

WITHIN- AND ACROSS-LANGUAGE EFFECTS OF ORAL LANGUAGE SKILL AT  
SCHOOL ENTRY ON LATER ENGLISH AND SPANISH READING  
COMPREHENSION GROWTH AMONG EARLY BILINGUALS

by

David Giguere

A Dissertation Submitted to the Faculty of  
The Charles E. Schmidt College of Science  
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Doctor of Philosophy

Florida Atlantic University

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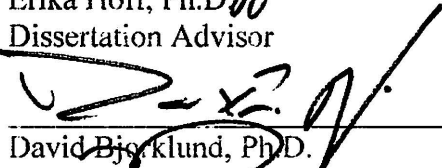
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This dissertation was prepared under the direction of the candidate's dissertation advisor, Dr. Erika Hoff, Department of Psychology, and has been approved by the members of his supervisory committee. It was submitted to the faculty of the Charles E. Schmidt College of Science and was accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

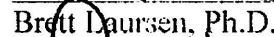
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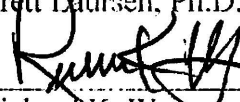
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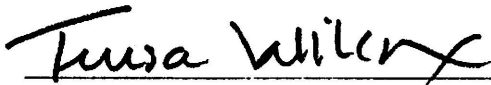
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## ABSTRACT

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Title: Within- and Across-Language Effects of Oral Language Skills at School Entry on Later English and Spanish Reading Comprehension Growth among Early Bilinguals

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Extensive evidence indicates that oral language skills at school entry predict later reading development among monolingual children. It is not clear if the effect is the same for bilingually developing children and whether their oral skills in one language can transfer to reading comprehension in the other. The current longitudinal study followed 72 Spanish-English bilingual children (42 girls, 30 boys) and examined the extent to which early oral language proficiency in English and in Spanish were related to later reading comprehension development within- and across-languages. Multilevel models revealed significant within-language relations between oral language skills at 5 years and reading comprehension growth from 6 to 8 years in both English and Spanish. Additionally, English oral skill predicted Spanish reading comprehension, whereas Spanish oral skill was unrelated to English reading comprehension. Theoretical and practical implications of the findings are discussed.

## DEDICATION

To Santiago. May all your dreams come true.

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## INTRODUCTION

Twenty percent of children in the United States hear a language other than English at home (Federal Interagency Forum on Child and Family Statistics, 2011) and this number is expected to rise. The largest group of dual language learners in the United States comes from Spanish-speaking homes. Children from Spanish speaking homes are at-risk of academic underachievement and poor literacy development (Gottardo, 2002; Verhoeven, 2000). Despite the prevalence of Spanish-English bilinguals growing up in the United States, the early literacy trajectories of these children have not been well documented.

Reading comprehension is critical for long term academic success. Studies that have examined early influences on later literacy development have largely been conducted on monolingually developing children. Among monolinguals, extensive research has found that early oral language skills strongly predict later literacy development (see Perfetti & Stafura, 2014 for a review). For example, vocabulary skill at kindergarten predicts reading comprehension in the 4<sup>th</sup> (Spira, Bracken, & Fischel, 2005) and 7<sup>th</sup> grade (Tabors, Snow & Dickinson, 2001).

Ultimate academic success of bilingual children similarly depends on reading comprehension in English. However, there is reason to suspect that the relation of oral language skill to later reading comprehension is different in bilingual children than it is in monolingual children. Bilingual children's oral language skills are distributed across languages. Consequently, measures of English proficiency alone may not capture the full

linguistic ability of these children. Among bilinguals with early exposure to two languages, literacy development may be influenced by within- and across-language skills. That is to say, earlier acquired Spanish skill may support the development of later English literacy development. There is some evidence to suggest that early literacy skills can transfer across languages (Goodrich, Lonigan & Farver, 2013; Hammer et al., 2014; Kieffer, 2012) but the degree to which precursors of literacy skills influence later literacy development within- and across- languages remains largely unclear.

The current study is the first to longitudinally follow the dual reading comprehension growth of bilingual individuals from school entry to 8 years. Furthermore, previous studies which have examined the reading comprehension development of bilingual children have typically been conducted on low SES samples of children who enter school with very limited English proficiency (Kieffer, 2012). Consequently, the literacy trajectories of these children reflect effects of SES making it difficult to disentangle the effects of SES and bilingual exposure on reading development. The present study examines the dual literacy trajectories of bilingually developing children during their transition to formal schooling among children from middle and high socioeconomic backgrounds.

The purpose of this study is to describe and predict individual differences in bilingual children's English and Spanish literacy trajectories from 6 to 8 years, and, specifically, to examine within- and across-language effects of oral language skill at 5 years on subsequent reading comprehension growth.

## **Theoretical Background**

How humans learn to take meaning from written text has been researched for decades. Although the nuances of reading theories continued to be debated today, it is widely accepted that reading comprehension is influenced by multiple cognitive components. The simple view of reading (SVR) postulates that reading comprehension (RC) is a function of listening comprehension (LC) skills and decoding (D) (Gough & Tunmer, 1986; Kirby & Savage, 2008). This theory of reading comprehension is expressed as  $RC = LC \times D$ . Within this theoretical framework, listening comprehension is used as an umbrella term to represent oral language skills including vocabulary, syntax, inferencing, and construction of mental schemas. Recently, several studies have found that measures of oral language skill account for more unique variance in reading comprehension than measures of decoding (Perfetti, & Stafura, 2014; Van Dyke, & Landi, 2015). Within monolingual populations, early oral language skills are strong predictors of reading comprehension for children learning to read (Muter, Hulme, Snowling, & Stevenson, 2004; Oullette, 2006; Senechal, Oullette, & Rodney, 2006). The impact of oral language skills on reading comprehension is further evidenced by intervention studies that have found that enhancing vocabulary knowledge supports reading comprehension skills (Beck, McKeown, & Kucan, 2002; Biemiller, & Boote, 2006). However, among bilingual children, it is less clear if oral language skills influence reading comprehension to the same degree that has been found for monolingual children.

The simple view of reading becomes a little more complex when attempting to explain bilingual literacy. Bilingual children may draw upon the oral language skills in

one or both of their languages when reading. In other words, bilingual children could use their Spanish oral skills to assist in their English reading comprehension. Studies that have examined whether skills can transfer across languages have often studied bilinguals with different language pairs. Evidence has suggested that transfer is more likely to occur when there are concrete similarities between languages that can be exploited (Oller & Jarmulowicz, 2007). For example, different aspects of language skills are more likely to be related across-languages for English-Spanish bilingual children, as these two languages largely share an alphabet, than they are for English-Chinese bilingual children (Oller & Jarmulowicz, 2007). There is also evidence that oral language skills in one language can support reading comprehension in the other, when bilingual children are explicitly taught to use cognates in their first language when reading in their second language (August, Carlo, Dressler, & Snow, 2005). In sum, studies that have tested the simple view of reading have shown that oral language skills are an important predictor of reading comprehension and that among bilinguals cross-linguistic transfer is most likely to occur when their languages have shared properties.

