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## The effects of Spanish heritage language literacy on English reading for Spanish–English bilingual children in the US

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### ABSTRACT

Models of monolingual literacy propose that reading acquisition builds upon children's semantic, phonological, and orthographic knowledge. The relationships between these components vary cross-linguistically, yet it is generally unknown how these differences impact bilingual children's literacy. A comparison between Spanish–English bilingual and English monolingual children (ages 6–13,  $N=70$ ) from the US revealed that bilinguals had stronger associations between phonological and orthographic representations than monolinguals during English reading. While vocabulary was the strongest predictor of English word reading for both groups, phonology and morphosyntax were the best predictors of Spanish reading for bilinguals. This comparison reveals distinct developmental processes across learners and languages, and suggests that early and systematic biliteracy exposure at home and through afterschool programs can influence children's sound-to-print associations even in the context of language-specific (monolingual) reading instruction. These findings have important implications for bilingual education as well as theories that aim to explain how learning to read across languages has a positive impact on the acquisition of literacy.

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With global migration on the rise, it has become increasingly important to understand how children acquire literacy in multilingual contexts. An important piece of this puzzle is to understand how bilingual children learn to read in each of their languages (Uchikoshi 2014). In pursuit of this inquiry, we are improving our understanding of differences in learning to read across orthographies (Ehri 2014; Perfetti, Cao, and Booth 2013; Ziegler and Goswami 2005). Research shows that literacy acquisition is largely reliant on children's ability to read individual words (Kroll et al. 2015; Perfetti and Hart 2002). Learning to read individual words relies on children's strengthening connections between words' sounds (phonology), meanings (semantics), and orthographic representations (Perfetti and Hart 2002; Perfetti, Liu, and Tan 2005). The nature of these connections varies across language populations; in turn, we ask how those relations might affect learners who speak two languages. Specifically, how does native-level exposure to written Spanish, at home and/or in afterschool programs, impact young bilinguals' literacy in English, their primary language of reading instruction? To answer this question, we compare the manner in which Spanish–English bilingual and English monolingual children form sound-to-print connections in their respective languages.

Research finds that even when bilinguals are in ‘monolingual mode,’ they often have simultaneous access to both languages’ phonological, semantic, and orthographic information (Kroll et al. 2015); this appears to be true of adults (van Hell and Dijkstra 2002; Kovelman et al. 2008), and children alike (Jared et al. 2011). For instance, French–English bilingual children are more accurate when reading words that are similar across their languages either in meaning and spelling (e.g. *table*), or just in spelling (e.g. *pour*; Jared et al. 2011). How might such a persistent interaction between bilinguals’ languages at the single-word level affect the manner in which children learn to read in each language?

Theories of bilingual literacy acquisition advance the Interdependent Continuum Model, suggesting that the aspects of a bilingual’s languages that are similar to each other allow young bilinguals to draw upon language and literacy skills mastered in one language to make gains in their other language (Cummins 2011; Proctor et al. 2010). Let us consider the manner in which knowledge of Spanish might affect the Spanish–English bilingual child’s sound-to-print associations in English. The world’s languages fall on a continuum of ‘phonological transparency’ with languages such as Spanish having a more fine-grained sound-to-print mapping than languages such as English, in which larger morpho-syllabic units map onto print (Defior, Martos, and Cary 2002; Ziegler and Goswami 2005). Logically, speakers of languages with a greater one-to-one correspondence between letters and sounds master sound-to-print associations faster than English monolinguals (Aro and Wimmer 2003). Studies that compared Spanish–English and Italian–English bilingual to English monolingual children have shown that the bilinguals have better phonological reading skills than English monolinguals (Bialystok, Luk, and Kwan 2005; D’Angiulli, Siegel, and Serra 2001; Kovelman et al. 2008). These findings suggest that bilingual children’s exposure to a phonologically transparent orthography enables the transfer of skills to their phonologically opaque language, thereby boosting bilinguals’ sensitivity to the sounds of language and how these map onto print for English (Bialystok 2012). However, not all studies demonstrate a bilingual advantage from exposure to a phonologically transparent orthography (Bialystok, Majumder and Martin 2003; Kovelman et al. 2008). Despite Chinese having a phonologically opaque orthography, some studies find that Chinese–English bilinguals might also have better phonological awareness abilities relative to English monolinguals (Siegel 2016), a finding that is difficult to explain in terms of language-specific bilingual experiences, as this may stem from the experience with Chinese in particular, bilingualism in general, or socio-cultural experiences (Siegel 2016).

