Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

HHS Public Access

Author manuscript

Child Dev. Author manuscript; available in PMC 2023 July 01.

Published in final edited form as:

Child Dev. 2022 July ; 93(4): 881–899. doi:10.1111/cdev.13748.

Contributions of bilingual home environment and language proficiency on children's Spanish–English reading outcomes

Neelima Wagley[1,2], **Rebecca A. Marks**[2], **Lisa M. Bedore**[3], **Ioulia Kovelman**[2]

[1]Department of Psychology & Human Development, Vanderbilt University, Nashville, Tennessee, USA

[2]Department of Psychology, University of Michigan, Ann Arbor, Michigan, USA

[3]Department of Communication Sciences & Disorders, Temple University, Philadelphia, Pennsylvania, USA

Abstract

This study examines the influence of language environment on language and reading skills and the cross-linguistic contributions to reading outcomes in 132 Spanish–English bilingual children ages 7–12 (52% female; 98% Hispanic). We present three major findings: children's language knowledge is separable into general (e.g., phonological awareness) and language-specific (e.g., meaning, grammar) skills; regular Spanish use positively relates to children's Spanish language and reading skills and does not limit English skills; and Spanish reading comprehension is positively associated with English reading comprehension. The model explains a significant percentage of the variance in English (R^2 = .89) and Spanish (R^2 = .87) reading comprehension outcomes. Findings shed light on the interdependence of Spanish and English as they relate to bilingual reading acquisition.

Reading comprehension, or the ability to understand text, is the ultimate goal of learning to read. Across the United States, English reading comprehension is a key benchmark for academic success, influencing decisions about grade retention and receipt of services for language disorders. Yet, young bilingual heritage language speakers—children who speak a different language in the home to that spoken in the community—disproportionately fail to meet national literacy standards in the United States (National Center for Education Statistics et al., 2019) and around the world (PISA & OECD, 2009).

The present study examines the possible mechanisms by which bilingualism influences literacy. While there is limited understanding of literacy development in young bilinguals beyond single-word reading (Melby-Lervåg & Lervåg, 2014), a growing body of research suggests that children's heritage language is a valuable resource that supports learning (e.g., Branum-Martin et al., 2014; Genesee et al., 2006). We investigate the influence of Spanish–English bilingual children's language experiences and literacy skills across their two

Correspondence Neelima Wagley, Department of Psychology & Human Development, Vanderbilt University, Nashville, TN 37205, USA. neelima.wagley@vanderbilt.edu.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

languages as they contribute to English reading comprehension. In particular, we examine the unique contributions of children's home environments, bilingual language use, and both the language-general and language-specific skills that support literacy success. Through a deeper understanding of how dual-language knowledge supports reading comprehension within and across languages, we aim to inform both theory and instructional practices for bilingual learners.

Bilingual reading comprehension

Learning to read builds on a child's existing language proficiency. Reading comprehension is often conceptualized as consisting of two overarching components: single-word identification and generalized linguistic comprehension (Hoover & Gough, 1990). Word identification relies heavily on phonological awareness and sound-to-print mapping, particularly in alphabetic languages such as English and Spanish. Linguistic comprehension is often operationalized as a combination of vocabulary and listening comprehension skills, including children's understanding of meaning and grammar (Melby-Lervåg & Lervåg, 2014).

Theoretical models of bilingualism suggest that emerging mechanisms for reading in two languages are not independent but developmentally *interdependent* (Chung et al., 2019; Cummins, 1979). Bilingual literacy development in one language is inextricably tied to the literacy development in their other language through *cross-linguistic transfer*: the process by which specific knowledge in one language may influence literacy development in another language (Chung et al., 2019). The Integrated Multilingual Model (MacSwan, 2017) suggests that a bilingual's linguistic system consists of both shared (language-general) and discrete (language-specific) cognitive resources. Developing critical skills for reading comprehension in one language may thus facilitate learning to read in both languages; however, some skills are more likely to transfer than others (e.g., phonological awareness), and transfer is most likely at points of contact between a bilingual's two languages (Chung et al., 2019; Proctor et al., 2010).

Spanish and English are closely related languages in many respects. The two languages share an alphabet, many phonemes, and have similar grapheme-phoneme mapping (although Spanish orthography is more transparent). Furthermore, because English has borrowed heavily from Romance languages, English and Spanish share Latin cognates such as *actor* or *control*. Thus, a Spanish–English bilingual child's linguistic resources—including their orthographic and phonological awareness as well as some vocabulary knowledge—are likely to be shared across languages. Yet, Spanish and English also differ in their syntactic structures, and are rife with false cognates, such as sensible/sensible ("sensitive" in Spanish) and embarrassed/embarazada ("pregnant"). Knowledge of morphosyntax is thus more likely to be language-specific and may transfer less readily to support reading across languages. In the following section, we review literature on both shared (e.g., likely to transfer) and discrete (e.g., less likely to transfer) language skills and their relation to bilingual reading comprehension.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Shared skills between English and Spanish

Phonological awareness, or sensitivity to the sounds of language, may be a language-general skill that can transfer between a bilinguals' two languages (Chung et al., 2019). Studies of Spanish–English bilinguals consistently reveal moderate to high intercorrelations between phonological awareness across languages (Leafstedt & Gerber, 2005; Sun-Alperin & Wang, 2011; Swanson et al., 2008). Furthermore, shared phonological skills may transfer to support word reading in both languages (Dickinson et al., 2004; Leafstedt & Gerber, 2005; Sun-Alperin & Wang, 2011). For instance, among a sample of Spanish-speaking first graders enrolled in transitional English language programs, children's Spanish phonological awareness was highly correlated with their English word and pseudoword reading (Durgunoğlu et al., 1993). Although these children were receiving primarily Spanish instruction, their Spanish phonological and word reading skills nevertheless predicted their English word reading over and above the contributions of English spoken language proficiency (Durgunoğlu et al., 1993). Similarly, kindergarten phonological awareness in Spanish effectively contributes to English word reading 2 years later (Manis et al., 2004). Thus, while English reading of course relies on children's proficiency with English language sounds, young bilinguals can effectively utilize phonological awareness from Spanish to support word reading in English.

Due to the phonological overlap and shared orthographic system of English and Spanish, orthographic knowledge and word identification skills may also be shared across languages. For instance, Spanish orthographic processing, or sensitivity to regularities in print, is associated with concurrent English reading outcomes in second- and third-grade English learners (Sun-Alperin & Wang, 2011), as well as fourth- and seventh-grade Spanish heritage speakers (Deacon et al., 2013). Furthermore, Spanish print knowledge in kindergarten contributes to English word reading two years later (Manis et al., 2004). Word reading outcomes are also closely associated across these languages. English learners' Spanish word reading in kindergarten predicts unique variance in their English word reading in first grade (Páez & Rinaldi, 2006), and kindergarten letter knowledge and phonological awareness as measured in Spanish even predicts first-grade reading comprehension (Lindsey et al., 2003). Importantly, although English and Spanish orthographies are similar, they differ in the consistency of sound-to-print mappings: Spanish is a relatively phonologically transparent language, while English is more opaque. This difference in orthographic transparency may affect the bilingual transfer of orthographic knowledge. Evidence from French–English bilinguals indicates that orthographic knowledge may transfer from French (the more transparent language) to support English, but perhaps not from the opaque to the transparent language (Chung et al., 2017).

In sum, phonological and orthographic awareness appear to be shared language-general skills for Spanish–English bilinguals, leading to cross-linguistic transfer of word reading skill. When we consider this evidence in light of the Simple View of Reading (Hoover & Gough, 1990), which conceptualizes reading comprehension as the product of word identification and language comprehension, the shared skills underlying word reading in Spanish and English should logically bolster bilinguals' reading comprehension in both of their languages.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Language-specific knowledge

In addition to single word identification, successful reading comprehension relies on language comprehension skills, including vocabulary, semantics, and syntactic knowledge (Hoover & Gough, 1990). However, unlike word identification, prior research has found little to no association among these language subskills between children's two languages (for a review, see Melby-Lervåg & Lervåg, 2011, 2014). Because semantics and morphosyntax are largely language-specific, these linguistic resources are less likely to transfer across languages (Chung et al., 2019).

The Simple View of Reading (Hoover & Gough, 1990) suggests that oral language comprehension, often operationalized in terms of vocabulary and semantic knowledge, is crucial for successful reading comprehension. Prior research has found little to no association between bilingual children's vocabulary or semantics across their two languages (Melby-Lervåg & Lervåg, 2011, 2014). Bilingual children develop shared and distinct vocabulary in each of their languages (Pearson et al., 1995), and vocabulary in one language does not generally transfer to support literacy in the other language. In a sample of second- and fourth-grade Spanish–English bilinguals, Spanish semantic knowledge, morphological awareness, and syntactic awareness did not contribute to English reading comprehension (Proctor et al., 2012). Similarly, English learners' Spanish and English vocabulary knowledge and oral language skills were related to children's reading comprehension within each language, but not across languages (Manis et al., 2004; Nakamoto et al., 2008). Unlike phonological awareness, orthographic knowledge, and word reading skill, bilinguals' language comprehension skills in one language are less likely to support their reading comprehension in their other language.

Although oral language comprehension is largely language-specific and unlikely to transfer, Spanish–English bilinguals may nevertheless benefit from shared Latin cognates. Pérez et al. (2010) found that bilingual kindergarteners and first graders with greater Spanish exposure knew more English cognates than their peers with greater English exposure, suggesting the possible transfer of semantic knowledge from Spanish to English. In a sample of fourth graders, English-dominant bilinguals performed better than their monolingual peers on their knowledge of Latin cognates, while Spanish-dominant bilinguals performed equivalently to monolinguals, despite having lower non-cognate vocabulary (Kuo et al., 2017). Furthermore, children's ability to recognize Spanish–English cognates was positively related to English reading comprehension in a sample of bilingual fourth and seventh graders (Ramírez et al., 2013). In other words, Spanish morphology and vocabulary indirectly affected children's literacy skills through their English cognate vocabulary (Ramírez et al., 2013). This point of language contact opens the tantalizing possibility that for Spanish–English bilinguals in particular, even Spanish-specific knowledge may positively support English reading comprehension.

Much like vocabulary acquisition, bilinguals acquire language-specific morphosyntactic properties of each language simultaneously (Genesee et al., 2006; Goldstein, 2004; Meisel, 2001). While there is limited work to our knowledge on the relation between English and Spanish syntactic awareness, a few correlational studies have reported weak, non-significant

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

relations across languages. For instance, bilingual first graders' performance on measures of syntactic awareness in Spanish, including verb tense, noun-verb agreement, and adjective production, was not correlated with their performance on equivalent tasks in English (Gottardo, 2002). Similarly, Swanson et al. (2008) revealed no association between English and Spanish syntax among bilingual third graders. Although English and Spanish syntax each contributed to within-language reading outcomes, Spanish syntax was not associated with English reading comprehension (Swanson et al., 2008). While it is important to note that there is some overlap in syntactic structure between English and Spanish, we would nevertheless expect less robust relations between morphosyntax and cross-language reading skill.