### **Early Dual Language Development**

Early experiences shape the oral language skills children possess at school entry, and in turn, these abilities are predictive of subsequent literacy development. The amount of exposure and experiences dual language learners have with each of their languages vary greatly. Dual language learners are exposed to two languages which results in, on average, less exposure to each language when compared with monolinguals. Consequently, a substantial literature documents that dual language learners often reach school with lower levels of English vocabulary skill than their monolingual counterparts

(Hammer et al., 2014; Hoff, & Ribot, 2017; Paez, Tabors, & Lopez, 2007), and these differences cannot be fully explained by SES (Hoff et al., 2012).

Despite this initial lag, there is evidence that the oral language skills of bilingually developing children eventually catch-up to their monolingual peers in the majority language (Gatehrcole & Thomas, 2009; Giguere & Hoff, 2018). This suggests that the relation between language skills at school entry and future language proficiency is potentially distinct for bilinguals. This is likely because English language skills at 5 years do not necessarily reflect the linguistic richness of dual language learners' environments. Environments that provide rich heritage language exposure may promote faster acquisition of the majority language and better school achievement outcomes than initial English vocabulary scores would predict (Castro, Paez, Dickinson, & Frede, 2011).

### **Within-Language Predictors of Reading Comprehension among Bilinguals**

**Vocabulary.** Vocabulary skills play a critical role in the acquisition of literacy. One must understand the meaning of individual words to comprehend written text. Among bilinguals, English vocabulary skills at school entry predict subsequent reading comprehension in English. A longitudinal study followed 295 Spanish-English bilingual children and found that English expressive vocabulary skills in kindergarten positively predicted reading comprehension in the 8<sup>th</sup> grade (Kieffer, 2012) and that English expressive vocabulary in kindergarten was a better predictor of later reading comprehension than other measures of oral language skill including listening comprehension and story retell. The positive relation between early English vocabulary and later literacy skills in English has been corroborated by other studies of Spanish-English bilinguals (Lindsey, Manis, & Bailey, 2003 Oller & Eilers, 2002; Prevoo, Malda,



Mesman, & IJzendoorn). Further evidence of the effect of vocabulary on reading comprehension comes from intervention studies in which bilingual students with explicit vocabulary instruction outperform bilingual controls on measures of reading skill (August et al., 2005; Lesaux, Kieffer, Faller & Kelley, 2010).

Predictors of heritage language literacy have not been thoroughly examined, but one longitudinal study followed dual language learners from a Texas border town from kindergarten to first grade and found that Spanish expressive vocabulary at kindergarten predicted Spanish emergent literacy skills (word identification) in the 1<sup>st</sup> grade (Lindsey et al., 2003). Other studies have also found a relation between Spanish skill and emergent literacy in Spanish (Hammer, Lawrence & Miccio, 2007). These findings suggest that early heritage language vocabulary skill is a potential candidate predictor for subsequent heritage literacy development, but to the author's knowledge, no study to date has directly examined the relation between heritage vocabulary skill and future heritage reading comprehension skills beyond 1<sup>st</sup> grade. As the majority of dual language learners in the United States attend English-only schools and receive no formal heritage language literacy instruction, predictors of heritage language reading comprehension may change over time and differ from predictors of reading skills in the majority language.

**Comprehension.** Several components of oral language skill are related to reading comprehension including the abilities to understand words, concepts, and grammatical structures. Literacy skills require more than vocabulary comprehension; an understanding of the grammatical structures of a language are also imperative when learning to read. For example, the sentences “the dog chased the cat” and “the cat chased the dog” have all the same words but completely different meanings. Furthermore,

general knowledge of a language may assist in the ability to anticipate the next word in the sentence which in turn will contribute to the comprehension of written text.

The language comprehension abilities of young children are often assessed by administering tests of receptive vocabulary skill and other examiner-administered tests in which examiners ask children to perform a series of events. The Preschool Language Scale (PLS-4; Zimmerman, Steiner & Pond, 1992) is a widely used measure that assesses children's general language abilities by asking them to point to specific objects, manipulate objects and follow a series of instructions. The oral language comprehension skills of Spanish-English bilingual children, as measured by the PLS-4, have been found to be concurrently and longitudinally related to their preliteracy abilities (i.e. letter identification) in each of their languages at school entry (Farver, Lonigan, Xu & Eppe, 2013). Furthermore, the rate of oral language comprehension growth among Spanish-English bilinguals also predicted pre-literacy skills in each language at kindergarten (Hammer, Lawrence & Miccio, 2007).

There is further evidence that oral language comprehension skills as measured by the PLS-4 and receptive vocabulary predict reading comprehension in the first grade (Davison, Hammer, & Lawrence, 2011). Davison et al. (2011) followed 81 Spanish-English bilinguals who attended Head Start for two years and found that receptive vocabulary and oral language comprehension skills predicted the children's English and Spanish reading comprehension at the end of 1<sup>st</sup> grade. Unlike other studies (Farver et al., 2013; Hammer et al., 2007) which created composite or latent variables of oral language comprehension, Davison et al. (2011) found that individual measures of

receptive vocabulary and oral language comprehension each uniquely predicted later reading comprehension within- and across-languages.

### **Across-Language Predictors of Reading Comprehension among Bilinguals**

Bilingual children could potentially use knowledge of one of their languages to assist with reading comprehension in the other. Theory regarding the mechanism in which linguistic-transfer could occur come from the common underlying proficiency model (Cummins, 1981) which postulates that the dual language skills stem from a single underlying proficiency. This theory suggests that skill in one language will advance skill in the other as the two languages are intrinsically connected. Cummins (1981) argued that even skills that appear to be language-specific, such as spelling ability, would still be closely related as they are tapping into a single underlying proficiency. According to this theory, the surface features of each language will be distinct, but the development of the two languages are interdependent. This suggests that gaining knowledge in English will support Spanish development, and vice-versa. There has been some support for the underlying proficiency model and the transferability of language skills from studies that have examined bilingual curricula. There is evidence that children enrolled in Spanish-English bilingual education tend to have better reading outcomes in Spanish than their counterparts in English immersion programs, and the two groups tend to have similar levels of English reading proficiency (Slavin & Cheung, 2005; Oller & Eilers, 2002).

The common underlying proficiency model has typically been tested on bilingual children who are exposed to a second language after a level of proficiency has already been attained in their first. The model is particularly relevant for sequential bilinguals who are exposed to their heritage language at home and do not receive large levels of

exposure to the majority language until they reach school. For these children, the common underlying proficiency model would suggest that those with high levels of Spanish skill at school entry would have less difficulty learning to read in English than their counterparts with lower levels of Spanish proficiency. And there is some evidence to support this claim (Davison et al., 2011). However, less is known about the transferability of language skills for bilingual children exposed to two languages from birth, and whether or not their majority language skills can transfer to support their heritage language reading development.

Studies that have tested the common underlying proficiency model and the transferability of language skills have typically examined if components of language skill are concurrently or longitudinally correlated across languages. The results suggest some domains are correlated across languages, such as phonological awareness skills which is the ability to manipulate sounds or words, while other skills such as oral language abilities typically have a small or no relation across languages (Melby- Lervåg & Lervåg, 2011; Lindsey et al., 2003). Other studies have used factor analysis to test for cross-linguistic transfer of language abilities and have found similar results in which English and Spanish phonological processing skills load onto a single factor and English and Spanish oral language skills load onto separate factors (Gottardo, 2002; Goodrich & Lonigan, 2017; Oller & Eilers, 2002). These findings suggest that aspects of languages are related across languages, but it is less clear if there is cross-linguistic transfer of oral language skills to subsequent development of reading comprehension.

