table 2. For both subtests, children were given three practice items and the test ended when they reached a ceiling of three consecutive incorrect responses. The CTOPP standardized scores were derived from a monolingual English-speaking sample, which was inappropriate to assess DLL linguistic performance (Acosta et al., 2020). Therefore, raw scores from the elision and sound matching subtests were used as a composite score and were calculated as a simple sum.

Phonological awareness in Spanish (S-PA) was operationalized as the two subtests, elision and sound matching from *Test of Phonological Processing in Spanish* (TOPPS; August et al., 2001).

TABLE 2 Measures used to determine metalinguistic and orthographic skill.

Time	Skill	Language	Test	α	Task	Example
1	Phonological awareness	Spanish	TOPPS	0.92[a]	sound matching	¿Qué palabra empieza con el sonido /p/ como piano? ¿hora, suelo, o pies?
					Sound elision	"Di tocadiscos. Ahora di tocadiscos sin decir discos."
		English	CTOPP	>0.90[b]	Sound matching	Which word begins with [s]? *fish, seat,* or *keys*
					Sound elision	Say *cat* without the [k]
2	Morphological awareness	English	ETB	0.89[d]	Morpheme elision	Emptiness. The cereal box is ____
	Word reading		TOWRE	0.89[c]		
	Word spelling		Spell	0.88[d]	Spell	Spell [joked]

TOPPS, Test of Phonological Processing in Spanish (Francis et al., 2001); CTOPP, Comprehensive Test of Phonological Processing (Wagner et al., 1999); Extract the Base (August et al., 2001); TOWRE, Test of Word Reading Efficiency (Torgensen et al., 1999); Spell, Morphologically Complex Word Spelling (Apel et al., 2004).
[a]Reported in Wagner et al. (1999).
[b]Reported for DLL children tested at the beginning of 1st grade (Goldenberg et al., 2014).
[c]Reported in Vaughn et al. (2008)
[d]Scores from this study's participants.

TABLE 3 Criteria for scoring extract the base morphological awareness task performance.

Score	Criteria	Example
3	The root or base word was identified and modified correctly	*Emptiness → empty*
2	The root or base word was identified and modified inaccurately	*Emptiness → empti*
1	Incorrect root or base word was identified and the derivational affix removed	*Emptiness → empt*
0	Produced answer was unrelated to the stimulus or if the written response was grossly incorrect	*Emptiness → eptin*

The TOPPS is a non-standardized test used to measure phonological processing skills in Spanish-speaking children. Raw scores from the two subtests were used as a composite score and were calculated as a simple sum. The tasks are analogous to the CTOPP, reported above, except in Spanish.

Morphological awareness

MA skill was measured by the *Extract the Base Test* (ETB; August et al., 2001). For this task, students were presented a derived word both orally and in writing, such as *emptiness*, and then were asked to write a word in the blank to finish a sentence, such as "The cereal box is _____." To correctly answer this question, the student must analyze the stimulus to identify the component derivational morphemes, separate them, identify the root morpheme, and make a surface form that finishes the sentence. A 4-point raw score scale, informed by Carlo et al. (2004), was developed to score the morphological analysis accuracy of ETB responses, presented in Table 3 (see Durant et al., 2024 for more details). The ETB is not standardized. Scores were calculated as a simple sum.

Word reading

Test of Word Reading Efficiency (*TOWRE*; Torgensen et al., 1999) was the standardized test used as the outcome measure of isolated word reading accuracy (READ). The timed measures of English word attack (sounding out or decoding non-sense words), called *phonetic efficiency* in this test, and word identification (reading progressively more challenging real words), called *sight word efficiency*, were used. The decoding/phonetic efficiency subtest measures children's ability to sound out as many non-sense words as possible in 45 s. The sight word efficiency subtest measures the number of real words that can be accurately read in 45 s. A composite score of the raw scores for the phonetic efficiency and sight word efficiency, calculated as a simple sum, was used as the reading accuracy (READ) measure.

Spelling

Spelling skill (SPELL) was measured with a non-standardized spelling test, developed by Apel et al. (2004). This consisted of a list of 50 words that tested English morphographemic spelling convention knowledge, such as <c> for /k/ and /s/, as in *cute* and *center*. Each word was dictated aloud, put into a sentence, and then spoken in isolation again. The SPELL score reported is the Element Score, calculated in accordance with the criteria in the Computerized Spelling Sensitivity System (CSSS) manual (Masterson and Apel, 2010). The element score reflects the accuracy of the orthographic representation of each phonological element, or sound unit, in the word as demonstrated in Table 4. See Masterson and Apel (2010) for more details. The measure reported is a sum of the phonological element score across items.