Negative associations between English and Spanish

Although a large body of work suggests that Spanish skills support English reading, others have found a negative relation between Spanish and English reading outcomes. For instance, although Swanson et al. (2008) found that phonological awareness in English and Spanish were positively correlated, they observed an opposite effect on literacy: English phonology was positively associated with English word reading, while Spanish phonology was *negatively* associated with English word reading. The authors suggest that in this sample of English language learners (ELLs), dominance in one language may impede the development of linguistic skills in the lower proficiency language (Swanson et al., 2008). These inconsistent findings point to the importance of considering the relative strength and unique contributions of a child's two languages to their literacy success. Specifically, bilingual proficiency is shaped by the relative *balance* of knowledge across the two languages (e.g., Hoff et al., 2021; Peña et al., 2016) that results from the diversity of language experiences. In other words, those with more balanced dual-language proficiency and use may demonstrate qualitatively different neuro-cognitive systems for language than less balanced bilinguals. (e.g., Claussenius-Kalman et al., 2021). For instance, more balanced Spanish–English bilinguals may develop greater automaticity for the processing of shared lexical elements and greater sensitivity to those word structures that are unique to each of their languages (Sun et al., 2022). Bilingual readers are far from monolithic, and studies of bilingual literacy acquisition must consider the contributions of each language separately, the relative differences in proficiency, and how the two languages interact.

In sum, bilingual reading comprehension is complex. Successful reading comprehension integrates word recognition and language comprehension skills (Hoover & Gough, 1990; Perfetti & Stafura, 2014). It is also important to acknowledge that decoding and comprehension can be independently impaired, as prior research has distinguished poor decoders from poor comprehenders (Spencer & Wagner, 2018). For a bilingual child, the shared and language-specific skills underlying reading comprehension develop in tandem and interact with one another. The emergence of this dynamic language system is largely influenced by developmental contexts. Thus, to better understand the cross-linguistic interactions that support bilingual literacy, we must first turn to two contextual factors that influence bilingual language development: the critical roles of socioeconomic status (SES) and bilingual language usage.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Bilingual language environment

Children's language environment at home plays a major role in bilingual language acquisition (McCardle and Hoff, 2006). Two types of interrelated home-based experiences have been at the forefront of literacy inquiry in child development: first, the effects of socioeconomic factors on literacy outcomes, and second, the quantity of language that children are experiencing.

Socioeconomic status is related to the proximal language and literacy practices at home such as amount and richness of language stimulation (Hoff, 2003, 2006; Noble et al., 2006), as well as encouragement of bilingual competence (Pearson, 2007). For instance, higher SES is associated with the use of more complex and responsive language as a family (e.g., more extensive vocabulary, longer sentences, more complex grammar; Hart & Risley, 1995; Pace et al., 2017). Nevertheless, children from language-minority homes across varied SES backgrounds may have different language development trajectories than their middle-class monolingual peers (e.g., Hernandez et al., 2007; Hoff, 2013). Given that language minority status is often confounded with SES in the United States, it has proven difficult to tease apart the effects of language status on children's reading and academic development.

The language environment at home, independent of SES, also contributes to children's language proficiency (e.g., Romeo et al., 2018). Bilingual children's daily use of each of their languages is strongly associated with their language development (Bedore et al., 2016). It is well documented that opportunities to hear (input) and use (output) language are strong predictors of children's knowledge of semantics and morphosyntax in each of their languages at school entry (Bohman et al., 2010). Similarly, current input and output in Spanish and English can explain preschoolers' dual-language proficiency and relative bilingual balance (Bedore et al., 2012). For slightly older children, the importance of continued bilingual experience becomes evident. First and third graders, studied in U.S. educational contexts, make steady gains in English (the primary language of education) but only make gains in Spanish if they continue to hear and use the language (Bedore et al., 2016; Pratt et al., 2020).

The current study

The overarching goal of this study is to shed light on the interdependence of Spanish and English as they relate to bilingual children's successful reading acquisition, accounting for the influence of varied bilingual environments. This goal is addressed through three specific research questions. First, what are the shared and language-specific aspects of bilingual competence in the context of phonological awareness, semantics, and grammar knowledge? Second, how do Spanish–English bilingual children's heritage language use and socioeconomic environment influence these language and literacy skills? Finally, how does language proficiency in Spanish and English contribute to children's reading comprehension in both of their languages, Spanish and English? To answer these questions, we examined the relation between bilingual environment, dual language proficiency, and reading comprehension in a sample of 132 Spanish–English bilingual children.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Figure 1 displays the proposed model to be tested in the current study. Some linguistic skills, such as phonological awareness, are likely shared across languages. For Spanish–English bilinguals specifically, prior work suggests that shared phonological and orthographic awareness contribute directly to single word identification in both languages (Dickinson et al., 2004; Leafstedt & Gerber, 2005; Manis et al., 2004). Other skills, such as children's sensitivity to language meaning and structure, support both single-word reading and comprehension, but are more likely to be language-specific. Guided by the Integrated Multilingual Model (MacSwan, 2017) and theories of bilingual transfer (Chung et al., 2019), we predict that while the association between linguistic competence and reading comprehension might be language-specific, children's reading comprehension in their heritage language may nevertheless contribute to their reading comprehension in English. Furthermore, we predict that children's home environments will contribute to their bilingual language skills, indirectly influencing literacy success. Through the deeper understanding of shared and language-specific literacy skills, we hope to inform both theories of bilingual language and reading development as well as instructional practices to best support bilingual readers.

METHOD

Participants

One hundred and thirty-two Spanish–English speaking bilingual children participated in the study (52% female, M_{age} = 8.75, range = 6.67–11.67, see Table 1). Participant selection criteria included exposure to Spanish at birth, and to English prior to age five, as well as a minimum of two continuous years of daily English use in the United States prior to testing. English was the primary language of instruction at school for all participants. All participants had at least one native Spanish-speaking parent who reported consistent use of Spanish at home. 98% of the parents identified as Hispanic, Latin, or of Spanish origin and 2% of the parents identified as mixed (as reported in the background questionnaire). Approximately 27% of the participants (N = 35) attended a Spanish heritage language-learning school for 2–3 h per week, which assigned daily Spanish language and literacy homework, while another 10% (N = 13) received 1–2 h of Spanish language and reading instruction at school. On average, participants were in third grade at the time of testing (full range of grades are as follows: N = 4 finished kindergarten, N = 26 in first, N = 19 in second, N = 37 in third, N = 32 in fourth, N = 8 in fifth, and N = 6 in sixth). All children had normal hearing, no known neurological conditions, or learning impairments.

Participants were recruited in Southeast Michigan, USA by a community liaison. This geographical region of the country is composed of majority White and English-dominant communities. Participants came from middle-class homes with a median household income on par with the surrounding county-level and national-level norms (U.S. Census Bureau, 2019). The majority of our participants (~70%) had at least one parent who held a bachelor's degree or higher, indicating relatively high educational attainment.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Procedure

Prior to the lab visit, parents completed a 24-item questionnaire over the phone to determine the child's eligibility for participation, as well as a language experience questionnaire detailing the child's daily use of Spanish and English (see Measures for more detail). During the laboratory visit, participants completed assessments of language and literacy in Spanish and in English (counterbalanced) with a native speaker of that language. Parents completed a 43-item survey that included questions regarding the family's socioeconomic information (e.g., parental educational, household income), and parental perceptions of economic and cultural socialization (retrieved from: www.macses.ucsf.edu). Families received monetary compensation and a small gift bag for participation.

Measures

Bilingual language use—To examine a child's everyday bilingual language use, parents completed the Bilingual Input Output Survey (BIOS; Peña, Gutierrez-Clellen, et al., 2018) describing the *quantity* of their child's home and school language use to the best of their ability. This questionnaire asked parents to detail a typical weekday and a typical weekend day of the child on an hour-by-hour basis, including the language(s) the child is exposed to inside and outside of the home. Parents reported both interpersonal interactions and use of technology and media. Specifically, we asked parents to indicate what the child is typically engaged in (e.g., breakfast, play), who is interacting with the child during each activity (e.g., parent, sibling), and using what modality (e.g., phone/TV, book/homework). For instance, a child may be independently reading and receiving language input in one language (e.g., Spanish or English), while producing little to no output. Alternatively, at the dinner table, the child might be actively engaging with family members and receiving language input in Spanish while producing output in both Spanish and English. Based on this hour-by-hour report, we calculated the number of hours children spent hearing (input) and speaking (output) each of their languages, and a relative percentage of time spent using each language for each child. Given that most bilingual participants in our sample are exposed to and use English most of the time (e.g., at school, at home with siblings, etc.), we used the approximate number of hours spent speaking Spanish in a typical week as a direct measure of heritage language experience. Thus, our independent variable is the hours of children's Spanish language use in a typical week, calculated using the formula: 5 × (hours of typical weekday Spanish use) + 2 × (hours of typical weekend day Spanish use). This measurement approach has been validated by the developers of BIOS (Peña, Gutierrez-Clellen, et al., 2018) and yields bilingual experience values that correspond well to children's dual language proficiency (Peña et al., 2021), although the measure does not tease apart differences in input modality (e.g., phone/TV, book/homework).

Bilingual language proficiency—Phonological awareness, the ability to understand and manipulate units of sound in spoken language, was measured using Woodcock *Sound Awareness* in both languages (Muñoz-Sandoval et al., 2009; Woodcock et al., 2001). Participants completed all four subtests of this assessment, which measured Rhyming (e.g., "What rhymes with "*moon?*"), Deletion (e.g., "Say swimmer without /er/"), Substitution ("If you replace the word *sun* in *sunny* with *fun*, what word would it be?"), and Reversal (e.g. "If

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

you say the sounds in the word *back (b-a-k)*, and then say them backward, what word would it be?").

Spanish and English language comprehension was measured using the Bilingual English Spanish Assessment—Middle Elementary (Peña et al., 2008). This assessment is normed specifically with Spanish–English bilinguals ages 7–12 in the United States. The *Semantic Knowledge* subtest measures semantic breadth and depth to assess how children organize and gain access to their lexical system (Peña et al., 2003). Participants are shown pictures and asked questions that tap into semantic knowledge such as category generation (e.g., Tell me all the zoo animals you can think of), similarities and differences (e.g., What makes these two gifts alike?), analogies (e.g., Legs are to table as wheels are to _____), and functions (e.g., What do lungs do?). The *Morphosyntax Knowledge* subtest examines grammatical morphemes and sentence structures, using both Cloze and Sentence Repetition items (Gutiérrez-Clellen & Simon-Cereijido, 2007).

Literacy outcomes—Bilingual reading outcomes were measured using the Woodcock–Johnson and Woodcock–Muñoz word reading and reading comprehension subtests. The *Letter-Word Identification (WID)* subtest required children to read single words of increasing difficulty out loud. Words were only scored as correct if they were fluidly, not sound-by-sound, and with correct pronunciation. The *Passage Comprehension (PC)* required participants to read short cloze sentences and fill in a missing word. Children completed both WID and PC in English and Spanish.