Few studies have directly examined cross-linguistic effects on the development of reading comprehension. One study examined the English reading comprehension skills

of Spanish-English bilinguals in the 4<sup>th</sup> grade and found concurrent evidence that Spanish vocabulary skill was positively related to English reading comprehension above and beyond the variance explained by English oral language skills (Proctor, August, Carlo & Snow, 2006). Spanish vocabulary was the only significant cross-linguistic effect, Spanish fluency, and listening comprehension were not predictive of English reading comprehension after accounting for English language skills (Proctor et al., 2006). Short-term longitudinal studies of 4- to 5-year-old bilingual children attending Head Start also found that Spanish vocabulary uniquely predicted English reading comprehension in kindergarten (Zhao, Dixon, Quiroz & Chen, 2017) and in 1<sup>st</sup> grade (Davison et al., 2011). Davison et al. (2011) also found a significant cross-linguistic effect of Spanish oral language comprehension skills, as measured by the PLS-4, on later English reading comprehension.

To better understand how earlier-acquired language skill may affect the development of reading comprehension across languages it is necessary to follow children beyond 1<sup>st</sup> grade. Only one study to date has examined the cross-linguistic effects of early language ability on subsequent literacy development over the course of more than one year. Kieffer (2012) followed a sample of low SES Spanish-English bilinguals and found that Spanish vocabulary skill at kindergarten predicted English reading comprehension in the 3<sup>rd</sup> grade, but this cross-linguistic effect went away after controlling for English language abilities. No study to date has examined the cross-linguistic influence of majority language abilities on heritage language literacy development beyond 1<sup>st</sup> grade. Examining the influence of English skill on Spanish literacy would be a unique test of transfer because bilingually developing children in the

United States typically do not receive formal reading instruction in Spanish. Therefore, these cross-linguistic effects would not be confounded by formal reading instruction.

Examining cross-linguistic transfer of early acquired language abilities on future reading trajectories has both theoretical and practical significance. Identifying across-language predictors of literacy development would expand our current understanding of how reading is acquired among bilingually developing children and under what conditions linguistic-transfer is most likely to occur. Additionally, there are practical implications for closing achievement gaps if early acquired Spanish skills are found to support subsequent English reading development. The current study will be the first to test for cross-linguistic transfer of English skills to Spanish literacy development passed the 1<sup>st</sup> grade.

The current study examined the influence of English and Spanish oral language skills at 5 years on subsequent dual literacy development among Spanish-English bilinguals. Four research questions were asked:

1. does English oral skill at age 5 predict English reading comprehension development from 6 to 8 years?
2. does Spanish oral skill at age 5 predict Spanish reading comprehension development from 6 to 8 years?
3. does English oral skill at age 5 predict Spanish reading comprehension development from 6 to 8 years, while controlling for Spanish oral skill?
4. does Spanish oral skill at age 5 predict English reading comprehension development from 6 to 8 years, while controlling for English oral skill?

It is hypothesized that the English oral language skills will predict English reading development, Spanish oral language skills will predict Spanish reading development, and there will be significant cross-linguistic effects in both directions.

## METHOD

### **Participants**

Participants were 72 Spanish-English bilingually developing children (42 girls, 30 boys). The data were gathered at four time points. Oral language skills were measured in English and in Spanish at age 5. English and Spanish reading comprehension were measured at 6, 7 and 8 years. The participants were part of a larger ongoing longitudinal bilingual language development study. The criterion for study participant were: (1) complete data at age 5, and (2) at least two measures of reading comprehension skill at ages 6, 7, and 8. An additional 50 children participated in the larger ongoing study but did not meet the criteria. Thirteen of these children did not have complete data at age 5, and 37 children did not have data available for at least two measures of reading comprehension.

All participants were born in the United States, reside in South Florida and have at least one parent who was born in a Spanish speaking country. The most frequent countries of origin of the Spanish-speaking parents were Colombia, Peru, Venezuela, and Cuba. Additional countries of origin for parents in this sample are Argentina, Mexico, Dominican Republic, Chile, Ecuador, El Salvador, Guatemala, Nicaragua, Panama, Spain, and Uruguay. The average age of arrival to the United States for mothers born in a Spanish-speaking country was 20.5 (SD = 9.8) and 18.7 (SD = 12.5) for fathers. Additional information regarding the parents' background is presented in Table 2.



All children were full term and healthy at birth, had normal hearing based on parental report of otoacoustic emissions testing at birth, and showed no sign of communicative delay at 30 months, based on the *Ages and Stages* screening instrument (Squires, Potter, & Bricker, 1999). Participants were recruited through advertisement in local magazines and at programs for parents with young children, as well as through word of mouth.

### **Procedure and Measures**

The children's English and Spanish skills were assessed once a year within six months of the child's birthday. At each assessment point, the primary caregiver was administered an extensive questionnaire in interview, and the children were administered multiple tests of their language skill, including recordings of spontaneous speech. Assessments took place in 1 to 2 ½ hour sessions over the course of four days. English and Spanish measures were administered on separate days in counterbalanced order. Assessments and interviews occurred in the participants' homes or in a university play space, depending on the participants' preference. Predictor variables were measured at age 5, and outcome measures were assessed at ages 6, 7 and 8.

### **Predictors**

**Expressive vocabulary.** The children's English and Spanish expressive vocabulary skills were assessed at 5 years using the *Expressive One-Word Picture Vocabulary Test—Spanish Bilingual Edition (EOWPVT; Brownell, 2001)*. This is an examiner administered standardized test in which participants view an image and are asked to provide a label. The bilingual version is an adaptation of the English test, created by excluding items that the developers found untranslatable or culturally biased.

The standard administration of the bilingual version allows the child to label the picture in either language and yields a conceptual score. This procedure was modified to only allow English labels during the English assessment and Spanish labels during Spanish assessment in order to attain separate assessments of the children's skills in each language, other studies have made similar modifications (Anthony et al., 2009).

**Receptive vocabulary.** Receptive vocabulary was assessed at 5 years with the *Peabody Picture Vocabulary Test (PPVT-4)*; Dunn & Dunn, 2012) and its Spanish counterpart, *Test de Vocabulario en Imágenes Peabody (TVIP)*; Dunn, Padilla, Lugo, & Dunn, 1986). In both versions of the test, the interviewer says a word and shows a flip book with four distinct pictures presented on the page. The participant must point to the matching illustration. The difficulty of the word increases with each item, and the test discontinues when the participant reaches the ceiling. The test has been normed on English (PPVT-4) and Spanish (TVIP) monolingual populations and is widely used in language development research.

**Oral language comprehension.** The *Preschool Language Scale, Fourth Edition (PLS-4)*; Zimmerman, Steiner, & Pond, 2002) was administered at 5 years to assess English and Spanish oral language comprehension. The PLS-4 is a widely-used instrument that assesses oral language skills in children from birth to 6 years and 11 months. The test is individually administered and includes a picture book and series of toys with which the experimenter presents tasks that assess skills in the areas of semantics, morphology, syntax, integrative language skills, and preliteracy skills. Extensive reliability and validity evidence have been previously reported (Zimmerman et al., 2002).