Research on linguistic and orthographic structures shows that the orthographic transparency of a language has a significant impact on the rate of single-word reading accuracy in monolingual learners of alphabetic languages (Aro and Wimmer 2003). How might these differences in sound-to-print associations impact a young bilingual learning to read in languages such as Spanish and English at the same time? The cumulative body of evidence suggests that bilingualism makes a significant impact on children’s literacy development, regardless of their primary language of reading instruction, as in the case of English in the United States (Atwill et al. 2010; Durgunoğlu, Nagy, and Hancin-Bhatt 1993; Goldenberg 2008; Gottardo and Mueller 2009; Pasquarella et al. 2015; Proctor et al. 2006; Uchikoshi 2014). For example, Durgunoğlu, Nagy, and Hancin-Bhatt (1993) showed that Spanish–English bilinguals’ performance on English reading tasks was best predicted by their phonological processing and single-word reading abilities in Spanish. Nevertheless, another study of Spanish–English bilinguals by Gottardo and Mueller (2009) did not find evidence of significant transfer between Spanish literacy skills onto English literacy. Such discrepancies highlight the primary issue intersecting bilingualism and literacy research. What is the relative contribution of bilingualism in general (learning to read in any two languages) versus learning to read in specific orthographies? Put another way, do specific characteristics of bilingual children’s heritage language make a significant contribution to their literacy in the dominant language of reading instruction (such as English in the United States)? These are not easy questions to answer given that bilingual acquisition also depends on the age of bilingual exposure, years of exposure, types of literacy instruction, and dual-language proficiency (Berens, Kovelman, and Petitto 2013; Goldenberg 2008; Kovelman et al.

2008, 2015). In the present study, we therefore aim to illuminate the nature of bilingual acquisition by focusing categorically on early-exposed Spanish–English bilinguals in comparison to English monolinguals and the extent to which English and Spanish language literacy abilities affect how each group learns to read in their respective languages.

## Hypotheses and predictions

First, we hypothesize that exposure to a language that places greater emphasis on sound-to-print associations (Spanish) will change the extent to which bilinguals' phonological abilities in English contribute to their English word reading abilities, in comparison to English monolinguals. This prediction is supported by at least three pieces of evidence, as discussed above: (i) bilinguals show evidence of cross-linguistic transfer for similar literacy skills, such as sound-to-letter mapping (Cummins 2011); (ii) bilingual exposure to Spanish might improve children's emergent phonological abilities in English (Siegel 2016); and (iii) monolingual learners of phonologically transparent orthographies show stronger sound-to-print associations than English speakers (Verhoeven, Leeuwe, and Vermeer 2011), as well as earlier mastery of phonology-related literacy skills (e.g. pseudoword reading) relative to English monolinguals (Aro and Wimmer 2003; Cuetos 1989). We therefore predict that the Spanish–English bilinguals will use the sound-to-print skills developed through reading in Spanish for reading in English. Thus, phonological awareness will make greater contribution to Spanish–English bilinguals' English literacy than in English monolinguals.

Secondly, we hypothesize that bilinguals' phonological reading skills in Spanish will also make a significant contribution to their English literacy. This prediction is based on the research discussed above, and evidence showing that bilinguals' literacy skills in one language can make a significant and direct contribution to their literacy skills in the other language (cf. Geva and Wang 2001). The children in this study were recruited in Midwestern US school districts that offered English-only education. The study sought to shed light on the impact of bilingual exposure on children's literacy during the key periods of literacy acquisition.

## Method

### Participants

Seventy children took part in the study (age range = 6.60–13.57 years; mean age [ $M_{age}$ ] = 9.80 years; standard deviation [SD] = 1.62), 33 English monolinguals (15 females, 18 males) and 37 Spanish–English bilinguals (17 females, 20 males), all raised and educated in a Midwestern US town. All children were typical, with no history of language, hearing, or reading delays. For monolingual children, English was the sole language spoken at home. For all children, English was the language of school instruction; all families were recruited from the same neighborhoods. The children did not differ in English language proficiency and cognitive abilities ( $p > .05$ ), see Table 1. All children included in the analyses had standard scores above 85 in a non-verbal IQ assessment (Matrices subtest from the Kaufman Brief Intelligence Test [KBIT-2]; Kaufman and Kaufman 2004). Institutional review boards approved the study; parents and children completed respective informed consent and assent forms. Families were monetarily compensated for their time, and children received a small prize.

### Language exposure for bilinguals

Bilingual children were from a suburban area in Southeast Michigan in which only 4% of the population in the area identified as Hispanic (U.S. Census Bureau 2015). At the time of testing, bilingual children were receiving daily exposure to both languages, Spanish in the home and English outside the home. All bilinguals were exposed to Spanish at birth. Bilingual children were exposed to English between birth and age five ( $M = 2.7$  years,  $SD = 2.02$ ), except one child who was

**Table 1.** Average (standard deviation) performance in English and Spanish language and literacy measures for English monolingual and Spanish–English bilingual children.