Data analysis

The goal of this study was to examine the relation between children's bilingual home environment, language proficiency, and their reading outcomes. We used a two-step approach to structural equation modeling (SEM), computed using Mplus8 (version 1.6; Muthén & Muthén, 2012). First, we used an exploratory factor analysis (EFA) to determine the appropriate factor structure of the measurement model. Second, we constructed a structural equation model to confirm the factor loadings onto their latent variables from the measurement model (confirmatory factor analysis), and analyze the within and cross-language associations between the latent constructs and observed variables, and their contributions to reading comprehension in both languages. All data were analyzed using full-information maximum likelihood estimates to maximize usable data (Byrne, 2001). The largest amount of data missing is no more than 20% for any given variable, with most variables missing <10% of the total sample, within the accepted bounds (Kline, 2015). Below, we present three structural models we tested.

RESULTS

Descriptive statistics

Participants had age-appropriate language and literacy scores in English and Spanish across all assessments (see Table 1). Paired sample *t*-tests across assessments revealed significant differences between Spanish and English. English assessment scores were higher than Spanish across all measures ($p < .01$). Correlations among study variables, controlling for

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

participant age and gender, are reported in Table 2. The language and literacy tasks were correlated within and across languages to varying degrees, indicating reciprocal relations between language and literacy abilities in Spanish and English. Children's language and literacy skills were also correlated with components of SES and hours speaking Spanish. Parental education was positively correlated with all measures of language and literacy across both languages. Household income was positively correlated with English morphosyntactic knowledge but no other language or literacy measures. The number of hours speaking Spanish positively correlated with Spanish morphosyntax knowledge and negatively correlated with English morphosyntax knowledge.

Exploratory factor analysis

Home environment—We measured home environment in terms of children's dual-language usage and familial SES. To capture the multifaceted aspects of SES, we computed an EFA using participants' reported household income, parental education, perception of social status at the community level, and perception of social status at the national level. The EFA revealed that all indicators of SES loaded onto a single factor. However, subjective social status at the community level had a low factor loading on the latent variable relative to other indicators and did not correlate as strongly with other SES variables. We, therefore, removed this variable and moved forward with a latent SES variable comprised of household income, parental education, and perception of social status at a national level. This model was a good fit (see Table 3; Figure 2; $\chi^2(2) = 1.17$, comparative fit index [CFI] = 1.00, Tucker–Lewis index [TLI] = 1.00, root mean square error of approximation [RMSEA] = .00, standardized root mean square residual [SRMR] = .01). We additionally entered the number of hours spent speaking Spanish as an observed measure of language experience into our structural equation model (Peña et al., 2008).

Bilingual language proficiency—To identify a factor structure of language proficiency broadly, we computed an EFA that estimated two to four factor structures across measures of phonological awareness, semantic, and morphosyntax knowledge in both languages. While the fit statistics revealed that the four-factor model was the best fit model initially, a closer examination of factor loadings showed that children's rhyming ability in both Spanish and English clustered together to form an independent fourth factor (see Supporting Information). Based on this clustering pattern, we used a three-factor model with latent constructs of Phonology in both languages, English language knowledge, and Spanish language knowledge (see Table 3; $\chi^2(52) = 81.99$, CFI = .97, TLI = .95, RMSEA = .06, SRMR = .03). This factor structure suggested a single, language-general construct underlying phonological awareness, and separate language-specific constructs for English and Spanish semantic and morphosyntactic knowledge (see Figure 2 for factor loadings).

Full structural model(s)

The aim of the study was to better understand the mechanisms underlying bilingual literacy development. In three separate structural models, we tested direct and indirect paths between measures of SES and children's bilingual language environment in the home, bilingual language skills, and reading outcomes. Raw scores of Spanish and English word reading and reading comprehension were entered as observed variables for each structural model

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

tested. Analyses used raw scores from all language and literacy assessments and controlled for age. Regression coefficients between age and all latent variables of language skills, bilingual word reading skills, and English reading comprehension were significant, $p < .001$. We did not control for age of English acquisition, as all participants were early exposed before the age of five (see Table 1, Bedore et al., 2016). Correlations among latent variables of phonological awareness and Spanish and English language skills were included in the model.

Model 1—Test of the conceptual model—The first structural model tested the paths specified by the theoretical model in Figure 1 (see Figure S1 for results). As prior literature suggests, word reading in English and Spanish seems to rely primarily on shared skills of phonological and orthographic awareness. This is evident in the strong positive bivariate correlations between measures of phonological awareness and word reading within and across the two languages (see Table 2). In line with this pattern of data, we observed high collinearity between the phonological awareness latent variable and Spanish word reading skills when testing this proposed structural model. Although the model had good fit (see Table 3; $\chi^2(252) = 344.95$, CFI = .94, TLI = .93, RMSEA = .06, SRMR = .06), the standardized path coefficient of 1.08 indicates large overlap in shared variability between the phonological awareness latent variable and Spanish word reading scores making this model inadmissible. Thus, in order to account for phonological and word reading skills in both languages, we tested a second structural model in which we modeled the correlations between these variables rather than modeling the directional paths.

Model 2—Modeling Spanish and English single word reading—The second structural model we tested is shown in Figure 3. The model yielded a good fit for our data (see Table 3; $\chi^2(224) = 346.50$, CFI = .94, TLI = .93, RMSEA = .06, SRMR = .06). Standardized β-coefficients among all direct paths tested are shown in Figure 3 and indirect paths tested are reported in Table S2. The model explained a large percentage of the variance in children's English ($R^2 = .89$, $p < .001$) and Spanish ($R^2 = .87$, $p < .001$) reading comprehension outcomes.

As predicted, we observed that children's home environments made important contributions to their bilingual language skills. SES had a direct effect on the three language-general and language-specific latent constructs, as well as an indirect effect on English reading comprehension through English knowledge ($\beta = .23$), and on Spanish reading comprehension through Spanish language knowledge ($\beta = .14$). The number of hours speaking Spanish was directly associated with Spanish-specific language skills, and indirectly associated with Spanish reading comprehension via Spanish-specific knowledge ($\beta = .14$).

Children's phonological awareness, English-specific knowledge, and Spanish-specific knowledge were all related to their bilingual word reading proficiency. Spanish word reading was directly influenced by both Spanish- and English-specific knowledge. In contrast, English word reading was only associated with English-specific knowledge. As expected, there was a significant correlation between the shared phonological awareness construct and

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Spanish (β = .43) and English (β = .47) word reading as well as a strong correlation between Spanish and English word reading (β = .67).

Spanish reading comprehension was directly associated with children's Spanish-specific knowledge (β = .38) and word reading skills (β = .45), but not English-specific knowledge. English reading comprehension was directly associated with children's English language knowledge (β = .54) and word reading skills (β = .28), but not Spanish-specific knowledge or word reading. We also observed evidence of cross-linguistic transfer on bilingual reading comprehension. English word reading skills directly contributed to Spanish reading comprehension (β = .24), and finally, Spanish reading comprehension directly contributed to English reading comprehension (β = .26).

Model 3—Assessing word reading "balance"—We also tested an alternate model accounting for word reading skills in both languages by computing a measure of children's relative word reading proficiency in English compared to Spanish (see Figure 4). In Spanish–English bilinguals, prior work suggests that shared phonological and orthographic awareness contribute directly to single word identification in both languages (Dickinson et al., 2004; Leafstedt & Gerber, 2005; Manis et al., 2004). Given the likely transfer of these skills between English and Spanish, a "balance" measure may represent word reading skills within this sample of bilingual children who are highly proficient in both languages. Specifically, we calculated word reading *balance*, in this case, from raw word reading scores using the equation $\frac{\text{Spanish WID}-\text{English WID}}{\text{Spanish WID}+\text{English WID}}$. This results in scores ranging from 1 (better word reading in Spanish) to −1 (better word reading in English). A score of 0 indicates equal bilingual word reading proficiency. Participants varied widely in their word reading ability across languages, ranging from −0.67 to 0.22; however, most children were relatively well-balanced though slightly more English-dominant readers (mean balance score = −0.05; see Figure 4). This alternate model also yielded a good fit for our data ($\chi^2(209) = 325.43$, CFI = .94, TLI = .93, RMSEA = .06, SRMR = .06).

DISCUSSION

How does a bilingual child's proficiency in each of their languages, as well as their language use at home, support bilingual reading comprehension? To answer this question, we used SEM to examine the relations between Spanish–English bilingual children's language and literacy skills, SES and language environment in the home, and their Spanish and English reading outcomes. We present three major findings. First, bilingual children's language knowledge includes largely shared (e.g., phonological awareness) and language specific (e.g., morphosyntax and semantics) components, which make distinct contributions to literacy. Second, children's home environments, including SES and heritage language use, make distinct and meaningful contributions to their language and reading outcomes in each of their languages. Third, children's Spanish literacy makes a direct contribution to children's reading comprehension in English. We address each of these findings and their implications in turn.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Shared and discrete skills

Theoretical models suggest that the mechanisms for reading in two languages are developmentally *interdependent* (see review by Chung et al., 2019). For a bilingual child, learning to read thus builds on their existing proficiency of the two languages. The first goal of the study was to understand the interrelation of English and Spanish language and literacy skills: which language competencies are unique to a given language, and which are shared? To this end, we used EFA to estimate a factor structure of children's phonological awareness, semantic, and morphosyntactic knowledge in both languages. Our first set of findings revealed both language-general (shared) and language-specific (discrete) skills among Spanish–English bilingual readers.

Our analyses revealed that phonological awareness in English and Spanish can best be understood as a single, shared construct. This finding extends prior work suggesting that phonological awareness can transfer from Spanish (Dickinson et al., 2004; Durgunoğlu et al., 1993; Leafstedt & Gerber, 2005) and Italian (D'Angiulli et al., 2001) to benefit English reading. Recent meta-analyses also suggest that phonological awareness may be a unitary, shared ability across languages (Branum-Martin et al., 2015). It is important to note that the present findings may be specific to bilingual speakers of similar orthographic systems such as English and Spanish. A large body of research suggests that phonology can transfer between alphabetic languages to support literacy (e.g., Turkish to Dutch; Verhoeven, 2007). Yet, similar inquiries with more distant language pairings have been mixed (e.g., Branum-Martin et al., 2012; Koda, 2007; Liow & Poon, 1998). Nevertheless, our results deepen the understanding of Spanish–English bilingual learners and provide support for the existence of closely integrated phonological processing in emerging bilingual readers (Cummins, 1979; MacSwan, 2017).

Unlike phonological awareness, the analyses suggest that bilingual children's semantic and morphosyntactic knowledge are language specific. In our EFA, measures of English semantics and syntax loaded onto one factor, while measures of Spanish semantics and syntax loaded onto a second, separate factor. This finding is also a logical extension of prior work suggesting that bilingual children's vocabulary and conceptual knowledge may be different across their two languages (Peña et al., 2016). Furthermore, studies of syntax have demonstrated independent, concurrent and largely monolingual-like development for bilinguals with early and systematic exposure to two languages (e.g., De Houwer, 2005; Meisel, 2001; Petitto & Kovelman, 2003). Our findings are thus consistent with theoretical frameworks of bilingual language interdependence (MacSwan, 2017; Proctor et al., 2010), indicating shared, language-general skills at points of close contact between languages, as well as language-specific skills that are less likely to be shared.