**Nonverbal IQ.** Nonverbal IQ was assessed using the Primary Test of Nonverbal Intelligence (PTONI; Ehrler & McGhee, 2008). The test has been normed on children across the United States and standard scores were calculated based on published norms, which had a mean of 100 ( $SD = 15$ ).

### **Outcome Measures**

**Reading comprehension.** English and Spanish literacy skills were assessed at 6, 7 and 8 years with passage comprehension subtest of the *Woodcock-Muñoz Language Survey-Revised (WMLS-R)*; Woodcock, Muñoz-Sandoval, Ruef, & Alvarado, 2005). The test requires participants to read a sentence or a small paragraph with a blank space representing a missing word. The participants must fill in the missing word. The test stops when the ceiling is reached. The test was designed to be able to assess the reading comprehension skills of individuals until late adulthood. The outcome measures yield a W score which is a developmental standard score that is centered on a value of 500, which is set to approximate the average performance of a 10-year-old (Jaffe, 2009). The English and Spanish subtest from the Woodcock-Muñoz Language Survey-Revised were co-normed and equated to produce a Rasch-based W score with an equal interval scale that is comparable across languages. Extensive research has documented strong reliability and validity (Alvarado, R., Ruef, M.L., & Shrank, F.A., 2005; Woodcock et al., 2005).

## RESULTS

### **Descriptive Statistics of Reading Comprehension and Oral Language Skills**

Table 3 presents the raw score means and standard deviations for the oral language predictor variables in English and Spanish. Standard scores of the predictors are also presented when available for descriptive purposes. The children's oral language skills are typically higher in English than in Spanish, but when compared to norms they are average to above average on all measures in both languages. Table 4 presents the skewness and kurtosis values for the predictor and outcome variables.

Means and standard deviations for W scores for reading comprehension outcome measures are presented in Table 5. The average score increased by more than 20 points per year in each language; and at each time point, the average W score in English was approximately 50 points higher than the average W score in Spanish.

### **Preliminary Analyses**

As a preliminary step, prior to examining the effects of oral language skill on subsequent reading comprehension growth, the intercorrelations among the predictors and outcome variables were examined. They are presented in Tables 6 and 7, respectively. All language predictors were positively and significantly related within each language. The magnitudes of the correlations were medium to strong (ranging from .419 to .662). The correlations among measures were strong but not so high as to be redundant. Because the roles of individual predictors were of interest, we choose not to create a composite variable. There were positive cross-linguistic correlations between

English oral language comprehension and Spanish oral language comprehension and Spanish receptive vocabulary. However, English and Spanish expressive vocabularies were not significantly related across-languages. All outcome measures were significantly and positively related.

Zero-order correlations between the predictor variables at age 5, and the outcome measures at 6, 7, and 8 years are presented in Table 8. The English predictors were positively and significantly related to the outcome measures in English at each time point, with one exception. English receptive vocabulary was not significantly related to English reading comprehension at age 7. The Spanish predictors were significantly related to the Spanish outcome measures at all time points, with one exception. Spanish receptive vocabulary was not significantly related to Spanish reading comprehension at age 6. There were fewer significant cross-linguistic correlations; however English oral language comprehension (measured by the PLS-4) was positively related to Spanish reading comprehension at each time point, and English receptive vocabulary was positively related to Spanish reading comprehension at age 7. Only Spanish oral language comprehension was related to English reading comprehension at age 8. No other Spanish oral language predictor was related to English reading comprehension.

Paired samples t-tests revealed that at age 5 the participants had higher expressive vocabulary skills in English than in Spanish,  $t(71) = 9.4, p < .001$ . There was not a significant difference between their English and Spanish receptive vocabulary,  $t(71) = 1.14, p = .257$ . But their oral language comprehension skills were significantly better in Spanish than in English,  $t(71) = -5.7, p < .001$ . In terms of the outcome measures, their

reading comprehension skills were significantly better in English than in Spanish at each time point (all  $ps < .001$ ).

### **Data Analyses**

A series of multilevel models was conducted to examine the relation of English and Spanish oral language skills at 5 years to the intercept and slope of reading comprehension in English and in Spanish. Multilevel modeling analysis allows researchers to model growth over time as well as examine factors related to individual differences in growth trajectories. With multilevel modeling, only one outcome variable can be predicted; therefore, separate models of English and Spanish reading comprehension were calculated. The hierarchical structure of the data is repeated measures nested within individuals. Age (level 1) was entered as a time-varying covariate in each model. Age was centered at 6 years and coded as age 6 = 0, 7 = 1, and 8 = 2. Oral language skills (level 2) were included in the models as time-invariant covariates. Predictor variables were entered uncentered. There was no missing data in any of the oral language predictors. However, there was missing data in the outcome variables (see Table 4). Little's MCAR analysis indicated the data were missing completely at random,  $\chi^2(20) = 17.627, p = .612$ . Missing data were handled using FIML (full information maximum likelihood) estimate in all analyses. FIML allows cases that have missing data in the outcome variable to be included in the analysis (Preacher, Wichman, MacCallum, & Briggs, 2008).

All models included random effects of intercept and linear slope. Model building for each reading comprehension outcome was conducted in the following steps: first, in the base model, age was entered as a time-varying covariate. In the second model, the

main effects of non-verbal IQ and the oral language predictors were added to the base models as fixed effects. The third model dropped the predictors that did not have a significant main effect. Next, the interaction between all significant predictors and age were individually added to subsequent models. Finally, once the best fitting and most parsimonious model of within-language predictors was established, subsequent models individually added main effects of across-language predictors and then individually added the interaction between across-language predictors and age. Model fit was assessed after each model and comparisons of fit between nested models were accomplished using chi-square difference test from the -2 log likelihood. More parsimonious models were preferred.

### **Research Question 1**

Research question 1 examined the relation between English oral skills at 5 years and English reading comprehension growth from 6 to 8 years. Table 9 presents the estimated fixed and random effects of all models that tested the relation between English oral skills and English reading comprehension growth. The base model tested whether the children's English reading comprehension skill grew over time. As expected, there was significant growth,  $p < .001$ . The intraclass correlation coefficient measures the proportion of variance at level 2 (between children differences in growth), and the results revealed that 71.4 percent of the variance is at level 2, which justified adding level 2 predictors.

Model 2 added non-verbal IQ and the English oral language predictors (expressive vocabulary, receptive vocabulary and oral language comprehension). The -2 log likelihood difference tests revealed that the inclusion of these predictors significantly

improved model fit  $\chi^2 (4) = 24.3, p < .001$ . There was a significant main effect of oral language comprehension, indicating that, while controlling for other variables in the model, high levels of oral language comprehension at age 5 was associated with high levels of initial status of reading comprehension. IQ, expressive vocabulary, and receptive vocabulary were not significant predictors. Model 3 dropped the non-significant predictors. Removing the non-significant predictors did not significantly reduce model fit,  $\chi^2 (3) = 2.6, p = .457$ . Model 4 added the two-way interaction between oral language comprehension and age. The interaction was significant, and Model 4 had marginally better model fit than Model 3,  $\chi^2 (1) = 3.1, p = .057$ . Model 4 was the best fitting and most parsimonious model. Figure 1 plots the estimated reading comprehension trajectories of children with high and low levels of oral language comprehension at age 5.