Procedures

Spanish and English PA testing occurred in the last 3 months of kindergarten, and MA and literacy skill testing occurred during the middle of 2nd grade. At both points in time, children were tested individually in relatively quiet locations at their school. In kindergarten, test sessions were conducted on two different

TABLE 4 Criteria for coring complex spelling morphological awareness performance.

Score	Criteria	Example
3	Accurate phoneme-grapheme correspondence	/ʃ/ → <sh>
2	Plausible phoneme-grapheme correspondence	/ʃ/ → <s>
1	Grossly incorrect phoneme-grapheme correspondence	/ʃ/ → <f>
0	Phoneme not represented by grapheme	/ʃ/ → ϕ

days and administered in Spanish and English by native speakers. Testing sessions did not exceed 1 h at any point in time. Digital recordings of every test session were made with Marantz PMD670 solid state professional digital recorders and Isomax E61OP6T2 Countryman headset microphones and used for off-line scoring and further analyses.

Analytic plan

The pre-analysis data inspection included examination of patterns of missing data, which showed that approximately 1% of data was missing at random, as determined by Little's Missing Completely at Random test (Li, 2013). Using SPSS version 22, multiple imputation was used to create complete data sets across all test score variables (S-PA, E-PA, MA, READ, and SPELL). Five imputed data sets were generated, with the imputed values constrained by the minimum and maximum possible score for each measure. Analyses were completed for all imputed data sets then averaged to reduce potential bias (Carpenter et al., 2023).

Descriptive statistics for the scores for performance of English and Spanish PA in kindergarten and MA, READ, and SPELL in 2nd grade met the assumptions of normality (Li, 2013). A paired *t*-test evaluated if there was a significant difference between students' kindergarten English and Spanish PA skills in kindergarten to infer the relative language dominance of the sample. Correlation analyses examined if the relationships between Spanish PA, English PA, MA, READ, and SPELL performance were significant, a preliminary step in determining if further path modeling was supported.

Although PLS path modeling is a form of structural equation modeling (SEM), it differs from traditional covariance-based SEM in that it is more appropriate for use in exploratory models predicting target constructs in smaller sample sizes (Dash and Paul, 2021). When target constructs are not measured using multiple indirect measurement instruments, PLS modeling is preferred over covariance-based SEM, as in this study (Sarstedt et al., 2014). Covariance-based SEM is preferred for confirming assumed structural relationships. Conversely, PLS modeling is recommended for theoretically motivated exploratory models where assumptions of normality for the target constructs are not known (Hair et al., 2017). Consequently, SmartPLS 3 (Ringle and Wende, 2015) was used to investigate the theoretically motivated model in Figure 1 using partial least squares (PLS) path model.

Path modeling calculates both direct relationships between two variables and indirect relationships through potentially mediating variables. Figure 1 illustrates the exploratory model, with the assigned relationships with dotted lines based on the theoretical sequence of language and literacy acquisition in DLLs represented in the literature. The path model proposes that: (1) Spanish and English PA serve as foundation skills that predict later metalinguistic and literacy outcomes; (2) English MA emerges later and is predicted by PA; (3) oral-language based metalinguistic skills, including MA, contribute to later literacy skills, such as single-word reading and spelling; and (4) single-word spelling is the final skill to develop in the model, predicted by PA, MA, and single-word reading.

The significance of both the direct and indirect estimated path coefficients between variables was tested through non-parametric bootstrapping procedures (Efron and Tibshirani, 1986). Specifically, the standard error estimates for the estimated model parameters were estimated via bootstrapping distributions from approximately 5,000 subsamples of size 500 of the study data. *T*-tests were computed using the bootstrapped standard error to assess the significance of the parameter estimate value (Wong, 2013). The direct effect values for each predictor variable represent the strength of the influence of the individual predictor variable on a dependent variable. The R^2 values reported for the path model, in contrast, represents the amount of variation explained for each dependent variable by the cumulative influence of all predictor variables.

Results

Descriptive analysis

Student performance on kindergarten PA tasks and 2nd grade MA and literacy tasks are presented in Table 5. At kindergarten, there was a significant effect of language on PA scores, $t_{(70)} = 2.75$, $p = 0.01$, with children demonstrating higher levels of phonological awareness in Spanish than English.