Contributions of SES

For many bilingual children in the United States, heritage language exposure occurs primarily at home. How does the language environment in the home contribute to children's developing dual language skills and their bilingual literacy outcomes? Bilingualism is often confounded with low-SES in the U.S. context, and both bilingual learners and children from low SES homes are more likely to fall behind in school (Kieffer, 2008). This makes it

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

of the utmost importance to disentangle the effects of heritage language use and SES on language and literacy development. However, this relationship has proved elusive in prior literature (see review by Hammer et al., 2014). Our second set of findings reveals that SES and Spanish use in the home make distinct and separable contributions to their language and reading outcomes in both languages. We constructed a latent variable that included measures of parental education, household income, and parents' subjective social status ratings. The analyses revealed that SES directly relates to shared phonological awareness and language-specific skills. Higher socioeconomic backgrounds were associated with greater English-specific knowledge, Spanish-specific knowledge, and improved phonological awareness. Through these latent factors, SES also contributed indirectly to word reading and reading comprehension outcomes.

These findings extend prior research highlighting the importance of SES for literacy development across monolingual and bilingual populations (Hoff, 2006; Kieffer, 2012; Mancilla-Martinez & Lesaux, 2011). There are many possible mechanisms underlying this association. For instance, SES is often associated with the language environment in the home, including the quality and quantity of linguistic input, engagement with reading materials, learning activities, and parents' own literacy habits (e.g., Duncan & Brooks-Gunn, 2000; Golinkoff et al., 2019; Hoff, 2003, 2006; Oller & Eilers, 2002; Pace et al., 2017; Weisleder & Fernald, 2013). Caregivers in both monolingual and bilingual higher SES homes more frequently ask probing questions or ask for explanations rather than giving directives (Hoff, 2006), which supports children's language and critical thinking skills. SES is also associated with the encouragement of bilingual competence (Oller & Eilers, 2002; Pearson, 2007) and parental involvement in literacy activities (e.g., shared book reading) which further promotes children's interest in reading (Farver et al., 2006). In line with this prior work, we find that higher SES is directly related to skills in bilingual children's phonological awareness, as well as language-specific knowledge in both English and Spanish.

Contributions of Spanish use

With regard to bilingual language use, we find that greater Spanish use makes significant contributions, not only to Spanish language knowledge, but also to word reading and reading comprehension outcomes. This finding is particularly noteworthy because all of our participants were living in majority White, English-dominant communities in the midwestern United States, with English as the primary language of instruction in school. Not surprisingly, parental questionnaires reveal that children spent on average, less than half of their time speaking Spanish. Nevertheless, prior work suggests that interactions in a heritage language may help to scaffold their learning both *within* and *across* their two languages (Ordóñez et al., 2002; Proctor et al., 2006, 2010). Consistent with this idea, we demonstrate that even limited Spanish use as a family makes a significant impact on Spanish language and literacy knowledge. In turn, Spanish language and literacy skills have direct and indirect effects on English literacy.

Spanish use positively relates to Spanish language knowledge and is not negatively associated with English language or literacy skills, as revealed through two complementary

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

analytical models of bilingual reading. For example, bivariate correlations indicate that Spanish use is positively associated with Spanish morphosyntax but negatively associated with English morphosyntax. Critically, the structural model, which considers the variabilities within and across both English and Spanish language skills, paints a different picture. Spanish use is positively associated with Spanish language knowledge (including both semantics and morphosyntax) and there were no significant associations with English language knowledge or phonological awareness. This stands in contrast to the bivariate correlations, which suggest a negative association between Spanish use and English skills. A more holistic examination reveals that Spanish use is not significantly associated with English-specific knowledge within a larger model of literacy. This larger model also considers the contributions of environmental context and literacy skills across both languages. Additionally, Spanish use is not directly related to English-specific language or literacy. Nevertheless, there was a significant indirect effect of Spanish use on Spanish reading comprehension, which, in turn, is positively related to English reading comprehension. Within our sample, Spanish use at home does not obstruct the English reading process. This finding is in line with prior works suggesting the positive relation between bilingual home language use and literacy, and their combined influence on immigrant children's literacy and broader academic outcomes (Dressler & Kamil, 2006; Genesee et al., 2006; Goldenberg et al., 2011).

Bilingual word reading and reading comprehension

Across schools in the United States, children of all language backgrounds are assessed on English reading comprehension as a key benchmark for academic success. Yet, little is known about the influence of heritage language experiences and proficiency on English reading comprehension. Guided by theories of linguistic interdependence, we tested the pathways between children's Spanish and English language knowledge and word reading skills in predicting reading comprehension outcomes. This method led to our third finding: children's Spanish language and reading skills significantly support their English reading success. This finding was supported by two distinct structural models in a manner we discuss in turn.

Consistent across both models of bilingual reading was the finding that bilingual children's language-specific knowledge in English and Spanish, and their language-general phonological awareness ability, were directly related to bilingual word reading skills. First, as expected, stronger English language knowledge was associated with better word reading and reading comprehension in English, while stronger Spanish language knowledge was associated with better word reading and reading comprehension in Spanish. Overall, these results are consistent with the "within language" findings on reading comprehension and support the understanding that for readers in later elementary grades, reading comprehension is best predicted by their spoken language knowledge (Lervåg & Aukrust, 2010; Manis et al., 2004).

First, we modeled Spanish and English word reading skills separately, and observed high correlations between phonological awareness and word reading in each language. This is logical, as English and Spanish are both alphabetic languages and prior work suggests

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

that phonological awareness is the most important predictor of early literacy acquisition in both languages (Jongejan et al., 2007). Word reading was also highly correlated in the two languages, as single word reading in both Spanish and English rely heavily on phonological awareness and shared sound-to-print correspondences. This high collinearity is to be expected, given prior literature suggesting that word reading is correlated across languages (e.g., Lesaux et al., 2006). Furthermore, English and Spanish orthographic systems are closely related. Prior work with speakers of two related alphabetic languages suggests that print knowledge may transfer from a bilingual's more transparent language to their more opaque language (Chung et al., 2017), perhaps strengthening the association between word reading in the two languages.

Because of this close association between word reading in English and Spanish, we also tested a model that conceptualized word reading in terms of relative balance. This operationalization was both methodologically and theoretically principled given the nature of bilingual development of these skills (e.g., two language bilingual ability models; Peña et al., 2016; Peña, Bedore et al., 2018), which suggests that shared phonological and orthographic awareness contribute directly to single word identification in both languages (Dickinson et al., 2004; Leafstedt & Gerber, 2005; Manis et al., 2004). A measure of word reading balance thus allowed us to test direct effects of phonological awareness as well as unique effects of Spanish and English broader language knowledge on bilingual word reading, tapping into lexical and sublexical processes of phonology, semantics, and orthography. Due to the English-dominant literacy instruction experiences in our bilingual sample, most children were better at reading in English than in Spanish. As a result, English word reading was also positively associated with Spanish reading comprehension, suggesting a reciprocal relationship in the cross-linguistic support of bilingual children's literacy. Bilingual word reading balance was positively associated with Spanish reading comprehension, meaning that children who were better readers of Spanish, and thus had a smaller gap between their English and Spanish word reading proficiency, were more likely to have higher Spanish reading comprehension scores.

Language processing in more balanced bilinguals may differ from bilinguals who are more dominant in one language (e.g., Claussenius-Kalman et al., 2021; Hoff et al., 2021, Peña et al., 2016). In our Spanish–English bilingual sample of children ages 7–11 years old, overall, English dominance is more prevalent than balanced bilingualism and there is no Spanish-dominant profile. This parallels the data observed in a recent paper by Hoff et al. (2021), who also argue for a measure of balance. However, in relation to our literacy results, balanced word reading scores (i.e., good proficiency in both English and Spanish; see Figure 5) is positively associated with Spanish reading comprehension, which is positively associated with English reading comprehension. This suggests that balanced bilingual proficiency is an overall strength to children's reading outcomes, potentially facilitated through cross-linguistic interactions.

We initially conceptualized word reading to be separate observed variables in our larger bilingual model (see Figure 1). However, in testing this model, we ran into a methodological issue of multicollinearity and decided to approach this aspect of the structural model in two ways. One approach was to directly map the strong links between phonological awareness

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

and Spanish and English word reading through bidirectional pathways (i.e., correlations in the model, see Figure 3), as this was the source of the multicollinearity. Another approach, given the strong relationship between English and Spanish word reading (R^2 = .49), was to analyze word reading as a single, relative, "balance" measure. As discussed above, the balance measure aims to capture those with Spanish skills relative to English reading skills (see Figure 4 for full model and Figure 5 for distributions of Spanish and English word reading standard scores in this sample).

Both conceptualizations of bilingual word reading, either modeled as two separate skills or as a relative balance score, revealed a positive association with Spanish reading comprehension. Furthermore, and perhaps most importantly, Spanish reading comprehension had a consistent direct effect on English reading comprehension. This finding supports theories of cross-linguistic interdependence which suggest that literacy in a bilingual child's heritage language is inextricably tied to their literacy in the language of schooling (Cummins, 1979). We also extend prior work by assessing Spanish and English word-level and comprehension skills in parallel and the direct influences of one language on the other. Prior work with bilinguals has mainly highlighted associations between children's English proficiency and English reading comprehension (e.g., Gottardo and Mueller, 2009; Lesaux et al., 2010; Proctor et al., 2005) and Spanish proficiency and Spanish reading comprehension (Nakamoto et al., 2008; cf. Proctor et al., 2010). In the present study, we provide evidence of transfer from English to Spanish, as well as from Spanish to English. Not only does heritage language reading comprehension support reading comprehension in the language of schooling, but children's word-level reading ability, likely driven largely by their English-dominant schooling context, also has a positive influence on their heritage language reading comprehension.

The direct effect of Spanish reading comprehension on English reading comprehension may be largely driven by children's shared linguistic knowledge at points of similarity between Spanish and English (Proctor et al., 2010). For example, Proctor et al. (2017) found that Spanish syntax at second grade predicted fifth-grade English spoken language and reading comprehension skills. Spanish syntax could be hypothesized to share cross-linguistic overlap with English syntax given the fact that word ordering is largely consistent across Spanish and English. Furthermore, in prior work with preschoolers, Castilla et al. (2009) found Spanish semantics and syntax predicted English syntax and semantics 8–9 months later. Correlation results from the current study also speak to this cross-linguistic overlap. In our sample, Spanish semantic and morphosyntax knowledge both correlated with children's English reading comprehension skills. Conversely, English semantic and morphosyntax knowledge also correlated with children's Spanish reading comprehension.