## **Research Question 2**

Research question 2 examined the relation between Spanish oral skills at 5 years and Spanish reading comprehension growth from 6 to 8 years. Table 10 presents the estimated fixed and random effects of all models that tested the relation between Spanish oral skills and Spanish reading comprehension growth. The base model revealed that the children's Spanish reading comprehension grew significantly over time ( $p < .001$ ). The intraclass correlation revealed that 75.4 percent of the variance in reading comprehension is at level 2 (between children), once again justifying the inclusion of level 2 predictors.

Model 2 added non-verbal IQ and the Spanish oral language predictors (expressive vocabulary, receptive vocabulary and language comprehension). The -2 log likelihood difference tests revealed that the inclusion of these predictors significantly



improved model fit  $\chi^2(4) = 34.3, p < .001$ . There were marginally significant main effects of expressive vocabulary ( $p = .066$ ) and oral language comprehension ( $p = .083$ ), indicating that, while controlling for other variables in the model, high levels of expressive vocabulary at age 5 was associated with high initial status of reading comprehension; similarly, high oral language comprehension was also associated with high initial status of reading comprehension skill. IQ and receptive vocabulary were not significant predictors. Model 3 dropped the non-significant predictors. Dropping the nonsignificant predictors did not significantly reduce model fit,  $\chi^2(2) = 3.4, p = .182$ . The interactions between expressive vocabulary and age, and oral language comprehension and age were not significant in Models 4 and 5, respectively. Model 3 was the best fitting and most parsimonious model. When compared to the base model, Model 3 explained 22.9 percent of the level 2 variance. Figure 2 plots the estimated reading comprehension trajectories of children with high and low levels of Spanish expressive vocabulary and oral language skills at age 5.

### **Research Question 3**

Research question 3 examined the relation between English oral skills at 5 years and Spanish reading comprehension growth from 6 to 8 years, while including Spanish oral skills in the model. Table 11 presents the estimated fixed and random effects of all models that tested the relation between English oral skills and Spanish reading comprehension growth.

English oral language predictors were individually added to the best fitting Spanish model (Model 3, established in research question 2) to test for cross-linguistic transfer of English oral skill to Spanish reading comprehension development. Model 2

added English expressive vocabulary as a main effect which was not significantly related to Spanish reading comprehension. The main effect of English receptive vocabulary in Model 3 was not significantly related to Spanish reading comprehension. In Model 4, English oral language comprehension was a significant predictor of the intercept of Spanish reading comprehension. In Model 5, there was a significant and negative interaction between English expressive vocabulary and age. There were no significant interactions between any other cross-linguistic predictor and age. Model 5 was the best fitting and most parsimonious model. The -2 log likelihood difference tests revealed that Model 5 significantly improved model fit,  $\chi^2(2) = 9.4, p = .009$ , when compared to the best fitting model with only Spanish predictors. Furthermore, the inclusion of English oral language predictors explained an additional 13.2 percent of the level 2 variance. Figure 3 plots the cross-linguistic transfer of English oral language skill at age 5 on the trajectories of Spanish reading comprehension growth.

#### **Research Question 4**

Research question 4 examined the relation between Spanish oral skills at 5 years and English reading comprehension growth from 6 to 8 years, while including English oral skills in the model. Table 12 presents the estimated fixed and random effects of all models that tested the relation between English oral skills and Spanish reading comprehension growth.

Main effects and interactions were individually added to the best fitting model with English oral language predictors (Model 4, established in research question 1). There were no significant cross-linguistic effects. No Spanish oral language predictor had a significant main effect, nor did any interact with age, nor was there an

improvement in model fit. These null findings suggest that Spanish oral language skill did not influence English reading comprehension while English oral skills were included in the model. Figure 4 plots the non-significant findings of transfer from Spanish to English.

## DISCUSSION

There is clear evidence that oral language skills at school entry predict later reading comprehension among monolingual children. Less is known about the relation between oral language skills and reading comprehension development among bilingually developing children. Some evidence has found that bilingual children's early oral language skills predict emergent literacy abilities and reading comprehension in the first grade. However, we do not know if bilinguals' oral skills at school entry predict reading comprehension at later developmental stages. Additionally, it is not clear if oral skills in one language can support reading comprehension in the other. Finally, no previous study has examined the relation between early majority language oral skills and later reading comprehension in the heritage language. The current study aims to fill these gaps.

The aim of the present study was to examine how oral language skills at school entry are related to reading comprehension growth within- and across-languages among bilingually developing children. Children's oral language skills in English and Spanish were measured at age 5; their reading comprehension skills in English and Spanish were assessed at ages 6, 7, and 8. With these data, the present study addressed the following research questions:

1. Is English oral language skill related to the later development of English reading comprehension?
2. Is Spanish oral language skill related to the later development of Spanish reading comprehension?

3. Do English oral abilities support Spanish reading comprehension?
4. Do Spanish oral abilities support English reading comprehension?

For English reading development, it was hypothesized that all English measures of oral language skill would predict English reading comprehension. Similarly, it was predicted that all Spanish oral language predictors would be related to Spanish reading comprehension. Finally, it was hypothesized that cross-linguistic transfer would occur in both directions.

The participants' oral language skills at age 5 were strong in each language. Only measures of receptive vocabulary and oral language comprehension provided standard scores that allowed for comparisons of monolingual norms. The children's English and Spanish oral skills were at or above the 50<sup>th</sup> percentile in each measure. The strong dual language skills of these children may be because they come from homes across the socioeconomic strata, including many middle-class families, which is not typical of other samples of studies involving Hispanic children in the United States born to immigrant parents, but it is representative of the Hispanic population in South Florida.

The children's expressive vocabulary skills were better in English than Spanish. But their oral language comprehension skills were significantly better in Spanish than in English. This finding is consistent with other studies that have shown that bilingual children often have unequal levels of comprehension and production skills (Ribot, Hoff, & Burrige, 2018). Furthermore, the children's reading comprehension skills were better in English than in Spanish at each time point. Taken together, the descriptive statistics of the children reveal that the participants were English dominant on most measures but had relatively strong skills in each language.

## **English Oral Skills and Later English Reading Comprehension**

Research question 1 asked whether English oral skill at age 5 predicted English reading comprehension growth from 6 to 8 years. Two relations between English oral skills and English reading comprehension were identified. First, oral language comprehension skills were significantly related to the intercept of reading comprehension development. Second, there was a negative interaction between age and oral language comprehension in English. The first finding is consistent with other studies that have examined the reading skills of bilingually developing children (Kieffer, 2012; Lindsey et al., 2003). In the current study, expressive vocabulary and receptive vocabulary did not contribute to reading comprehension development. The zero-order correlations between expressive vocabulary and reading comprehension were significant at each time point, and correlations between receptive vocabulary and reading comprehension were significant at two of the three time points. However, these predictors did not contribute to reading comprehension in the multilevel model analysis. The finding that oral language comprehension is a strong predictor of reading comprehension skills is consistent with other studies (Davison et al., 2011). The current finding provides further evidence that the English oral skills bilingual children possess at school entry matter. English-only measures do not capture the child's entire linguistic abilities, but nonetheless, they provide valuable information about future reading comprehension trajectories. These findings have practical implications for early educational programs designed to close achievement gaps.