Correlation analyses

Pearson correlation coefficients are presented in Table 6. Spanish-English DLLs cross-linguistic PA skills in kindergarten were significantly and positively related to word-level MA, reading, and spelling in 2nd grade.

Path analysis

The significant direct effects and R^2 values resulting from the estimation of the path model are presented in Figure 2. Each line in Figure 2 represents a regression pathway. Solid lines represent significant regression coefficients while dashed gray lines represent relationships that did not meet significance. Note that the influence of non-significant regression pathways were not removed from the model in Figure 2 and were consequently represented in the R^2 values. The combined influence of E-PA and S-PA accounted for 40% of the variation in English MA performance. When the combined influence of all oral-language based metalinguistic skills were entered into the model account, it accounted for 38% of

TABLE 5 Descriptive statistics for test scores by administration time.

Administration time	Test	Mean (SD)	Min	Max	Average % correct
	Metalinguistics				
Kindergarten	Spanish PA	12.20 (7.00)	0	25	30%
	English PA	10.48 (6.69)	0	27	26%
2nd Grade	MA	42.96 (14.48)	0	69	51%
	Literacy				
	READ	101.19 (15.98)	62	139	73%
	SPELL	120.63 (15.95)	80	148	80%

PA, Phonological Awareness; MA, Morphological Awareness.
Maximum possible score of Spanish PA = 40, English PA = 40, MA = 84, SPELL = 150. The maximum achieved score for READ in the sample, 139, was used as the maximum possible score.

TABLE 6 Correlations across phonological awareness, morphological awareness, and literacy scores.

Variable	Kindergarten measures		2nd grade measures		
	S-PA	E-PA	MA	READ	SPELL
S-PA	1				
E-PA	0.70	1			
MA	0.58	0.54	1		
READ	0.51	0.63	0.43	1	
SPELL	0.67	0.73	0.66	0.76	1

$N = 71$; $p < 0.001$ level for all correlations. S-PA, Spanish Phonological Awareness; E-PA, English Phonological Awareness; MA, Morphological Awareness.

the variation in single-word reading speed and accuracy (READ). When the cumulative influence of all predictor variables on spelling accuracy was calculated, they explained 76% of the variation in single-word spelling in 2nd grade for Spanish-English DLLs.

Table 7 presents the direct, indirect, and total effects of each predictor variable on the outcome variable SPELL. For example, the effect of Spanish PA on SPELL was indirectly mediated by English MA, reflecting that identifying units of meaning in English words depended in part on sound pattern awareness in Spanish. Likewise, the effect of English PA on SPELL was mediated by English READ, meaning that students with stronger awareness of English sounds were more accurate at reading words, which in turn contributed to higher spelling accuracy.

The total effects represent the total magnitude of the influence of all predictor variables in the model. Overall, English PA had the largest influence on SPELL performance of the predictor variables. MA had second largest impact in the model, followed by READ, with Spanish PA having the least overall impact on single-word spelling accuracy in English.

Discussion

The results from the exploratory PLS model of cross-linguistic early literacy development in the current study add to our understanding of single-word reading and spelling development in Spanish-speaking, English-learning children in three ways. First, this study demonstrates how DLLs' awareness of linguistic sound patterns in Spanish when they enter school in kindergarten (i.e., PA) uniquely supports their awareness of units of meaning in English in 2nd grade (i.e., MA), providing evidence of cross-linguistic transfer of metalinguistic knowledge. Second, this study is the first to describe the relationship between MA and spelling in English for Spanish-speaking, English-learning children in 2nd grade, an important contribution to evidence-based assessment of English writing development in this population. Third, using a PLS path model to investigate developmental relationships allowed for more nuanced quantification of both direct and indirect influences of DLLs' awareness of the structure of oral language (phonemes, morphemes) on early literacy outcomes from kindergarten to 2nd grade. This approach offered advantages over traditional regression models, which do not estimate mediating pathways. Several paths in the model did not reach statistical significance but were retained based on their theoretical (i.e., developmental) and empirical (e.g., replication) relevance.[1] The cross-linguistic spelling development model (see Figure 1), in which earlier-developing oral-language-based metalinguistic skills support later-developing single-word literacy skills (cf. Figure 2), was partially supported.