Another possible contributor to the current results may be children's domain-general cognitive skills. Several executive functioning skills (e.g., working memory) and meta-linguistic strategies (e.g., making inferences, predicting) are highly relevant to reading comprehension and reading success (Bialystok, 2007, 2018). Future studies may consider including additional measures of general cognitive skills in order to tease apart these possible effects in populations of bilingual children who vary in their relative dual-language proficiency. Taken together, we find evidence in support of Spanish–English

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

interdependence, at the sublexical and lexical levels of bilingual reading development. Importantly, the present study extends our understanding by measuring *both* of a bilingual child's languages to show that Spanish reading further benefits children's English reading outcomes.

Implications

In the United States, national measures of reading achievement consistently portray bilingual children as underachieving. Historically, this has raised major concerns over whether bilingual language exposure might interfere with language and literacy acquisition in English. On the contrary, we find that bilingual children's Spanish proficiency positively supports their reading comprehension in English. These findings have important implications for policy, research, and educational practices. For example, simultaneous dual-language learning may provide children with some bilingual reading benefits, particularly in early development (Berens et al., 2013). Furthermore, some of our findings may also generalize to learners of two different or closely related pairings of languages, particularly in instructional settings.

One important finding from the current study that contributes to theory and practice is that phonological awareness across Spanish and English is one shared latent construct. Current theoretical models suggest that phonological awareness may be shared across many language pairing (e.g., Chung et al., 2019). While our data can only inform Spanish–English bilingualism more specifically, it seems reasonable to think that similar models of the contribution of phonology would hold across other language pairings. When teaching phonological awareness for English reading, perhaps children of different language backgrounds could benefit from bringing in knowledge of the shared sounds between English and their heritage language (e.g., "What other words can we think of that also have an "ih" sound?"). We also find that, in terms of measurement and assessment, including measurements of language environment and children's language and literacy knowledge across both languages is necessary to appropriately understand bilingual development (Bedore & Pena, 2008; Kohnert, 2010; Peña et al., 2015). Our findings continue to support the idea that bilingual development in the home should be viewed as a resource to be encouraged and used to support children's academic achievements (Durgunoğlu, 2017).

Limitations and future directions

The current study examined a wide age range spanning a critical developmental period of literacy acquisition. To address this, we controlled for age in our structural models. However, there are several age-related differences worth noting. In general, the relative importance of decoding and language comprehension skills for reading comprehension changes during the course of development (Melby-Lervåg & Lervåg, 2014). Phonological awareness and word decoding skills are stronger predictors of reading comprehension in younger elementary children as compared to older elementary children, who rely more on oral language skills for reading comprehension (Lervåg & Aukrust, 2010; Manis et al., 2004). Furthermore, recent work suggests that the relative contribution of phonology and semantic knowledge for reading may vary as a function of age of bilingual exposure (Jasińska & Petitto, 2018). Our sample was intentionally limited to children who had been

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

exposed to English (second language) prior to age five, with the majority of the children exposed prior to age 3 years old. This methodological decision allowed us to examine the relative contributions of early English and Spanish exposure to literacy outcomes in children with daily usage of and high proficiency in both of their languages. This is an important addition to the literature, which has primarily focused on English learners, or bilinguals with limited proficiency in their language of schooling. Nevertheless, future studies could expand this inquiry to ELLs with varying English proficiency to better capture the diversity of the bilingual experience.

As some components of our model refer to language-specific skills, we are unable to speculate about generalizability beyond bilinguals who speak English and Spanish (or perhaps other closely related languages such as Portuguese), limiting the conclusions we can draw from the current study. Future work should examine other language pairings, particularly bilingual speakers of two structurally distinct languages and orthographies such as English and Chinese, or English and Arabic. Similarly, we should also consider speakers of two more closely related languages, as well as less distant language pairs such as Spanish and Catalan or French and Italian, as the semantic and morphosyntactic links between the two languages might lead to additional shared latent components, impacting the reading system as a whole. These next steps will strengthen our theoretical understanding of bilingual language representations more broadly and allow us to generalize findings to a wider array of diverse bilingual learners.

CONCLUSIONS

The study provides three pieces of evidence on the mechanisms by which bilingualism influences literacy. First, bilingual children's language-general and language-specific skills each make distinct contributions to their literacy development. Second, regular Spanish use positively relates to children's Spanish language and reading skills and does not detract from children's English language and reading skills. Third, children's Spanish reading skills are positively associated with children's English reading outcomes. These findings help illuminate the complexities of cross-linguistic interactions in bilingual literacy development, with proximal influences at single-word level and more indirect relations at the comprehension level. Together, the findings carry implications for both theory and literacy practices for bilingual learners.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGMENTS

We thank Isabel Hernandez and Akemi Tsutsumi-Rioboo for their assistance with data collection and Dr. Alisa Baron for her valuable input and feedback. We also thank the University of Michigan Department of Psychology, the NICHD Developmental Training Grant (T32, awarded to NW), and the Center for Human Growth and Development for their support.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Funding information

This work was supported by the NICHD (R01HD09249801, PI: Kovelman; R01HD078351; PI: Hoeft, Subcontract PI: Kovelman).

Abbreviations:

BIOS	Bilingual Input Output Survey
CFI	comparative fit index
EFA	exploratory factor analysis
ELL	English language learner
PC	Passage Comprehension
RMSEA	root mean square error of approximation
SEM	structural equation modeling
SES	socioeconomic status
SRMR	standardized root mean square residual
TLI	Tucker–Lewis index
WID	word identification

REFERENCES

Bedore LM, & Peña ED (2008). Assessment of bilingual children for identification of language impairment: Current findings and implications for practice. International Journal of Bilingual Education and Bilingualism, 11(1), 1–29. 10.2167/beb392.0

Bedore LM, Peña ED, Griffin ZM, & Hixon JG (2016). Effects of age of English exposure, current input/output, and grade on bilingual language performance. Journal of Child Language, 43(3), 687–706. 10.1017/S0305000915000811 [PubMed: 26916066]

Bedore LM, Peña ED, Summers CL, Boerger KM, Resendiz MD, Greene K, Bohman TM, & Gillam RB (2012). The measure matters: Language dominance profiles across measures in Spanish-English bilingual children. Bilingualism, 15(3), 616. 10.1017/S1366728912000090 [PubMed: 23565049]

Berens MS, Kovelman I, & Petitto LA (2013). Should bilingual children learn reading in two languages at the same time or in sequence? Bilingual Research Journal, 36(1), 35–60. 10.1080/15235882.2013.779618 [PubMed: 23794952]

Bialystok E (2007). Acquisition of literacy in bilingual children: A framework for research. Language Learning, 57, 45–77. 10.1111/j.1467-9922.2007.00412.x

Bialystok E (2018). Bilingualism and executive function. In Miller D, Bayram F, Rothman J, & Serratrice L (Eds.), Bilingual cognition and language: The state of the science across Its subfields (Vol. 54, pp. 283–306). John Benjamins.

Bohman TM, Bedore LM, Peña ED, Mendez-Perez A, & Gillam RB (2010). What you hear and what you say: Language performance in Spanish-English bilinguals. International Journal of Bilingual Education and Bilingualism, 13(3), 325–344. 10.1080/13670050903342019 [PubMed: 21731899]

Branum-Martin L, Mehta PD, Carlson CD, Francis DJ, & Goldenberg C (2014). The nature of Spanish versus English language use at home. Journal of Educational Psychology, 106(1), 181–199. 10.1037/a0033931

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Branum-Martin L, Tao S, & Garnaat S (2015). Bilingual phonological awareness: Reexamining the evidence for relations within and across languages. Journal of Educational Psychology, 107(1), 111–125. 10.1037/a0037149

Branum-Martin L, Tao S, Garnaat S, Bunta F, & Francis DJ (2012). Meta-analysis of bilingual phonological awareness: Language, age, and psycholinguistic grain size. Journal of Educational Psychology, 104(4), 932.

Byrne BM (2001). Structural equation modeling with AMOS, EQS, and LISREL: Comparative approaches to testing for the factorial validity of a measuring instrument. International Journal of Testing, 1(1), 55–86. 10.1207/S15327574IJT0101_4

Castilla AP, Restrepo MA, & Perez-Leroux AT (2009). Individual differences and language interdependence: A study of sequential bilingual development in Spanish-English preschool children. International Journal of Bilingual Education and Bilingualism, 12(5), 565–580. 10.1080/13670050802357795

Chung SC, Chen X, & Geva E (2019). Deconstructing and reconstructing cross-language transfer in bilingual reading development: An interactive framework. Journal of Neurolinguistics, 50, 149–161. 10.1016/j.jneuroling.2018.01.003

Chung SC, Koh PW, Deacon SH, & Chen X (2017). Learning to read in English and French. Topics in Language Disorders, 37(2), 136–153. 10.1097/TLD.0000000000000118

Claussenius-Kalman HL, Vaughn KA, Archila-Suerte P, & Hernandez AE (2021). Highly proficient, balanced bilingualism is related to thinner cortex in two cognitive control regions. Annals of the New York Academy of Sciences, 1485(1), 83–94. [PubMed: 32978797]

Cummins J (1979). Cognitive/academic language proficiency, linguistic interdependence, the optimum age question and some other matters. Working papers on bilingualism, no. 19.

D'Angiulli A, Siegel L, & Serra E (2001). The development of reading in English and Italian in bilingual children. Applied Psycholinguistics, 22, 479–507. 10.1017/S0142716401004015

De Houwer A (2005). Early bilingual acquisition. In Kroll JF & De Groot AMB (Eds.), Handbook of bilingualism: Psycholinguistic approaches (pp. 30–48). Oxford University Press.

Deacon SH, Chen X, Luo Y, & Ramirez G (2013). Beyond language borders: Orthographic processing and word reading in Spanish-English bilinguals. Journal of Research in Reading, 36(1), 58–74. 10.1111/j.1467-9817.2011.01490.x

Dickinson DK, McCabe A, Clark-Chiarelli N, & Wolf A (2004). Cross-language transfer of phonological awareness in low-income Spanish and English bilingual preschool children. Applied Psycholinguistics, 25(3), 323–347. 10.1017/S0142716404001158

Dressler C, & Kamil ML (2006). First- and Second-Language Literacy. In August D & Shanahan T (Eds.), Developing literacy in second-language learners: Report of the National Literacy Panel on Language-Minority Children and Youth (pp. 197–238). Lawrence Erlbaum Associates Publishers.

Duncan GJ, & Brooks-Gunn J (2000). Family poverty, welfare reform, and child development. Child Development, 71(1), 188–196. [PubMed: 10836573]

Durgunoğlu AY (2017). An updated review of cross-language transfer and its educational implications. In Segers E & van den Broek P (Eds.), Developmental perspectives in written language and literacy: Honor of Ludo Verhoeven (pp. 167–182). John Benjamins Publishing Company.

Durgunoğlu AY, Nagy WE, & Hancin-Bhatt BJ (1993). Cross-language transfer of phonological awareness. Journal of Educational Psychology, 85(3), 453–465. 10.1037/0022-0663.85.3.453

Farver JAM, Xu Y, Eppe S, & Lonigan CJ (2006). Home environments and young Latino children's school readiness. Early Childhood Research Quarterly, 21(2), 196–212.