	Bilingual Mean (SD)	Monolingual Mean (SD)	<i>t</i>
Age	9.78 (1.70)	9.81 (1.57)	.09
<i>English language and literacy measures</i>			
Vocabulary (KBIT Verbal Knowledge)	34.13 (8.31)	37.03 (6.80)	1.53
Vocabulary Std. Scores	108.30 (16.94)	118.64 (12.95)	2.77**
Reading (Woodcock)	75.23 (15.49)	75.18 (13.20)	−0.01
Reading Std. Scores	107.89 (23.89)	112.97 (14.12)	1.05
Phonological awareness (CTOPP-Elision)	15.74 (3.76)	16.41 (2.88)	0.79
Phonological awareness Std. Scores	11.32 (2.34)	11.48 (3.10)	.235
Phonological awareness percentage <sup>a</sup>	77.19 (20.40)	80.00 (18.37)	.585
Morphosyntactic competence (CELF)	28.65 (3.49)	29.64 (2.29)	1.35
Morphosyntactic competence percentage	88.77 (11.52)	92.61 (7.15)	1.61
Naming speed (RAN)	27.41 (7.80)	31.01 (9.69)	1.63
Naming speed Std. Score	105.13 (15.21)	96.30 (21.66)	−1.88
<i>Cognitive development</i>			
Non-verbal IQ (KBIT Matrices)	32.44 (5.35)	33.79 (5.08)	0.63
Non-verbal IQ Std. Scores	111.22 (13.48)	112.73 (23.16)	.32
<i>Spanish language and literacy measures</i>			
Vocabulary (ROWPVT)	96.81 (29.28)		
Vocabulary Std. Score	104.66 (18.49)		
Reading (Woodcock)	48.73 (22.23)		
Reading Std. Score	90.84 (14.55)		
Phonological awareness (TOPPS-Elision) <sup>a,b</sup>	15.51 (4.24)		
Phonological awareness percentage <sup>a</sup>	77.57 (21.20)		
Morphosyntactic competence (CELF)	22.51 (3.39)		
Morphosyntactic competence percentage	74.28 (19.43)		
Naming speed (RAN) <sup>b</sup>	34.37 (15.67)		

<sup>a</sup>Not all items administered (i.e. testing stopped after three consecutive incorrect answers).

<sup>b</sup>Standard scores not available.

\* $p \leq .05$ .

\*\* $p \leq .01$ .

\*\*\* $p \leq .001$ .

exposed to English at the age of seven (this child was included in the analysis due to difficulty in recruiting bilingual children outside of large urban centers. Additionally, checks of assumptions on linear regressions did not reveal that this child's performance was an outlier). Bilingual children had a minimum of three years of continuous English exposure (range = 3–12 years,  $M = 7.13$  years,  $SD = 2.66$ ) either inside or outside their home, as measured through parental questionnaires that asked parents to indicate linguistic environment and input for each year of the child. Twenty-five bilinguals were born in the US and 12 were born in Spanish-speaking countries. All mothers and all but two fathers were native Spanish speakers and reported consistent use of Spanish at home by the parent(s) to their child(ren); the two fathers who were native English speakers reported consistent use of English at home with their children.

### *Literacy development for bilinguals*

Parents reported that all children had exposure to Spanish literacy ranging from 1 to 5 hours per week (the questionnaire included options of 'none,' '1–5,' and '5–10' hours of literacy exposure with all the parents circling the '1–5' option). Parents were provided with space to detail how their children learned how to read in Spanish, and included the following examples: learning to read with parents, learning to read during weekly Spanish language classes at the local public schools (three monolingual and four bilingual participants were attending local schools offering up to 1 hour per week of Spanish lessons as a foreign language class), and/or attending weekly Saturday morning Spanish heritage language and literacy classes (on average 2.5 hours per week) with daily homework

assignments in Spanish (14 of the bilingual children attended such classes). Thus, formal within/after-school Spanish classes were reported for 18 bilingual participants.

### **Procedure**

This research was part of a larger study focusing on bilingual language and cognitive development. Children were tested for approximately one hour. Testing was completed in one session for monolingual children and two sessions for bilingual children, one for each language and the language of the first session was randomly assigned. A native speaker of Spanish or English conducted each session.

### **Measures of language, literacy, and cognitive development**

Parents completed a detailed Language Background and Use questionnaire (Jasinska and Petitto 2013) about their child's cognitive, language, and motor development, plus family history of learning impairments. Parents also completed questions on their educational level and household income from the John D. and Catherine T. MacArthur Foundation Research Network on Socioeconomic Status and Health questionnaire (retrieved from: [www.macses.ucsf.edu](http://www.macses.ucsf.edu)).

*English and Spanish phonological awareness* was assessed using the Elision subtest from the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, and Rashotte 1999) and the Test of Phonological Processing in Spanish (TOPPS; Francis et al. 2001), respectively. During testing, the child was asked to say a word, then repeat it without a specific phoneme; for example, 'say bold. Now say bold without saying /b/.' Participants earned 1 point for correct responses; 20 testing items were presented; testing stopped when ceiling level was reached (3 consecutive errors).