The second important finding of the multilevel model analysis that examined the within language effects of oral skill on later English reading comprehension was the

negative interaction between age and oral language comprehension in English. This unexpected finding revealed that bilinguals with lower levels of English oral language comprehension at age 5 grew at faster rates in reading comprehension than bilinguals with higher levels of English oral language comprehension. The literature points to two, not mutually exclusive, explanations for this finding. First, single-language measures of oral language proficiency may underestimate the academic preparedness of bilingually developing children (Castro et al., 2011). The current finding suggests that this might be particularly true for bilinguals with initially low levels of English skill. Second, the reading comprehension development of bilinguals with initially low levels of English skill, have been found to decelerate at a slower rate than bilinguals with higher levels of English skill (Nakamoto, Lindsey, & Manis, 2006). The current study examined growth at three time points and therefore was unable to reliably model quadratic or curvilinear growth trajectories. Consequently, there is no direct evidence of decelerated growth, nor different rates of deceleration between individuals with high and low initial status. Nonetheless, a potential explanation of the negative interaction between oral language comprehension and age is that the result is tapping into differences in decelerated growth that cannot be modeled in the context of the current study.

### **Spanish Oral Skills and Later Spanish Reading Comprehension**

Research question 2 asked whether Spanish oral skill at age 5 predicted Spanish reading comprehension growth from 6 to 8 years. The results of the multilevel model revealed that expressive vocabulary and oral language comprehension were significantly related to the development of Spanish reading comprehension. This is consistent with the evidence of the relation between oral language skill in the heritage language and

emergent heritage literacy development (Hammer et al., 2007; Lindsay, 2003), and contributes to the literature that early oral language skill predicts later reading comprehension in the heritage language through the mid-elementary school years. Similar to the English reading comprehension model, there were not significant within-language relations between Spanish receptive vocabulary and Spanish reading comprehension. Once again, the zero-order correlations between receptive vocabulary and reading comprehension were significant in two of the three time points, but receptive vocabulary was not significantly related to reading comprehension in the multilevel model. This finding once again highlights the strong within-language predictive power of expressive vocabulary and oral language comprehension.

### **English Oral Skills and Later Spanish Reading Comprehension**

Research question 3 asked whether English oral skill at age 5 predicted Spanish reading comprehension growth from 6 to 8 years, while controlling for within-language relations. Two relations were identified. First, English oral language comprehension was positively related to the intercept of Spanish reading comprehension. Second, there was a negative interaction between age and English expressive vocabulary.

The two findings reveal cross-linguistic influence from English oral skill to subsequent Spanish reading comprehension. The first positive finding revealed that English oral abilities can support Spanish reading comprehension one year later. This positive relation is consistent with other studies that have examined the early literacy skills of bilingually developing children (Lindsey et al., 2003). The second cross-linguistic finding suggested that children with high levels of English expressive vocabulary at age 5 grew in Spanish reading comprehension at a slower rate than children



with low levels of English expressive vocabulary at age 5. The unanticipated finding of a negative relation is not interpreted as reflecting the cognitive capacities of bilingual development. If it were, a negative relation would be expected in both directions. And there were no across-language relations in which Spanish oral skill was negatively related to English reading comprehension growth. Rather, a candidate explanation for the current finding is that English skills threaten heritage language development. This explanation is consistent with previous findings (Hoff, Quinn, & Giguere, 2018; Montrul, 2008). Further research is required to better explore the relation between English skill and Spanish growth.

Finding the cross-linguistic relation between English oral skill and Spanish reading comprehension has practical and theoretical implications. However, it is important to note that the finding only identifies a relationship and not the mechanism that causes it. The finding is in agreement, at least in part, with the common underlying proficiency framework. As previously stated, this hypothesis suggests that dual language abilities stem from a single underlying proficiency. Thus, explaining the mechanism by which English oral skill supported Spanish reading comprehension. Theoretical implications of the finding will be discussed in a later section.

### **Spanish Oral Skills and Later English Reading Comprehension**

Research question 4 asked whether Spanish oral skill at age 5 predicted English reading comprehension growth from 6 to 8 years, while controlling for within-language relations. The multilevel model analyses did not find evidence that heritage oral skills predict later English reading comprehension. After controlling for English oral skill, no Spanish predictor was significantly related to the intercept or slope of English reading

comprehension. The lack of Spanish transfer to English reading development is inconsistent with the common underlying proficiency model proposed by Cummins (1981). Taken together, the findings that English oral skills transferred to Spanish reading, but Spanish oral skills did not transfer to English reading have important implications for theories of language transfer and provides important insights into when one language is more likely to support the other.

### **Theoretical Implications**

The leading theory on language transfer comes from the common underlying proficiency model (Cummins, 1979) which suggest that all language skills should be related across languages. In the context of the current study, this model would predict that transfer of oral language skills to reading comprehension would occur in both directions. That is to say, English oral skill should be related to Spanish reading, and Spanish oral skill should be related to English reading. More recently, this model has been expanded to suggest that a minimum threshold in language proficiency must be passed before language transfer will occur across languages (Cummins, 1991). The threshold hypothesis still cannot fully explain the findings of the current study. The findings were that language transfer only occurred in one direction, from English to Spanish. The Spanish oral language skills of the participants were, on average, strong and at or above the 50<sup>th</sup> percentile when compared to monolingual norms. This would suggest that the threshold required for Spanish to transfer to English should have been met. Nonetheless, the cross-linguistic influence was not observed. This null finding is consistent with other studies that have examined reading comprehension among samples

of bilingually developing children who only receive formal reading instruction in English (Mancilla-Martinez & Lesaux, 2010; Proctor, Silverman, Haring, & Montecillo, 2012).

The results of the current study suggest that language transfer will not necessarily occur across all languages under all conditions. The findings suggest that language experience and proficiency will likely influence the extent to which bilingual children use one language to support abilities in their other language. There are three candidate explanations as to why the current study found unidirectional evidence of linguistic transfer.

First, the participants were formally taught how to read in English. Consistent with educational practices across the United States, a small proportion of participants attended schools with bilingual instruction. Of the 72 participants, only three children went to a bilingual school at age 6, and only two of these children continued to attend bilingual schools at ages 7 and 8. Throughout the course of the study, all participants received formal education in English which included reading instruction, and only three of the participants received any formal reading instruction in Spanish. Unlike learning to speak and communicate, the acquisition of reading is not guaranteed by human DNA. Learning to read typically requires instruction. The results of the current study revealed that transfer only occurred from the language with formal instruction to the language without it.