Genesee F, Geva E, Dressler C, & Kamil M (2006). Synthesis: Cross-linguistic relationships. In August D & Shanahan T (Eds.), Developing literacy in second-language learners: Report of the National Literacy Panel on Language-Minority Children and Youth (pp. 53–174). Routledge.

Goldenberg C, Reese L, & Rezaei A (2011). Contexts for language and literacy development among dual-language learners. In Durgunoglu AY & Goldenberg C (Eds.), Language and literacy development in bilingual settings (pp. 3–25). Guilford Press.

Goldstein BA (2004). Bilingual language development and disorders in Spanish-English speakers. Brookes Publishing Company.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Golinkoff RM, Hoff E, Rowe ML, Tamis-LeMonda CS, & Hirsh-Pasek K (2019). Language matters: Denying the existence of the 30-million-word gap has serious consequences. Child Development, 90(3), 985–992. [PubMed: 30102419]

Gottardo A (2002). The relationship between language and reading skills in bilingual Spanish-English speakers. Topics in Language Disorders, 22(5), 46–70. 10.1097/00011363-200211000-00008

Gottardo A, & Mueller J (2009). Are first-and second-language factors related in predicting second-language reading comprehension? A study of Spanish-speaking children acquiring English as a second language from first to second grade. Journal of Educational Psychology. 10.1037/a0014320

Gutiérrez-Clellen VF, & Simon-Cereijido G (2007). The discriminant accuracy of a grammatical measure with Latino English-speaking children. Journal of Speech, Language, and Hearing Research, 50(4), 968–981. 10.1044/1092-4388(2007/068)

Hammer CS, Hoff E, Uchikoshi Y, Gillanders C, Castro DC, & Sandilos LE (2014). The language and literacy development of young dual language learners: A critical review. Early Childhood Research Quarterly, 29(4), 715–733. 10.1016/j.ecresq.2014.05.008 [PubMed: 25878395]

Hart B, & Risley TR (1995). Meaningful differences in the everyday experience of young American children. Paul H Brookes Publishing.

Hernandez DJ, Denton NA, & Macartney SE (2007). Children in immigrant families—The US and 50 states: National origins, language, and early education. Research brief series. 2007–11. Child Trends.

Hoff E (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. Child Development, 74(5), 1368–1378. 10.1111/1467-8624.00612 [PubMed: 14552403]

Hoff E (2006). How social contexts support and shape language development. Developmental Review, 26(1), 55–88. 10.1016/j.dr.2005.11.002

Hoff E (2013). Interpreting the early language trajectories of children from low-SES and language minority homes: Implications for closing achievement gaps. Developmental Psychology, 49(1), 4. 10.1037/a0027238 [PubMed: 22329382]

Hoff E, Tulloch MK, & Core C (2021). Profiles of minority-majority language proficiency in 5-year-olds. Child Development, 92(5), 1801–1816. [PubMed: 34042172]

Hoover WA, & Gough PB (1990). The simple view of reading. Reading and Writing, 2(2). 10.1007/BF00401799

Jasińska KK, & Petitto LA (2018). Age of bilingual exposure is related to the contribution of phonological and semantic knowledge to successful reading development. Child Development, 89(1), 310–331. 10.1111/cdev.12745 [PubMed: 28169419]

Jongejan W, Verhoeven L, & Siegel LS (2007). Predictors of reading and spelling abilities in first-and second-language learners. Journal of Educational Psychology, 99(4), 835–851. 10.1037/0022-0663.99.4.835

Kieffer MJ (2008). Catching up or falling behind? Initial English proficiency, concentrated poverty, and the reading growth of language minority learners in the United States. Journal of Educational Psychology, 100(4), 851–868. 10.1037/0022-0663.100.4.851

Kieffer MJ (2012). Before and after third grade: Longitudinal evidence for the shifting role of socioeconomic status in reading growth. Reading and Writing, 25(7), 1725–1746.

Kline RB (2015). Principles and practice of structural equation modeling. Guilford Publication.

Koda K (2007). Reading and language learning: Crosslinguistic constraints on second language reading development. Language Learning, 57, 1–44. 10.1111/0023-8333.101997010-i1

Kohnert K (2010). Bilingual children with primary language impairment: Issues, evidence and implications for clinical actions. Journal of Communication Disorders, 43(6), 456–473. 10.1016/j.jcomdis.2010.02.002 [PubMed: 20371080]

Kuo LJ, Ramirez G, de Marin S, Kim TJ, & Unal-Gezer M (2017). Bilingualism and morphological awareness: A study with children from general education and Spanish-English dual language programs. Educational Psychology, 37(2), 94–111. 10.1080/01443410.2015.1049586

Leafstedt JM, & Gerber MM (2005). Crossover of phonological processing skills: A study of Spanish-speaking students in two instructional settings. Remedial and Special Education, 26(4). 10.1177/07419325050260040501

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Lervåg A, & Aukrust VG (2010). Vocabulary knowledge is a critical determinant of the difference in reading comprehension growth between first and second language learners. Journal of Child Psychology and Psychiatry, 51(5), 612–620. 10.1111/j.1469-7610.2009.02185.x [PubMed: 19878367]

Lesaux NK, Crosson AC, Kieffer MJ, & Pierce M (2010). Uneven profiles: Language minority learners' word reading, vocabulary, and reading comprehension skills. Journal of Applied Developmental Psychology, 31(6), 475–483. 10.1016/j.appdev.2010.09.004 [PubMed: 21243117]

Lesaux N, Koda K, & Siegel L (2006). Development of literacy. I: August D & Shanahan T, Developing literacy in second-language learners. Report of the National Panel on Language-Minority Children and Youth (pp. 75–22).

Lindsey KA, Manis FR, & Bailey CE (2003). Prediction of first-grade reading in Spanish-speaking English-language learners. Journal of Educational Psychology, 95(3), 482. 10.1037/0022-0663.95.3.482

Liow SJR, & Poon KK (1998). Phonological awareness in multilingual Chinese children. Applied Psycholinguistics, 19(3), 339–362. 10.1017/S0142716400010213

MacSwan J (2017). A multilingual perspective on translanguaging. American Educational Research Journal, 54(1), 167–201. 10.3102/0002831216683935

Mancilla-Martinez J, & Lesaux NK (2011). The gap between Spanish speakers' word reading and word knowledge: A longitudinal study. Child Development, 82(5), 1544–1560. 10.1111/j.1467-8624.2011.01633.x [PubMed: 21848955]

Manis FR, Lindsey KA, & Bailey CE (2004). Development of reading in grades K–2 in Spanish-speaking English-language learners. Learning Disabilities Research & Practice, 19(4). 10.1111/j.1540-5826.2004.00107.x

McCardle PD, & Hoff E (Eds.). (2006). Childhood bilingualism: Research on infancy through school age (Vol. 7). Multilingual Matters.

Meisel IM (2001). The simultaneous acquisition of two first languages. Trends in Bilingual Acquisition, 1, 11.

Melby-Lervåg M, & Lervåg A (2011). Cross-linguistic transfer of oral language, decoding, phonological awareness and reading comprehension: A meta-analysis of the correlational evidence. Journal of Research in Reading, 34(1), 114–135. 10.1111/j.1467-9817.2010.01477.x

Melby-Lervåg M, & Lervåg A (2014). Reading comprehension and its underlying components in second-language learners: A meta-analysis of studies comparing first-and second-language learners. Psychological Bulletin, 140(2), 409–433. 10.1037/a0033890 [PubMed: 23937316]

Muñoz-Sandoval AF, Woodcock RW, McGrew KS, Mather N, & Ardoino G (2009). Batería III Woodcock-Muñoz. Ciencias Psicológicas, 3(2), 245–246.

Muthén LK, & Muthén BO (2012). MPlus: Statistical analysis with latent variables, user's guide.

Nakamoto J, Lindsey KA, & Manis FR (2008). A cross-linguistic investigation of English language learners' reading comprehension in English and Spanish. Scientific Studies of Reading, 12(4). 10.1080/10888430802378526

National Center for Education Statistics, National Assessment of Educational Progress (Project), Educational Testing Service, & United States. (2019). NAEP … reading report card for the nation and the states. National Center for Education Statistics, Office of Educational Research and Improvement, U.S. Dept. of Education.

Noble KG, Farah MJ, & McCandliss BD (2006). Socioeconomic background modulates cognition–achievement relationships in reading. Cognitive Development, 21(3), 349–368. 10.1016/j.cogdev.2006.01.007 [PubMed: 19789717]

Oller DK, & Eilers RE (Eds.). (2002). Language and literacy in bilingual children (Vol. 2). Multilingual Matters.

Ordóñez CL, Carlo MS, Snow CE, & McLaughlin B (2002). Depth and breadth of vocabulary in two languages: Which vocabulary skills transfer? Journal of Educational Psychology, 94(4), 719–728. 10.1037/0022-0663.94.4.719

Pace A, Luo R, Hirsh-Pasek K, & Golinkoff RM (2017). Identifying pathways between socioeconomic status and language development. Annual Review of Linguistics, 3, 285–308. 10.1146/annurev-linguistics-011516-034226

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Páez M, & Rinaldi C (2006). Predicting English word reading skills for Spanish-speaking students in first grade. Topics in Language Disorders, 26(4), 338–350. 10.1097/00011363-200610000-00006 [PubMed: 20396623]

Pearson BZ (2007). Social factors in childhood bilingualism in the United States. Applied Psycholinguistics, 28(3), 399–410. 10.1017/S014271640707021X

Pearson BZ, Fernández S, & Oller DK (1995). Cross-language synonyms in the lexicons of bilingual infants: One language or two? Journal of Child Language, 22(2), 345–368. 10.1017/S030500090000982X [PubMed: 8550727]

Peña ED, Bedore P, Grosjean F, & Byers-Heinlein K (2018). Assessing perception and comprehension in bilingual children, without and with speech and language impairment. The Listening Bilingual, 220–243.

Peña ED, Bedore LM, Gutiérrez-Clellen VF, Iglesias A, & Goldstein BA (2008). Bilingual English–Spanish Assessment—Middle Extension Experimental Test Version (BESA-ME). Unpublished research version.

Peña ED, Bedore LM, & Kester ES (2015). Discriminant accuracy of a semantics measure with Latino English-speaking, Spanish-speaking, and English-Spanish bilingual children. Journal of Communication Disorders, 53, 30–41. [PubMed: 25573288]

Peña ED, Bedore LM, & Kester ES (2016). Assessment of language impairment in bilingual children using semantic tasks: Two languages classify better than one. International Journal of Language & Communication Disorders, 51(2), 192–202. 10.1111/1460-6984.12199 [PubMed: 26541642]

Peña E, Bedore LM, & Rappazzo C (2003). Comparison of Spanish, English, and bilingual children's performance across semantic tasks. Language, Speech, and Hearing Services in Schools, 34, 5–16. 10.1044/0161-1461(2003/001) [PubMed: 27764487]

Peña ED, Bedore LM, & Torres J (2021). Assessment of language proficiency and dominance in monolinguals and bilinguals. Bilingualism across the lifespan: Challenges and opportunities for cognitive research in a global society. Routledge.