*English vocabulary* was assessed using the Verbal Knowledge subtest from KBIT-2 (Kaufman and Kaufman 2004). During testing, the child was instructed to point to a picture (out of six possible options) that best matched a word or answered a question. Participants earned 1 point for correct responses; up to 60 items could be presented; testing stopped when ceiling level was reached (4 consecutive errors).

*Spanish vocabulary* was assessed using the Receptive One-Word Picture Vocabulary Test Spanish Bilingual Edition (ROWPVT-4; Brownell 2000). Similar to the English vocabulary assessment, the child was instructed to point to a picture (out of four possible options) that best matched a word. Participants earned 1 point for correct responses; out of a possible 170 testing items, a basal level was established based on the participant's age; testing stopped when ceiling level was reached (once the child incorrectly answered four out of six consecutive items).

*English and Spanish syntactic competence* was assessed using the Word Structure subtest from the Clinical Evaluation of Language Fundamentals (CELF-4; Semel, Wiig, and Secord 2003, 2006), which measures children's ability to apply morphology rules and appropriate pronouns. During testing, the experimenter showed pictures and asked the child to finish a sentence based on the picture; for example, 'this man teaches, he is called a ... (teacher).' Participants earned 1 point for correct responses; 32 testing items were presented for English and 29 items for Spanish.

*Spanish and English single-word reading* was assessed using the Word-ID subtest from the Woodcock Reading Mastery for English (Woodcock 1998) and the Batería III Woodcock-Muñoz Pruebas de Aprovechamiento for Spanish (Muñoz-Sandoval et al. 2005). During testing, the child was asked to read words aloud and the experimenter recorded if the child pronounced them correctly. Participants earned 1 point for correct responses; the task included 106 testing items for English and 76 items for Spanish; testing stopped when ceiling level was reached (after 6 consecutive errors).

*Naming speed* was assessed using the Numbers subtest from the Rapid Automatized Naming (RAN; Wolf and Denckla 2005). This task assesses the ability to name a symbol accurately and efficiently, and its performance is thought to predict reading fluency (Norton and Wolf 2012). During testing, the experimenter instructed each child to name 50 numbers on a card as fast as possible;

the numbers included: 2, 6, 9, 4, and 7. This task was administered in English, and a direct Spanish translation was used for bilingual children. The amount of time that the child took to complete this task is reported in seconds, and used during analyses. This measure is thought to tap into the efficiency with which children link visual/orthographic representations with verbal labels, a key characteristic of meaning-to-print mappings and reading fluency (Norton and Wolf 2012).

*Non-verbal intelligence* was assessed using the KBIT-2 Matrices subtest (Kaufman and Kaufman 2004), which measures the ability to find spatial and abstract relationships among a set of images and patterns by finding the best option out of 4. Basal and ceiling levels were established; this task served as a participant selection criterion to ensure all participants had age-appropriate levels of cognitive development (standard score of 85 and above).

### **Data analysis**

Analyses controlled for age were conducted using raw scores that were calculated by totaling the number of correct responses. First, we investigated potential difference in performance between the groups using independent samples *t*-tests. Second, we investigated the relationship between variables using partial correlations that controlled for age. Finally, we investigated how language and cognitive abilities supported word reading for bilingual and monolingual children using separate stepwise regression analyses.

## **Results**

### **Group comparisons and correlations**

*T*-test comparisons did not reveal significant differences between bilinguals and monolinguals on age, language, word reading, naming speed, and IQ (see Table 1).

For monolingual children, single-word reading was significantly correlated with phonological awareness, vocabulary, and naming speed (see Table 2). Note that the negative relationship between naming speed and word reading demonstrates that a faster time to complete the naming task is associated with higher word reading scores. An important observation is that word reading did not significantly correlate with syntactic competence, likely due to a ceiling effect for the syntactic measure in English monolinguals.

Similarly, for the bilingual children, single-word reading in English was significantly correlated with English phonological awareness, vocabulary, naming speed, and syntactic competence (see Table 2). Word reading in English also significantly correlated with children's performance on Spanish word reading, phonological awareness, vocabulary, and naming speed.

Bilingual children's word reading in Spanish significantly correlated with the following measures in Spanish: phonological awareness, syntactic competence, vocabulary, and naming speed (see Table 2). Word reading in Spanish also significantly correlated with bilingual children's performance on the following measures in English: word reading, phonological awareness, vocabulary, naming speed, and syntactic competence.

### **Regression analyses**

In order to determine which linguistic abilities significantly contributed to and predict literacy abilities for each of the groups, stepwise regressions were performed. A two-stage stepwise regression was conducted with word reading as the dependent variable. Age was entered along with all the other variables through stepwise selection, but did not explain additional variance in word reading when combined with other measures. Thus, the variables included in the final models explained the largest amount of variance in single-word reading, for each respective language.