Second, the participants' dominant language skills transferred to their weaker language. In general, the participants were English dominant in terms of expressive vocabulary skill at school entry, and also English dominant in reading comprehension skill at each time point. This bilingual profile is not unique to the sample of the current

study, there is a substantial body of research that finds that among bilingually developing individuals, English language skills tend to take over heritage language proficiency (Gathercole & Thomas, 2009; Giguere, 2018; Montrul, 2008; Montrul, 2009), resulting in consistent bilingual profiles in which English is dominant over the heritage language. Since surprisingly few studies have examined reading comprehension in the heritage language, it is hard to find corroborating evidence of English oral skills transferring to the weaker language. However, during early developmental periods, it is possible to find bilinguals that are still dominant in their heritage language. Studies that examined young children who are Spanish dominant find evidence of cross-linguistic transfer of Spanish to emergent literacy skills in English (Zhao et al., 2017; Davison et al., 2011). This is consistent with the conclusion that the dominant language is more likely to transfer to the weaker one. Additionally, studies that examine participants in the mid- to late-elementary school years find that heritage language skill does not predict English reading development (Kieffer, 2008; Mancilla-Martinez & Lesaux, 2010; Manis, Lindsey, & Bailey, 2004; Nakamoto et al., 2008), which is consistent with conclusion that a bilingual's weaker language is less likely to predict their stronger language.

A third potential reason that English oral skill transferred to Spanish reading comprehension, but Spanish oral skill did not transfer to English reading comprehension may be that Spanish and English have different orthographic depths. The orthographic depth of a language refers to the degree to which letters correspond to phonemes (sounds). Languages with a shallow (sometimes called transparent) orthography, have a one-to-one correspondence between letters and phonemes. In other words, the spelling is direct and consistent, and one can correctly sound out a word without knowing its

meaning. Languages with deep orthographies have a less direct correspondence between letters and phonemes. The two languages measured in the current study are on different ends of the spectrum: Spanish has a shallow orthography and English a deep orthography. There is both experimental evidence (Share, 2004) and cross-cultural evidence of children learning to read in shallow and deep orthographies (Aro, 2004) that it is more difficult to read in a language with a deep orthography than it is to read in a language with a shallow orthography. Accordingly, it is reasonable to suspect that language transfer is more likely to occur from a language with a deep orthography to a language with a shallow orthography rather than in the opposite direction. Results of the current study are consistent with this hypothesis.

### **Practical Implications**

The study provided important practical implications. There is evidence of an academic achievement gap between Hispanic bilingually developing children and their European-American, monolingual counterparts (National Center for Education Statistics, 2013). Results of the present study can provide practical insights for initiatives designed to close this achievement gap. High-quality early childhood education that focuses on English vocabulary and other English oral language skills will likely benefit bilingual children and assist in their future reading comprehension. This recommendation is consistent with the conclusions of other studies that examined the literacy development of bilingual children (Hammer, Lawrence, & Miccio, 2008; Kieffer, 2012; Oller, & Eilers, 2002). Measures of English oral skills may not fully capture bilingual children's linguistic abilities, but nonetheless, their early skills have important implications for their

future reading comprehension trajectories. Supporting early oral English skills with high-quality education programs may help close the academic achievement gap.

### **Limitations and Future Directions**

The current study provided important contributions to the literature; nevertheless, there are some limitations worth noting. First, the sample size was adequate for the analyses of the study, but it was not very large. A larger, more diverse sample could have shed light on the reading comprehension trajectories of individuals that are Spanish dominant with limited English skills. These results could have additional practical implications for closing achievement gaps.

A second limitation of the study is that reading comprehension was only measured at three time points which removed the possibility of testing for quadratic growth. Quadratic growth is often observed among studies that examine language and literacy outcomes and may provide a more accurate depiction of the children's growth trajectories. As the participants in the current study are part of a larger ongoing study, once the data have been collected and entered, it would be interesting and informative to follow their reading comprehension skill for another year and then re-evaluate their growth trajectories.

A final limitation of the study was that oral language skills were the only predictors of reading comprehension growth. It is well attested that other components of early language skill influence later literacy abilities. Specifically, the inclusion of the phonological processing measures would have likely provided a better picture of the skills the children used to complete the reading comprehension task. Furthermore, it would have been interesting to examine the unique contributions of both phonological

processing and oral language skills on later reading comprehension. Future research is required to examine how both phonological processing and oral language skills are related to the reading development of the majority and heritage language.

### **Conclusion**

The current study was the first to examine the within- and across-language relations between oral skills and the development of English and Spanish reading comprehension. The longitudinal analyses found significant within-language relations between oral language skills and reading comprehension in English and in Spanish, which was consistent with previous studies. In terms of cross-language relations, Spanish oral skill was not significantly related to English reading comprehension, which is also consistent with previous research that examined bilinguals during the middle- to late-elementary school years. An important finding of the current study is that English oral skill transferred to Spanish reading comprehension after accounting for the within-language relation. This finding provides a significant contribution to the language transfer literature and expands our current understanding of how two languages develop and affect each other over time. Additionally, the study provides practical insights regarding early factors that influence later biliteracy development among children born in the United States to immigrant parents.

Table 1

*Means and (Standard Deviations) for Child Age, Spanish Exposure at Home, and English Exposure at Home at Ages 5, 6, 7, and 8*

|                            | 5             | 6             | 7             | 8             |
|----------------------------|---------------|---------------|---------------|---------------|
| Age (in months)            | 60.44 (.51)   | 74.66 (3.18)  | 85.73 (1.84)  | 97.74 (1.23)  |
| % Spanish exposure at home | 61.10 (25.70) | 56.14 (27.52) | 61.42 (24.72) | 55.95 (25.74) |
| % English exposure at home | 38.56 (25.97) | 43.42 (27.77) | 38.58 (24.72) | 44.05 (25.74) |



Table 2

*Parent Characteristics*

|  | Household | Mother | Father |
|--|-----------|--------|--------|
| <b>Parent constellations</b>                 |           |        |        |
| 2 Spanish speaking parents                   | 54        |        |        |
| Spanish mother, English father               | 14        |        |        |
| Spanish father, English mother               | 3         |        |        |
| Other  | 1         |        |        |
| <b>Highest level of Education in English</b> |           |        |        |
| Less than high school                        |           | 41     | 33     |
| High School                                  |           | 4      | 8      |
| 2-year degree                                |           | 11     | 15     |
| College degree                               |           | 7      | 9      |
| Advanced degree                              |           | 9      | 7      |
| <b>Highest level of Education in Spanish</b> |           |        |        |
| Less than high school                        |           | 19     | 32     |
| High school                                  |           | 22     | 18     |
| 2-year degree                                |           | 6      | 4      |
| College degree                               |           | 22     | 13     |
| Advanced degree                              |           | 3      | 5      |

Table 3

*Observed Mean and (Standard Deviation) and Corresponding Standard Score and (Standard Deviation) for Oral Language Predictors in English and in Spanish at Age 5 (N = 72)*

| Measures at 5 years         | Observed mean (SD) | Standard score mean (SD) |
|-----------------------------|--------------------|--------------------------|
| Non-verbal IQ               |                    | 111.97 (14.78)           |
| English                     |                    |                          |
| Expressive vocabulary       | 47.44 (13.03)      |                          |
| Receptive vocabulary        | 87.25 (21.72)      | 103.39 (14.47)           |
| Oral language comprehension | 55.93 (4.05)       | 101.76 (14.33)           |
| Spanish                     |                    |                          |
| Expressive vocabulary       | 21.46 (17.93)      |                          |
| Receptive vocabulary        | 35.33 (14.08)      | 100.82 (16.88)           |
| Oral language comprehension | 54.68 (5.44)       | 110.65 (14.47)           |

*Note.* Non-verbal IQ is assessed by the Primary Test of Nonverbal Intelligence (PTONI; Ehrler & McGhee, 2008); expressive vocabulary is assessed by the Expressive One-Word Picture Vocabulary Test– Spanish Bilingual Edition (EOWPVT; Brownell, 2001); Receptive vocabulary is assessed by Peabody Picture Vocabulary Test (PPVT-4; Dunn & Dunn, 2012) and its Spanish counterpart, Test de Vocabulario en Imágenes Peabody (TVIP; Dunn, Padilla, Lugo, & Dunn, 1986); Oral language comprehension is assessed by The Preschool Language Scale, Fourth Edition (PLS-4; Zimmerman, Steiner, & Pond, 2002); All standard scores are normed to have a mean of 100 and a standard deviation of 15.