While prior research in literacy development in Spanish-speaking English-learning DLLs linked phonological awareness (PA) to literacy outcomes (e.g., Anthony et al., 2011; Goldenberg et al., 2014; Míguez-Álvarez et al., 2022), the developmental relationship between PA and MA, and the specific role of English MA in early spelling Spanish-speaking DLLs remained unsubstantiated. This study expands the evidence-base by empirically modeling how Spanish PA in kindergarten uniquely predicts English MA in 2nd grade. The study also provides the first empirical evidence of a direct relationship between English MA and English spelling in early elementary DLLs. By retaining theoretically meaningful but non-significant pathways, the model offers a more comprehensive view of how young DLLs apply developing metalinguistic knowledge to accurately decoding and

1 To evaluate the robustness of the model, we also estimated the parameters using traditional covariate-based SEM procedures in LISREL, which yielded results comparable to those of the PLS path analysis. This convergence further supports the stability of the observed predictive relationships in the participant sample (Dash and Paul, 2021).

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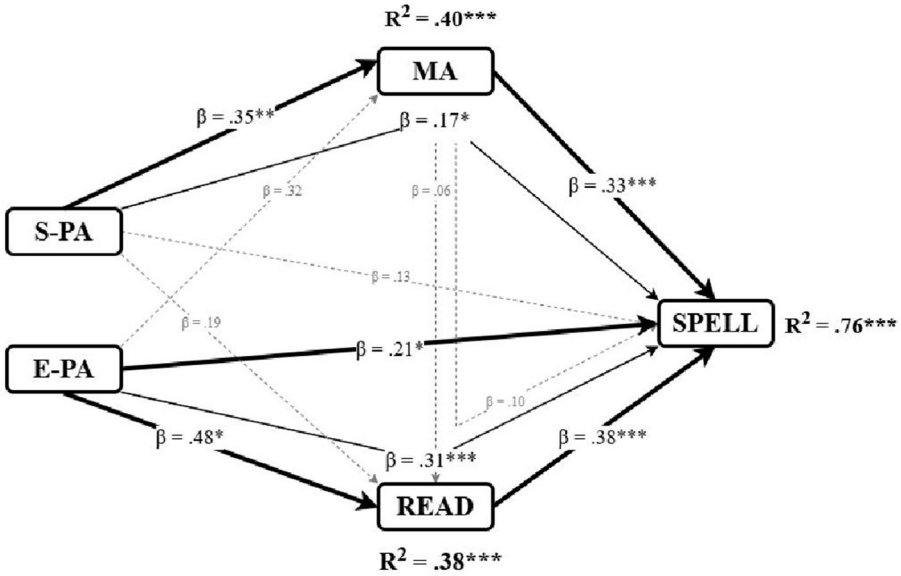

FIGURE 2
Cross-linguistic developmental spelling model results. S, Spanish; E, English; PA, Phonological Awareness; MA, Morphological Awareness. Thick solid lines represent statistically significant direct path coefficients. Dashed lines represent retained non-significant paths. Thin lines that connect variables only indirectly (e.g., from MA to SPELL via READ) represent indirect effects based on the combined influence of multiple direct paths. β indicates standardized path coefficients; R^2 indicates variance explained in each endogenous variable. *$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$.

encoding the relationships between sounds and letters in single words across early elementary school.

Phonological awareness as a cross-linguistic foundational skill

PA in both Spanish and English support later developing English MA and literacy skills in 2nd grade Spanish-speaking DLLs, confirming the strong relationship between awareness of sound structure to the skill of accurately associating sounds with letters that is a pre-requisite for decoding single-words in reading and encoding during single-word spelling (Míguez-Álvarez et al., 2022). Furthermore, the high correlation between Spanish and English PA performance supports the theoretical position that awareness tasks cross-linguistically tap into a singular underlying competence (Anthony et al., 2011). The current study also contributes to the to the literature on typical cross-linguistic metalinguistic skill development for sequential Spanish-speaking DLLs by showing how children flexibly draw on their first language knowledge to support multiple literacy skills.

A possible interpretation of English PA's significant direct impact and Spanish PA's significant indirect impact on spelling performance may be a consequence of how literacy instruction in the classroom is structured. The school district where the participants were enrolled followed an English immersion model. Considerable time in kindergarten and early elementary school was spent on developing sound awareness and applying it to word reading, decoding, and spelling in English. The children in this study were directly taught the relationship between letters and the phonemes they represent in English. Successful completion of the English MA task required children to manipulate syllables within words using contextual information provided in a sentence before encoding orthographically. For example, students were presented with a derived word such as *emptiness* and asked to write a word to complete the sentence *The cereal box is* _____. English PA skills facilitating accurate single-word reading and spelling did not robustly generalize to manipulating more complex phonological structures (e.g., syllables and sentences) during the early literacy period targeted in this study. Spanish PA skills honed through oral-aural learning in the community, however, did generalize to support both English MA and single-word spelling accuracy, as evidenced by significant indirect pathway mediated by English MA performance.