**Table 2.** Partial correlations (controlling for age) between language and literacy measures for bilinguals and monolinguals.

<i>Partial correlations between English measures for English monolinguals</i>					
Variables	1	2	3	4	5
1. Reading (Woodcock)	–				
2. English phonology (CTOPP-Elision)	.52**	–			
3. English morphosyntax (CELF)	–.08	.21	–		
4. English vocabulary (KBIT)	.49**	.29	.17	–	
5. Naming speed (RAN)	–.80***	–.59***	.19	–.32	–

<i>Partial correlation between Spanish and English measures for Spanish–English bilinguals</i>										
Variables	<i>English measures</i>					<i>Spanish measures</i>				
	1	2	3	4	5	6	7	8	9	10
1. Reading (Woodcock)	–									
2. English phonology (CTOPP-Elision)	.69***	–								
3. English morphosyntax (CELF)	.72***	.40*	–							
4. English vocabulary (KBIT)	.79***	.61***	.62***	–						
5. Naming speed (RAN)	–.59***	–.33	–.50**	–.50**	–					
6. Spanish reading	.86***	.57***	.58***	.63***	–.46*	–				
7. Spanish phonology (TOPPS-Elision)	.81***	.59***	.60***	.65***	–.55***	.77***	–			
8. Spanish morphosyntax (CELF)	.30	.11	.35°	.13	–.18	.48**	.18	–		
9. Spanish vocabulary (ROWPVT)	.47**	.25	.10°	.36*	–.14	.42*	.31°	.11	–	
10. Spanish naming speed (RAN)	–.56**	–.23	–.25	–.37*	.27	–.58***	–.40**	–.45**	–.44**	–

\* $p \leq .05$ .\*\* $p \leq .01$ .\*\*\* $p \leq .001$ .

Each step used in determining the most conservative models is shown in the results below (see Tables 3–6).

### English reading

For monolingual children (see Table 3), the stepwise regression revealed that at Step 1, naming speed contributed significantly to the variation in word reading ( $r = .85$ ,  $F(1, 30) = 78.86$ ,  $p < .001$ ). Step 2

**Table 3.** Stepwise regression analyses predicting single-word reading in English for monolingual children.

	Reading in English for monolinguals					
	Unstandardized $b$	SE $b$	Standardized $\beta$	$R^2$	Adjusted $R^2$	$\Delta R^2$
Step 1				.72	.72	.72***
Constant	110.92	4.17				
Naming speed	–1.14	.13	–.85***			
Step 2				.76	.75	.04*
Constant	88.69	10.83				
Naming speed	–.97	.15	–.721***			
Vocabulary	.45	.21	.237*			

\* $p < .05$ .\*\* $p < .01$ .\*\*\* $p < .001$ .



**Table 4.** Stepwise regression analyses predicting single-word reading in English for bilingual children.

	Bilingual reading in English predicted by English measures					
	Unstandardized <i>b</i>	SE <i>b</i>	Standardized $\beta$	$R^2$	Adjusted $R^2$	$\Delta R^2$
Step 1				.68	.67	.68***
Constant	22.80	6.89				
Vocabulary	1.54	.20	.82***			
Step 2				.76	.74	.08**
Constant	-9.28	12.15				
Vocabulary	1.07	.23	.58***			
Morphosyntactic competence	1.67	.55	.38**			
Step 3				.81	.79	.05*
Constant	-14.68	11.11				
Vocabulary	.65	.26	.35*			
Morphosyntactic competence	1.62	.49	.37**			
Phonological awareness	1.35	.49	.33*			

\* $p < .05$ .\*\* $p < .01$ .\*\*\* $p < .001$ .

added vocabulary to the relationship with word reading; altogether, naming speed and vocabulary significantly supported word reading ( $r = .87$ ,  $F(2, 29) = 46.93$ ,  $p < .001$ ). Adding vocabulary to the model increased the explained variance from 72.4% to 76.4%, a net increase of 4.0%.

For bilingual children in English word reading (see Table 4), the stepwise regression revealed that at Step 1, vocabulary contributed significantly to the variation in word reading ( $r = .82$ ,  $F(1, 29) = 61.32$ ,  $p < .001$ ). Step 2 added syntactic competence to the relationship with word reading; altogether, vocabulary and syntactic competence significantly supported single-word reading ( $r = .87$ ,  $F(2, 28) = 44.08$ ,  $p < .001$ ). Adding syntactic competence to the model increased the explained variance from 67.9% to 75.9%, a net increase of 8.0%. Step 3 of the regression added phonological awareness, after vocabulary and syntactic competence, to the relationship with word reading in English. Vocabulary, syntactic competence, and phonological awareness significantly supported English word reading ( $r = .90$ ,  $F(3, 27) = 38.76$ ,  $p < .001$ ). Adding phonological awareness to the model increased the explained variance from 75.9% to 81.2%, a net increase of 5.3%.