Peña ED, Gutiérrez-Clellen VF, Iglesias A, Goldstein BA, & Bedore LM (2018). Bilingual English Spanish Assessment (BESA). Brookes.

Pérez AM, Peña ED, & Bedore LM (2010). Cognates facilitate word recognition in young Spanish-English bilinguals' test performance. Early Childhood Services, 4(1), 55. [PubMed: 23565068]

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

Petitto LA, & Kovelman I (2003). The bilingual paradox: How signing-speaking bilingual children help us to resolve it and teach us about the brain's mechanisms underlying all language acquisition. Learning Languages, 8(3), 5–18.

PISA, & OECD. (2009). The OECD programme for international student assessment.

Pratt AS, Peña ED, & Bedore LM (2020). Sentence repetition with bilinguals with and without DLD: Differential effects of memory, vocabulary, and exposure. Language and Cognition.

Proctor CP, August D, Carlo MS, & Snow C (2006). The intriguing role of Spanish language vocabulary knowledge in predicting English reading comprehension. Journal of Educational Psychology, 98(1), 159–169. 10.1037/0022-0663.98.1.159

Proctor CP, August D, Snow C, & Barr CD (2010). The interdependence continuum: A perspective on the nature of Spanish-English bilingual reading comprehension. Bilingual Research Journal, 33(1), 5–20. 10.1080/15235881003733209

Proctor CP, Carlo M, August D, & Snow C (2005). Native Spanish-speaking children reading in English: Toward a model of comprehension. Journal of Educational Psychology, 97(2), 246. 10.1037/0022-0663.97.2.246

Proctor CP, Harring JR, & Silverman RD (2017). Linguistic interdependence between Spanish language and English language and reading: A longitudinal exploration from second through fifth grade. Bilingual Research Journal, 40(4), 372–391. 10.1080/15235882.2017.1383949

Proctor CP, Silverman RD, Harring JR, & Montecillo C (2012). The role of vocabulary depth in predicting reading comprehension among English monolingual and Spanish-English bilingual children in elementary school. Reading and Writing, 25(7), 1635–1664. 10.1007/s11145-011-9336-5

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Ramírez G, Chen X, & Pasquarella A (2013). Cross-linguistic transfer of morphological awareness in Spanish-speaking English language learners: The facilitating effect of cognate knowledge. Topics in Language Disorders, 33(1), 73–92. 10.1097/TLD.0b013e318280f55a

Romeo RR, Leonard JA, Robinson ST, West MR, Mackey AP, Rowe ML, & Gabrieli JD (2018). Beyond the 30-million-word gap: Children's conversational exposure is associated with language-related brain function. Psychological Science, 29(5), 700–710. 10.1177/0956797617742725 [PubMed: 29442613]

Spencer M, & Wagner RK (2018). The comprehension problems of children with poor reading comprehension despite adequate decoding: A meta-analysis. Review of Educational Research, 88(3), 366–400. 10.3102/0034654317749187 [PubMed: 29785063]

Sun X, Zhang K, Marks RA, Nickerson N, Eggleston RL, Yu C-L, Chou T-L, Tardif T, & Kovelman I (2022). What's in a word? Cross-linguistic influences on Spanish-English and Chinese-English bilingual children's word reading development. Child Development, 93(1), 84–100. [PubMed: 34570366]

Sun-Alperin MK, & Wang M (2011). Cross-language transfer of phonological and orthographic processing skills from Spanish L1 to English L2. Reading and Writing, 24(5). 10.1007/s11145-009-9221-7

Swanson HL, Rosston K, Gerber M, & Solari E (2008). Influence of oral language and phonological awareness on children's bilingual reading. Journal of School Psychology, 46(4), 413–429. 10.1016/j.jsp.2007.07.002 [PubMed: 19083366]

U.S. Census Bureau. (2019). American Community Survey 1-year estimates. Census reporter profile page for Michigan. http://censusreporter.org/profiles/04000US26-michigan/

Verhoeven L (2007). Early bilingualism, language transfer, and phonological awareness. Applied Psycholinguistics, 28(3), 425–439. 10.1017/S0142716407070233

Weisleder A, & Fernald A (2013). Talking to children matters: Early language experience strengthens processing and builds vocabulary. Psychological Science, 24(11), 2143–2152. [PubMed: 24022649]

Woodcock RW, McGrew KS, & Mather N (2001). Woodcock-Johnson III NU Complete. Riverside Publishing.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

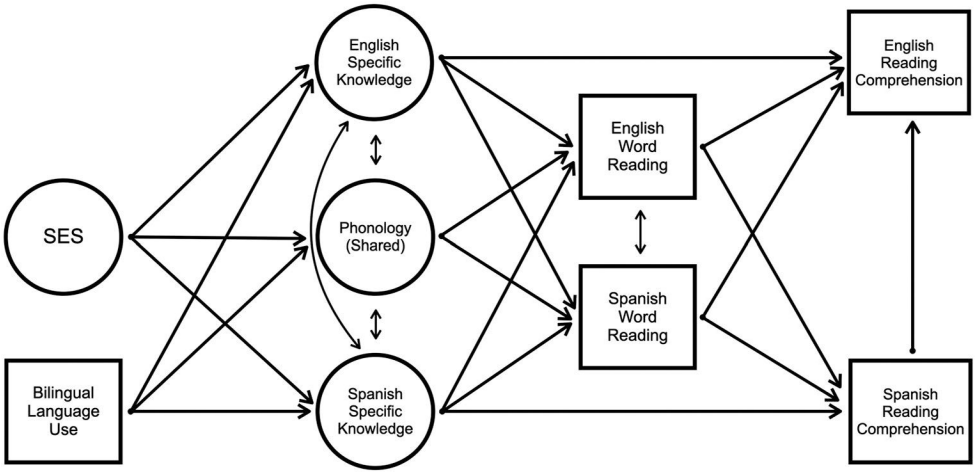

FIGURE 1.
Conceptual model of Spanish-English bilingual reading comprehension

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

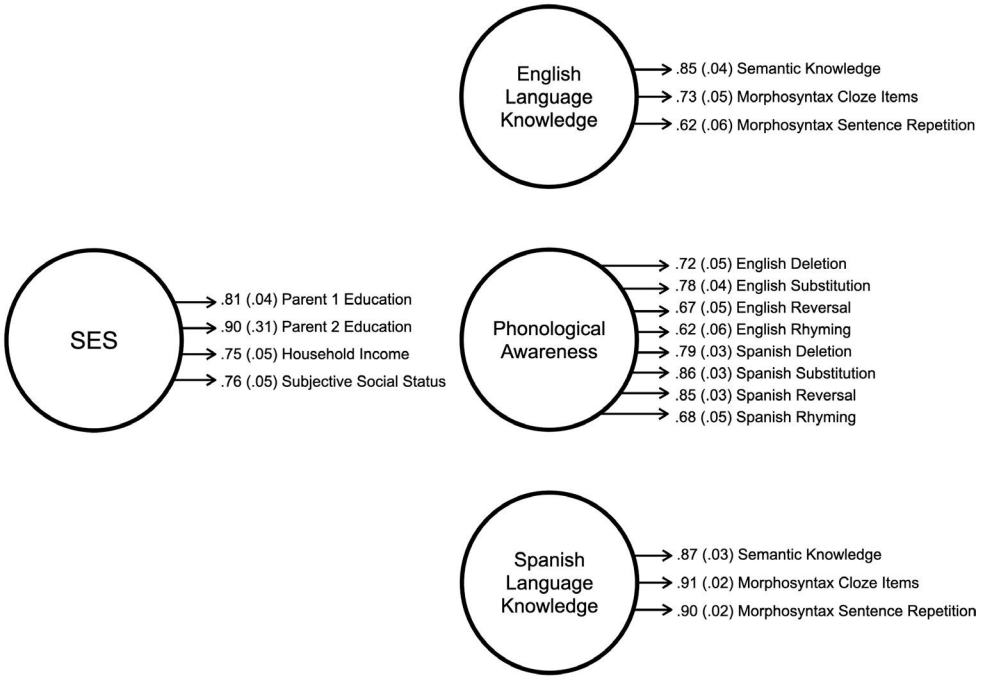

FIGURE 2.

Standardized factor loadings (*SE*) for language-specific and language-general components, and socioeconomic status, onto latent construct

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

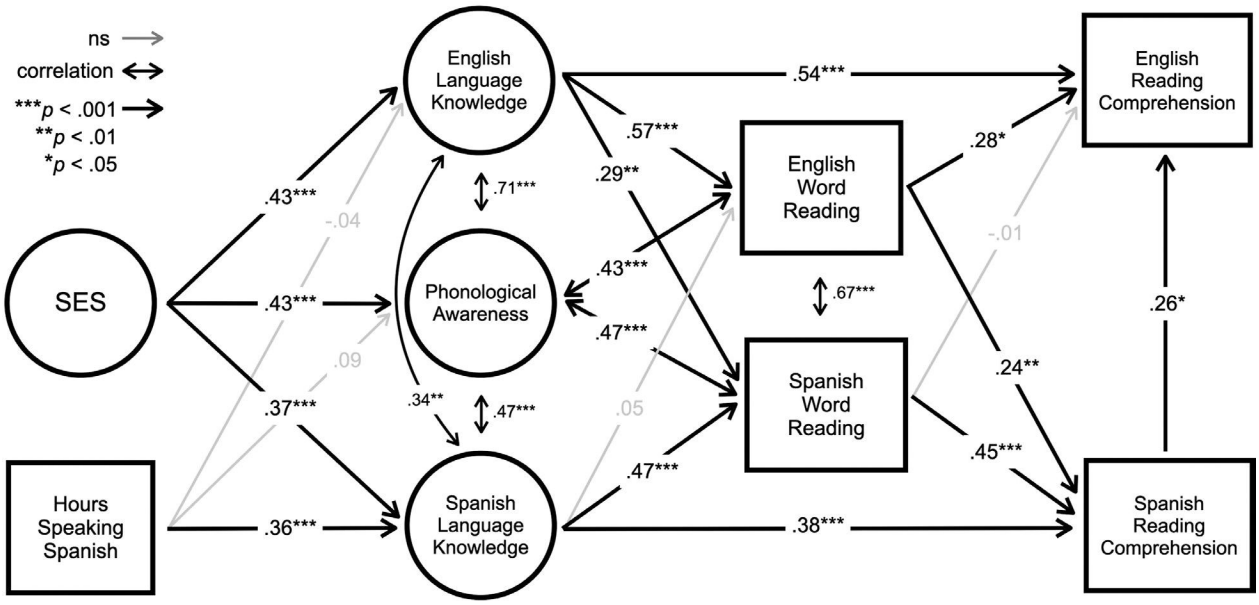

FIGURE 3.