TABLE 7 Indirect and total effects of phonological awareness, morphological awareness, and reading on spelling.

Paths	Direct	Indirect	Total
Spanish PA	0.13	0.17*	0.30**
English PA	0.21*	0.31***	0.52***
MA	0.33***	0.10	0.43**
READ	0.38***		0.38***

Values reported are path coefficients (β), PA, Phonological Awareness; MA, Morphological Awareness.
*$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$.

Spanish PA supports English MA development

Few other studies have examined the specific developmental contribution of Spanish PA to English MA. The pattern of

differential predictive relationships between Spanish and English PA at kindergarten with later developing metalinguistic and literacy skills in 2nd grade was a surprise finding. Spanish PA directly predicted English MA but not English single-word reading, and vice versa for English PA. We expected both Spanish and English PA to significantly predict MA development because morphemes contain phonological segments and both PA and MA are metalinguistic skills, but this was not the case. The pattern of results can be explained from both a developmental and cross-language structure perspective.

Developmentally, the period between 1st and 3rd grade is a period of dramatic growth for MA in monolingual English speakers (Berninger et al., 2010). This window of early elementary school also encompasses the early stages of English acquisition for DLLs who begin learning English as a consequence of enrolling in kindergarten. In the present study, Spanish PA performance was observed to be significantly higher than English PA performance in kindergarten. Consequently, the relatively detailed phonological representations supporting children's Spanish PA skills could provide a stronger foundation for the newly developing morphological analysis skills. Given time, English PA may match or overtake Spanish PA as a unique predictor of MA, as the child's English phonological system develops increasing detailed phonological representations of English-specific vocabulary.

The second possible interpretation of the cross-linguistic relationship is that shared word origins of complex derived vocabulary come into play. Spanish PA's unique predictive relationship with MA could be explained by the similarity in word forms between high frequency Spanish vocabulary and derived morphologically complex vocabulary in English (Nagy et al., 1993). Research in adult Spanish-speaking DLLs has found their MA skills in English uniquely predicted their reading comprehension. This is especially true for cognates (e.g., *direction* and *dirección),* or words that have similar phonological, semantic, syntactic, and possibly orthographic representations in both of the speakers' languages. Within the context of the classroom, English's latinate academic vocabulary is likely to be similar in form to the Spanish vocabulary DLL children learn at home with their families. Current findings demonstrate DLL children are also able to leverage Spanish knowledge to learn English vocabulary across early elementary school despite the differences in the two languages' syllabic inventories and the regularity of stress patterns (Ortega-Llebaria et al., 2013). This study illustrates how Spanish-speaking children's ability to consciously reflect on sound patterns aids them in analyzing unfamiliar English derived words to identify units of meaning. These two explanations, developmental and cross-linguistic, are not isolated. It is possible, indeed it is quite likely, that developmental and structural factors interact in creating the cross-linguistic metalinguistic skill developmental pattern of the observed results.

MA skill supports accurate spelling in 2nd grade DLLs

The identification of MA as a unique predictor of spelling performance in 2nd grade Spanish-speaking DLLs extends the evidence-base of the typical sequence of acquisition of both MA and single-word spelling. Previous work has documented the causative relationship between MA and spelling accuracy in English monolinguals and French-speaking DLLs (Deacon and Kirby, 2004; Masterson and Apel, 2010). Path modeling in the current study revealed that MA supported accurately encoding English speech sounds into letters and words. Even though the MA task measured a metalinguistic skill requiring comprehending sentences presented orally in English, MA skill produced the second largest direct effect and second largest total effect on decontextualized single-word spelling accuracy in the path model. Overall, MA performance reflected the application of cross-linguistic metalinguistic knowledge to English writing tasks, such as segmenting root words and affixes with when spelling morphologically complex words with potentially phonologically opaque orthographic representations.

This study contributes to the body of research validating the predictive power of the ETB task as a reliable measure of MA development in DLLs in early elementary school (Carlo et al., 2004; Goodwin et al., 2017; Kieffer et al., 2013; Kieffer and Lesaux, 2008; Ramirez et al., 2010, 2013). However, contrary to our prediction, MA did not have a significant direct effect on isolated word reading. It is possible that we did not obtain direct effect between MA and reading because the MA targeted derived words, the spelling test targeted morphologically inflected items, and the reading task progressed from simple to complex syllable shapes. Thus, the specific stimuli used in the study may have inadvertently weakened the relationship between MA and reading and strengthened the relationship between MA and spelling.