### Spanish reading

For bilingual children in Spanish (see Table 5), the stepwise regression revealed that at Step 1, phonological awareness contributed significantly to the variation in single-word reading ( $r = .80$ ,  $F(1, 33) = 59.93$ ,  $p < .001$ ). Step 2 added syntactic competence to the relationship with single-word reading in Spanish; altogether, phonological awareness and syntactic competence significantly supported single-word reading in Spanish ( $r = .88$ ,  $F(2, 32) = 53.61$ ,  $p < .001$ ). Adding syntactic competence to the model increased the explained variance from 64.5% to 77.0%, a net increase of 12.5%.

**Table 5.** Stepwise regression analyses predicting single-word reading in Spanish for bilingual children.

	Bilingual reading in Spanish					
	Unstandardized <i>b</i>	SE <i>b</i>	Standardized $\beta$	$R^2$	Adjusted $R^2$	$\Delta R^2$
Step 1				.65	.63	.65***
Constant	-12.47	8.40				
Phonological awareness	4.03	.52	.80***			
Step 2				.77	.76	.13***
Constant	-51.45	11.59				
Phonological awareness	3.61	.44	.72***			
Morphosyntactic competence	2.03	.49	.36***			

\* $p < .05$ .\*\* $p < .01$ .\*\*\* $p < .001$ .

**Table 6.** Cross-linguistic stepwise regression analyses predicting single-word reading in English for bilingual children.

	Bilingual reading in English predicted by English and Spanish measures					
	Unstandardized <i>b</i>	SE <i>b</i>	Standardized $\beta$	$R^2$	Adjusted $R^2$	$\Delta R^2$
Step 1				.78	.77	.77***
Constant	40.17	3.97				
Spanish single-word reading	.66	.07	.88***			
Step 2				.86	.84	.08***
Constant	-26.24	4.94				
Spanish single-word reading	.46	.08	.61***			
English vocabulary	.73	.19	.39***			
Step 3				.88	.87	.03*
Constant	-20.43	5.12				
Spanish single-word reading	.32	.09	.43***			
English vocabulary	.633	.18	.34**			
Spanish phonological awareness	1.01	.42	.27*			

\* $p < .05$ .\*\* $p < .01$ .\*\*\* $p < .001$ .

For bilingual children, a cross-linguistic model was also analyzed (see Table 6). All variables from English and Spanish were included to predict English word reading ability. The stepwise regression revealed that at Step 1, single-word reading in Spanish contributed significantly to the variation of single-word reading in English ( $r = .88$ ,  $F(1, 27) = 94.05$ ,  $p < .001$ ). Step 2 added English vocabulary to the relationship with English single-word reading; altogether English vocabulary and single-word reading in Spanish significantly supported English single-word reading ( $r = .93$ ,  $F(2, 26) = 76.82$ ,  $p < .001$ ). Adding English vocabulary to the model increased the explained variance from 77.7% to 85.5%, a net increase of 7.8%. Step 3 added Spanish phonological awareness to the relationship with English single-word reading; altogether single-word reading in Spanish, English vocabulary, and Spanish phonological awareness significantly supported word reading in English ( $r = .94$ ,  $F(3, 25) = 62.86$ ,  $p < .001$ ). Adding Spanish phonological awareness to the model increased the explained variance from 85.5% to 88.3%, a net increase of 2.8%.

## Discussion

In the present study, we investigated the impact of bilingualism on children's literacy. Specifically, we hypothesized that learning to read in Spanish, a language that places greater emphasis on sound-to-print associations than English might impact bilingual children's sound-to-print associations in English, compared with English monolinguals. The correlation analyses revealed that a significant association exists between phonological awareness and reading abilities in English for both bilinguals and monolinguals. This finding is supported by prior work highlighting the importance of phonological awareness for literacy and the idea that the same processes are used by monolinguals in both phonologically transparent and phonologically opaque languages (Cañado 2005), though with critical differences in reliance/emphasis on the components (Álvarez, Alameda, and Dominguez 1999). Consistent with cross-linguistic transfer hypotheses, stepwise regressions for English-only variables revealed that independently for bilinguals, and not monolinguals, phonological awareness significantly supported word reading in English (note that while correlations isolate associations, hierarchical regressions help adjudicate which of these correlating variables are best at predicting the dependent variable). Moreover, once Spanish variables were added to the bilingual model, phonological awareness in Spanish was also a significant predictor of bilinguals' English literacy. The findings are especially notable considering that these were early-exposed bilinguals with monolingual-like English language and reading proficiency, attending English-only schools. Taken together, the findings are consistent with our hypotheses and predictions, suggesting that structural characteristics of the bilingual's heritage language can have a significant impact on his/her learning to read in both

languages. The findings are further discussed in terms of their contribution to theories of bilingual reading acquisition and learning to read across languages.