Model 2—Accounting for phonology & bilingual word reading skills. Structural equation model of home environment, bilingual language skills, and reading outcomes showing standardized path coefficients (controlling for age). Bidirectional arrows denote correlations. Unidirectional arrows denote model paths. Not pictured are direct paths between English language knowledge and Spanish reading comprehension ($\beta = .00$, $p = .99$) and Spanish language knowledge and English reading comprehension ($\beta = -.12$, $p = .15$)

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

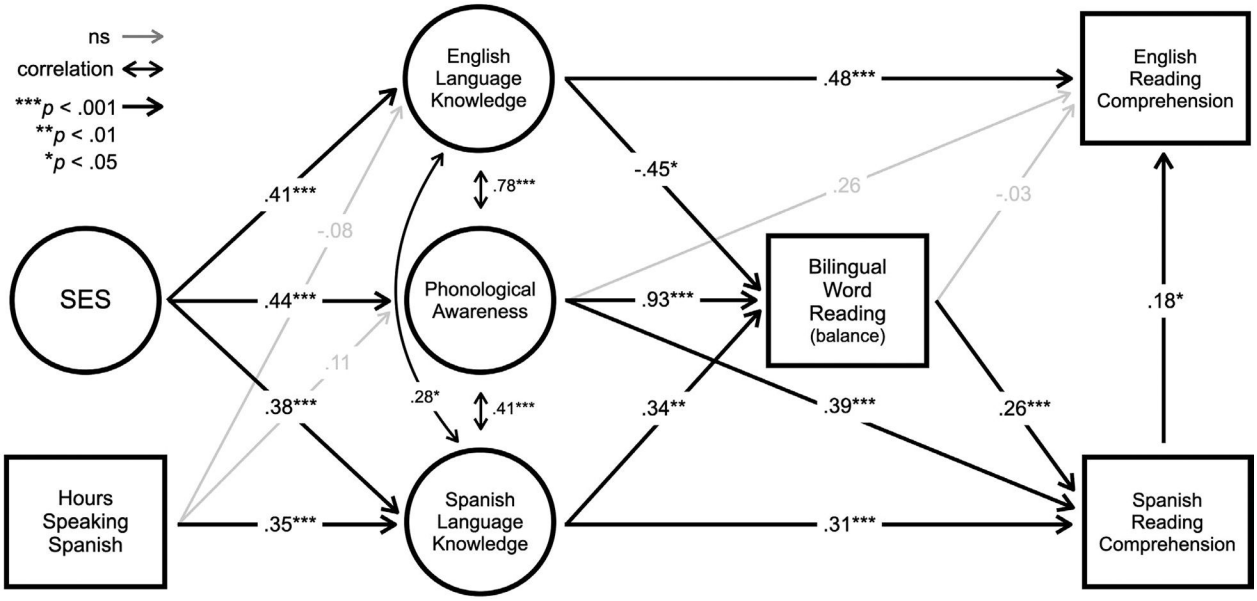

FIGURE 4.

Model 3—Assessing word reading "balance". Structural equation model of home environment, bilingual language skills, and reading outcomes showing standardized path coefficients (controlling for age). Bidirectional arrows denote correlations. Unidirectional arrows denote model paths

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

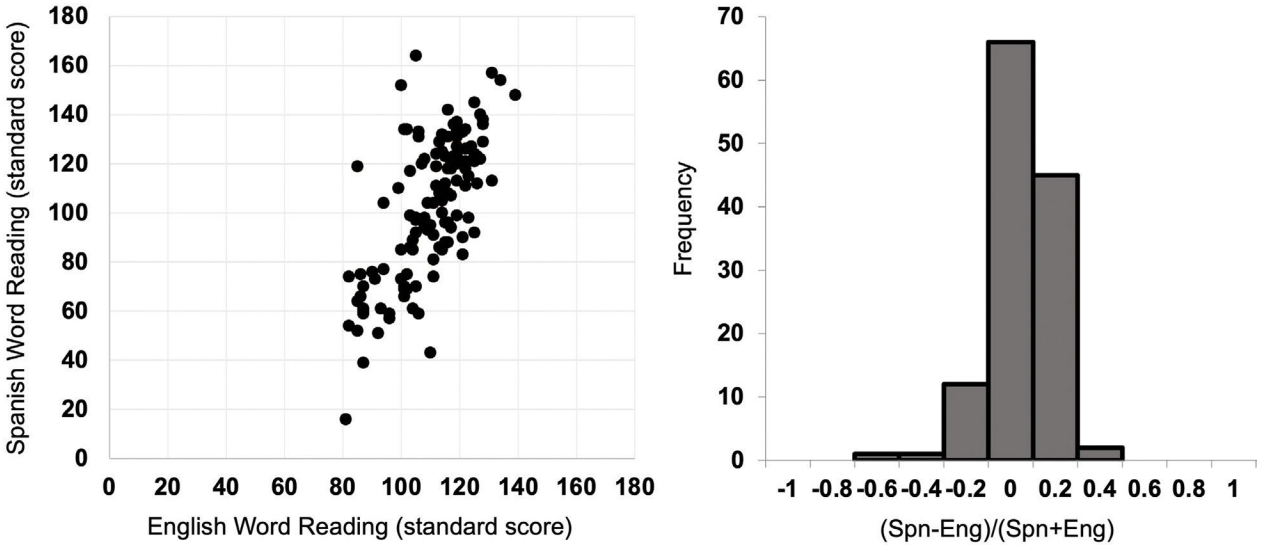

FIGURE 5.

Distribution of Spanish and English word reading standard scores. The histogram shows the distribution of ‘bilingual word reading—balance’. Scores range from 1 (better word reading in Spanish) to −1 (better word reading in English)

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Child Dev. Author manuscript; available in PMC 2023 July 01.

TABLE 1

Descriptive statistics of child and parent/family variables. $N = 132$ (52% female, 48% male)

	N	*M* (*SD*)		
Child age (years)	132	8.75 (1.41)		
Child grade	132	2.96 (1.37)		
Parent 1 education	127	2.83 (1.13)		
Parent 2 education	117	2.85 (0.99)		
1. Primary & secondary school	41			
2. GED & associate degree	37			
3. Bachelor's degree	86			
4. Master's & doctoral degree	80			
Household income	125	2.46 (0.75)		
1. <$12,000	14			
2. $12,000–$50,000	44			
3. $50,000–$100,000	62			
4. >$100,000	5			
Subjective SES—National[a]	126	7.8 (0.18)		
Subjective SES—Community[a]	126	6.7 (0.19)		
Children who qualified for free/reduced lunch	39			
		English	**Spanish**	
Age of first words (years)	132	2.39 (1.30)	1.02 (0.40)	
Age at which child started reading	132	5.14 (1.07)	5.28 (1.29)	
Weekly hours speaking each language[b]	132	135.87 (19.5)	57.33 (17.3)	
				t
Woodcock Assessments (standard scores)				
Phonological awareness	109	107 (19)	102 (19)	3.29*
Word reading	127	110 (13)	103 (29)	3.78*
Reading comprehension	121	98 (12)	84 (21)	9.89*
Bilingual English Spanish Assessment (% correct)				

Author Manuscript
Author Manuscript
Author Manuscript
Author Manuscript

	N	*M* (*SD*)		
Semantic knowledge	120	74 (18)	63 (21)	6.84*
Morphosyntax knowledge total	117	88 (12)	63 (24)	11.60*
Cloze items	118	86 (15)	61 (26)	11.41*
Sentence repetition	117	90 (12)	66 (26)	10.09*

Abbreviations: GED, general education diploma; SES, socioeconomic status.

[a]Parent response from the McArthur Subjective Socioeconomic Status questionnaire measured with respect to the community and the national level. Scale ranged from 1 to 11.

[b]Hours speaking each language in a typical week measured with the Bilingual Input Output Survey (Peña et al., 2008).

*$p < .01$.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

TABLE 2

Correlations among study variables, controlling for participant age and gender

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Hours speaking English (child)	—																
2. Hours speaking Spanish (child)	**−.49**	—															
3. Parent 1 education	**.29**	**−.24**	—														
4. Parent 2 education	.14	−.10	**.59**	—													
5. Household income	.03	−.09	**.48**	**.64**	—												
6. Subjective SES—Community	−.04	.02	.10	**.36**	**.27**	—											
7. Subjective SES—National	.12	−.17	**.52**	**.61**	**.50**	**.58**	—										
8. English semantic knowledge	.23	−.13	**.29**	**.30**	.18	.19	**.27**	—									
9. English morphosyntax knowledge	.20	**−.33**	**.26**	.19	**.25**	**.33**	**.40**	**.61**	—								
10. Spanish semantic knowledge	−.13	.16	.22	**.32**	.19	−.00	.08	**.29**	.16	—							
11. Spanish morphosyntax knowledge	−.18	**.33**	.11	**.25**	.21	.10	.12	.20	.18	**.66**	—						
12. English phonological awareness	.18	−.10	**.29**	**.26**	.16	.22	.20	**.58**	**.59**	.16	.11	—					
13. English word reading	.11	−.08	**.26**	**.27**	.18	.24	**.26**	**.68**	**.49**	**.31**	**.27**	**.63**	—				
14. English reading comprehension	.20	−.13	**.28**	**.32**	.18	.21	.22	**.72**	**.59**	**.38**	**.28**	**.70**	**.80**	—			
15. Spanish phonological awareness	.01	.01	**.29**	**.36**	.16	.17	.10	**.47**	**.42**	**.51**	**.50**	**.62**	**.67**	**.67**	—		
16. Spanish word reading	−.08	.09	**.26**	**.30**	.11	.09	.11	**.43**	**.23**	**.52**	**.52**	**.43**	**.71**	**.55**	**.73**	—	
17. Spanish reading comprehension	−.14	.17	.19	**.30**	.15	.10	.07	**.46**	**.29**	**.68**	**.66**	**.42**	**.69**	**.63**	**.74**	**.83**	—

Note: Significant two-tailed partial correlations (controlling for age and gender) are in boldface. Correlations >.40 are at the $p < .001$ level; correlations equal to and in between .29 and .39 are at the $p < .01$ level; and correlations equal to and under .29 are at the $p < .05$ level.

Abbreviation: SES, socioeconomic status.

Child Dev. Author manuscript; available in PMC 2023 July 01.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

TABLE 3

Fit statistics of exploratory factor analyses and full structural model

Model	χ^2	*df*	CFI	TLI	RMSEA	SRMR
Bilingual language knowledge						
2 factor	133.41***	64	.93	.90	.09	.04
3 factor[a]	81.99**	52	.97	.95	.06	.03
4 factor	59.81*	41	.98	.96	.06	.02
Home environment						
1 factor	52.48	5	.85	.67	.27	.07
1 factor, revised[a]	1.04	2	1.0	1.0	.00	.01
Full structural model						
Model 1	344.95***	225	.95	.93	.06	.06
Model 2	346.50***	224	.94	.93	.06	.06
Model 3	325.53***	209	.94	.93	.06	.06

Abbreviations: CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker–Lewis index.

[a]Final measurement models.

*$p < .05$.

**$p < .01$.

***$p < .001$.