PA, MA, and single-word reading performance predicts single-word spelling in DLLs

The model results revealed that all variables in the path analysis had significant total effects on spelling performance. Furthermore, the combined direct and indirect influences of the predictors explained 76% of the variation in spelling skill in the model. Single-word spelling was the result of a complex interaction of Spanish PA and English PA at kindergarten in addition to MA and single-word reading in 2nd grade. Of the four variables in the model, three had direct effects on spelling performance: E-PA at kindergarten ($\beta = 0.21$), as well as MA ($\beta = 0.33$), and single-word reading ($\beta = 0.38$) at 2nd grade. The results suggest that Spanish PA has a lesser role to play in the development of accurate English spelling development in early elementary school than does English PA. Taken together, the results of the path analysis confirm the relative importance of active metalinguistic skills in early literacy development for Spanish-speaking DLLs in early elementary school (Oller and Jarmulowicz, 2007).

Further considerations

The path analysis procedure requires the assignment of a direction of the relationship between variables. The proposed developmental model presented here is therefore unidirectional. It is unlikely, however, to be an exact estimation of the reality

of language development. Linguistic development is somewhat unidirectional (e.g., we learn how to babble before we learn how to talk, we learn how to talk before we learn how to read). However, within specific areas of linguistic development, it is likely that domains of language interact. For example, the relationship between MA and vocabulary is thought to be bi-directional in that larger vocabularies predict better MA performance and vice versa (Deacon et al., 2014). A similar bi-directional relationship between vocabulary and PA has been described in the literature, where a larger vocabulary results in phonological restructuring and finer detailed PA which facilitates vocabulary learning (Jarmulowicz et al., 2008; Walley et al., 2003). Consequently, a measure of vocabulary that accounts for the frequency of exposure to phonological and morphological patterns (e.g., cognates) across DLL children's languages could possibly add additional explanatory power to the model. Finally, PA skill and reading instruction efficacy also have a bi-directional relationship, where higher levels of PA support greater transfer of skills taught during reading instruction and vice versa (Míguez-Álvarez et al., 2022).

In addition to the directional constraints of path modeling, measurement considerations may also have influenced observed relationships among variables. For instance, this study was constrained to a single MA measure. The unexpectedly weak relationship between MA and word reading may, in part, reflect task-specific variance rather than a true lack of association. Expanding the range of MA assessments, such as including both oral and written tasks in both Spanish and English, may yield a more comprehensive understanding of how MA supports reading development across modalities in future research.

Conclusion

Three key findings of this study were that in the period between kindergarten and 2nd grade for DLLs: (1) Spanish PA significantly influenced English MA, but not reading; (2) Spanish PA indirectly supported accurate spelling in English through its influence on English MA development, and (3) Within English, PA directly supported both word reading and spelling, but not MA. The two distinct predictive paths from kindergarten Spanish PA and English PA to later developing 2nd grade literacy skills may reflect English immersion experiences, such as Spanish-speaking children being unable to receive support from classroom educators while sounding out words in Spanish-language books that interest them. The present findings underscore the value of assessing metalinguistic skills in both languages to better understand and support early literacy trajectories in DLLs.

This study expands the evidence-base of early multilingual literacy development across learning environments. While prior research has linked phonological awareness (PA) to literacy outcomes, the developmental relationship between PA and morphological awareness (MA), and the specific role of English MA in early spelling, remain underexplored in Spanish-speaking DLLs. This study addresses those gaps by demonstrating that Spanish PA in kindergarten uniquely predicts English MA in 2nd grade, and by providing the first empirical evidence of a direct relationship between English MA and English spelling in early elementary DLLs. By retaining theoretically meaningful but non-significant pathways, the model offers a more comprehensive view of how young DLLs apply developing metalinguistic knowledge to accurately decoding and encoding the relationships between sounds and letters in single words across early elementary school. The present findings underscore the value of assessing metalinguistic skills in both languages to better understand and support early literacy trajectories in DLLs.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Institutional Review Board, University of Memphis. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

KD: Writing – original draft, Writing – review & editing. MO: Writing – original draft, Writing – review & editing. LH-W: Writing – original draft, Writing – review & editing. LJ: Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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