### ***Effects of phonological awareness and orthographic transparency***

Literacy research with monolinguals suggests that learning to read relies on sound-to-print and meaning-to-print associations (Ehri 2014; Perfetti and Hart 2002; Ziegler and Goswami 2005), and that the strength of these associations may vary across languages (Perfetti, Liu, and Tan 2005). Children learning to read in phonologically transparent orthographies are found to form stronger sound-to-print associations than learners of more phonologically opaque orthographies (Verhoeven, Leeuwe, and Vermeer 2011). Given that bilingual children's two languages are known to interact (Cummins 2011; Kroll et al. 2015), we hypothesized that bilinguals' heritage language exposure to Spanish (a phonologically transparent orthography) might influence bilinguals' literacy in their dominant language of reading instruction (i.e. English). In line with this hypothesis, our findings suggest that Spanish–English bilinguals place greater reliance on English phonological awareness for learning to read in English compared to age-matched English monolinguals. In particular, in monolinguals, literacy was best predicted by vocabulary and naming speed. In bilinguals, when we only used children's English literacy skills (so as to compare to monolinguals), English literacy was best predicted by vocabulary, syntax, and phonological awareness abilities.

These results are consistent with prior evidence showing that bilingual exposure to languages of varying phonological transparency can result in better phonological awareness abilities in children's less phonologically transparent language, in comparison to monolinguals or bilinguals with two languages of similar phonological transparency (Bialystok, Luk, and Kwan 2005; D'Angiulli, Siegel, and Serra 2001; Kovelman, Baker, and Petitto 2008a; Lallier, Acha, and Carreiras 2015). Nevertheless, earlier research suggests that a phonological 'advantage' is not always observed, and when it is present, it could be rather short-lived (cf. Bialystok 2012). The present study revealed that even in light of monolingual-like task performance in English, bilinguals may nevertheless form stronger associations between their phonological and orthographic knowledge in English as compared to English monolinguals.

Importantly, the findings suggest that phonological awareness is important for learning to read in English, as phonological awareness was significantly associated with learning to read for both groups (correlation results). We suggest that the strength of the association between phonological awareness and reading ability may change as a factor of language-specific experiences, both bilingual and monolingual. A similar study with Chinese–English bilinguals found *weaker* sound-to-print associations and stronger meaning-to-print associations in bilinguals compared to age- and English-proficiency-matched monolinguals (Hsu et al. 2016). Of note, these Spanish–English, Chinese–English, and English monolinguals have all been recruited from the same school districts, and are therefore likely to have experienced the same type of English literacy instruction in terms of phonics versus whole-language emphases at the schools (Ip et al. 2016).

Finally, naming speed was a significant literacy predictor in monolinguals; this measure is thought to incorporate phonological (Torgesen et al. 1997) as well as object naming and word retrieval skills that are key in mapping visual information onto linguistic units (Norton and Wolf 2012). It is therefore possible that bilingual exposure to Spanish and English affects the type of phonological and other linguistic abilities that bilingual versus monolingual children might find most valuable for learning to read in English.

### ***Cross-linguistic literacy predictors***

Most of our bilingual participants first began schooling in English in the US, with the exception of one 7-year-old child. In addition, 14 (38%) children were attending weekly heritage language classes (one class per week) and completing daily homework in Spanish, and 4 (10%) children were receiving a

1-hour weekly Spanish as a foreign language class at their local public schools. Therefore, we asked whether children's abilities in their heritage language would make a significant direct contribution to their literacy ability in their dominant language of reading instruction. Remarkably, once both Spanish and English language factors were introduced into the model, the findings revealed that bilinguals' English literacy was best predicted by their Spanish word reading, Spanish phonological awareness, and English vocabulary knowledge. These findings support the Interdependent Continuum Model (Proctor et al. 2010), suggesting that skills that are similar across bilinguals' languages are likely to contribute the most to children's literacy. The findings are overall consistent with prior research that investigated bilinguals with more diverse language backgrounds (i.e. including children with lower English proficiency and/or later ages of first bilingual exposure to English; Chiappe, Siegel, and Gottardo 2002; Geva and Wang 2001; Pasquarella et al. 2015; Proctor et al. 2006). These findings are consistent with the idea that while bilinguals might rely on the same sets of language and cognitive skills as monolinguals while learning to read, the manner in which bilinguals do so may differ as a result of their specific language experiences (therefore differing across bilingual speakers; Geva and Wang 2001), as well as overall bilingual experiences which we detail below (see also Bialystok, Craik, and Luk 2012; Farnia and Geva 2013; Kovelman, Baker, and Petitto 2008b).

In both English and Spanish, bilinguals' reading was significantly predicted by their morphosyntactic abilities in each language, respectively. One possibility is that while much of the basic morphosyntactic knowledge is established around age 8 in monolingual children, the bilinguals in the present study were more actively developing their linguistic abilities in each language and therefore this ability was a better predictor of their reading than in monolinguals. Yet, there were no significant differences in children's performance in bilinguals' and monolinguals' morphosyntactic ability in English. Therefore, another possibility is that, similar to phonological awareness, morphosyntax is another structural difference for learning to read in Spanish versus English. Morphological awareness is linked to reading outcomes (Carlisle 2000). Spanish has a high degree of morphological inflection which allows for subjects to be understood even when omitted; therefore children's sensitivity to these inflections is important for single-word reading as well as reading comprehension. Research by Escamilla et al. (1996) indicates that Spanish-speaking children, as developing readers and writers, use morphological patterns in ways not attested in their English-speaking counterparts. Whereas English-speaking children make use of onset-rime patterns in which the first letter of the word is changed: bat→cat→hat, etc., Spanish-speaking children manipulate the morphological content at the end of words: (eat) come (*he/she eats*), *comemos* (*we eat*), *comen* (*they eat*). In contrast, in English, individual words are less frequently inflected and map more directly onto single-morpheme vocabulary items. It is possible that children's bilingual experiences in Spanish literacy and morphosyntax also affect their reliance on English morphosyntax while learning to read in English, although more research is necessary to adjudicate the relative contributions of spoken-only versus spoken and orthographic experiences, particularly given the current status of minority languages such as Spanish in the US in relation to learning to read in English. Growing evidence across languages marks the importance of oral and written morphology in addition to semantics in predicting literacy outcomes (Arredondo et al. 2015; Cain and Oakhill 2007). Evidence of respective skills in reading and writing development in Spanish versus English confirms this study's claims that while the bilingual child may use similar abilities, they do not necessarily function in parallel.

### ***Theoretical and research implications***

Taken together the findings carry important implications for both theory and practice of bilingual literacy. The Lexical Quality Hypothesis of word knowledge, which posits that phonology, orthography, and semantics are all necessary constituents of literacy, suggests that the semantic unit is likely to be a 'lemma' – the grammatical frame necessary to understand language, therefore containing both syntax and semantics (Perfetti and Hart 2002). In English, a language with relatively limited morphological or otherwise structural variation at the word level, vocabulary is possibly the best predictor of

children's literacy. In contrast, for languages with rich word-level morphological variation supported by the alphabetic system (Italian, Spanish), children's sensitivity to phonological and morphosyntactic word structure might make a stronger contribution to their reading abilities than does vocabulary knowledge. This effect might be even stronger in bilinguals whose heritage language is morphologically rich, as these heritage language speakers typically have lower vocabulary knowledge when compared with monolinguals (Bialystok 2012), and might therefore be placing greater reliance on phonological and morphosyntactic competence for recognizing familiar and unfamiliar words in print. This suggestion, of course, requires further investigation of structurally different languages.

### ***Educational and clinical implications***

The present results carry three important implications for literacy instruction both in the classroom and in the homes of bilingual children: (i) literacy clinicians and educators must be trained to recognize the distinct set of skills that typically developing bilingual readers may be expected to utilize, and to adjust interventions/instruction accordingly (Mortimore et al. 2012); (ii) dual-language literacy instruction benefits children's literacy acquisition in both of their languages through mechanisms of cross-linguistic transfer. However, educators should not assume that a curriculum of 'Spanish as a foreign language' serves similarly as 'heritage language classes' to their bilingual students, as the former are typically geared towards monolingual speakers with no prior linguistic or cultural connection to the foreign language (Leeman 2005); and (iii) educators should emphasize to parents of (Spanish) heritage language students the benefits of developing their child's linguistic competence and literacy skills in the home language. These parents should be encouraged and supported with access to Spanish reading materials and resources, such as the free, research-based bilingual website, 'Colorín Colorado <<http://www.colorincolorado.org>>' maintained by the National Education Association.

### **Conclusion**

With increasing migration across the world and growing multilingual communities, it is vital to undertake investigations on how to best support bilingual children's language acquisition and academic success. The present study demonstrates that US Latino children largely benefit from learning to read in their heritage language through additional learning opportunities, such as attending Spanish heritage language school programs. This finding adds to the growing body of literature (Arredondo, Rosado, and Satterfield, 2016; Tijunelis, Satterfield, and Benkí 2013) advocating for the benefits of heritage language education in learning to read in the heritage language, as well as the overall academic success and socio-cultural well-being of immigrant children. On a final note, while bilinguals and monolinguals in the present study varied in how their literacy skills supported their English reading abilities, the groups did not differ in their overall language and reading mastery. Because a portion of children (48%) in this study attended schools that support their heritage language, the findings revoke educational concerns towards an educational system that has often excluded dual-language and literacy support. The findings suggest that children's experiences with spoken and written Spanish, their heritage language, make direct and positive contributions to their literacy in English, the primary language of reading instruction. Further research is warranted on the benefits of bilingualism that positively impact other academic abilities.

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