Table 4

*Skewness and Kurtosis for Predictor Variables at 5 Years and Outcome Variables at 6, 7, and 8 Years*

|                                     | N  | Skewness (S.E.) | Kurtosis (S.E) |
|-------------------------------------|----|-----------------|----------------|
| <b>Predictors</b>                   |    |                 |                |
| IQ                                  | 72 | .047 (.28)      | 2.4 (.56)      |
| English expressive vocabulary       | 72 | -.09 (.28)      | -.66 (.56)     |
| English receptive vocabulary        | 72 | -.63 (.28)      | 1.1 (.56)      |
| English oral language comprehension | 72 | -.84 (.28)      | .46 (.56)      |
| Spanish expressive vocabulary       | 72 | .74 (.28)       | -.44 (.56)     |
| Spanish receptive vocabulary        | 72 | -.17 (.28)      | -.26 (.56)     |
| Spanish oral language comprehension | 72 | -3.4 (2.8)      | 17.8 (.56)     |
| <b>Outcomes</b>                     |    |                 |                |
| English reading (6 years)           | 59 | -1.53 (.31)     | 3.5 (.61)      |
| English reading (7 years)           | 59 | -2.8 (.31)      | 12.2 (.63)     |
| English reading (8 years)           | 66 | -1.38 (.29)     | 5.1 (.58)      |
| Spanish reading (6 years)           | 59 | -.63 (.31)      | .068 (.61)     |
| Spanish reading (7 years)           | 59 | -.86 (.31)      | .93 (.61)      |
| Spanish reading (8 years)           | 64 | -.41 (.29)      | 1.1 (.59)      |

*Note.* Non-verbal IQ was assessed by the Primary Test of Nonverbal Intelligence (PTONI; Ehrler & McGhee, 2008); expressive vocabulary was assessed by the Expressive One-Word Picture Vocabulary Test– Spanish Bilingual Edition (EOWPVT; Brownell, 2001); Receptive vocabulary was assessed by Peabody Picture Vocabulary Test (PPVT-4; Dunn & Dunn, 2012) and its Spanish counterpart, Test de Vocabulario en Imágenes Peabody (TVIP; Dunn, Padilla, Lugo, & Dunn, 1986); Oral language comprehension was assessed by The Preschool Language Scale, Fourth Edition (PLS-4; Zimmerman, Steiner, & Pond, 2002). English reading was assessed by the English passage comprehension subtest of the Woodcock-Muñoz Language Survey-Revised (Woodcock et al., 2005); Spanish reading was assessed by the Spanish passage comprehension subtest of the Woodcock-Muñoz Language Survey-Revised (Woodcock et al., 2005).

Table 5

*Mean W Scores and (Standard Deviations) of Reading Comprehension in English and in Spanish at 6, 7, and 8 Years*

|                        | 6 years        | 7 years        | 8 years        |
|------------------------|----------------|----------------|----------------|
| Reading comprehension, | 446.31 (28.83) | 476.08 (23.50) | 490.76 (17.60) |
| English                | n=59           | n=59           | n=66           |
| Reading comprehension, | 401.25 (39.03) | 427.36 (30.56) | 443.77 (25.94) |
| Spanish                | n=59           | n=59           | n=64           |

Table 6

*Intercorrelations among Oral Language Predictors at Age 5 (N=72)*

| Measure Age 5                          | 1           | 2           | 3           | 4           | 5           | 6           | 7 |
|--|-------------|-------------|-------------|-------------|-------------|-------------|---|
| 1. Non-verbal IQ                       |             |             |             |             |             |             |   |
| 2. English expressive vocabulary       | <b>.345</b> |             |             |             |             |             |   |
| 3. English oral language comprehension | <b>.447</b> | <b>.624</b> |             |             |             |             |   |
| 4. English receptive vocabulary        | <b>.265</b> | <b>.611</b> | <b>.662</b> |             |             |             |   |
| 5. Spanish expressive vocabulary       | .168        | -.119       | .115        | .096        |             |             |   |
| 6. Spanish oral language comprehension | <b>.243</b> | .177        | <b>.535</b> | <b>.463</b> | <b>.419</b> |             |   |
| 7. Spanish receptive vocabulary        | <b>.319</b> | .030        | <b>.322</b> | <b>.241</b> | <b>.731</b> | <b>.602</b> |   |

*Note.* Bold numbers indicate significant correlations ( $p < .05$ ); Non-verbal IQ was assessed by the Primary Test of Nonverbal Intelligence (PTONI; Ehrler & McGhee, 2008); Expressive vocabulary was assessed by the EOWPVT = Expressive One-Word Picture Vocabulary Test– Spanish Bilingual Edition (EOWPVT; Brownell, 2001); Receptive vocabulary in English was assessed by Peabody Picture Vocabulary (PPPVT) and it in Spanish the Test de Vocabulario en Imagenes Peabody (TVIP); Oral language comprehension was assessed by the PLS4 = Preschool Language Scale, Fourth Edition (PLS-4; Zimmerman, Steiner, & Pond, 2002).

Table 7

*Intercorrelations among Outcome Measures of English and Spanish Reading**Comprehension at 6, 7, and 8 Years*

| Measure                         | 1           | 2           | 3           | 4           | 5           | 6 |
|---------------------------------|-------------|-------------|-------------|-------------|-------------|---|
| 1. English reading<br>(6 years) |             |             |             |             |             |   |
| 2. English reading<br>(7 years) | <b>.584</b> |             |             |             |             |   |
| 3. English reading<br>(8 years) | <b>.357</b> | <b>.599</b> |             |             |             |   |
| 4. Spanish reading<br>(6 years) | <b>.649</b> | <b>.400</b> | <b>.338</b> |             |             |   |
| 5. Spanish reading<br>(7 years) | <b>.318</b> | <b>.498</b> | <b>.540</b> | <b>.508</b> |             |   |
| 6. Spanish reading<br>(8 years) | <b>.211</b> | <b>.418</b> | <b>.576</b> | <b>.470</b> | <b>.764</b> |   |

*Note.* Bold numbers indicate significant correlations ( $p < .05$ ); English reading was assessed by the English passage comprehension subtest of the Woodcock-Muñoz Language Survey-Revised (Woodcock et al., 2005); Spanish reading was assessed by the Spanish passage comprehension subtest of the Woodcock-Muñoz Language Survey-Revised (Woodcock et al., 2005)

Table 8

*Zero-Order Correlations between Oral Language Predictors and Reading**Comprehension Outcome Measures*

| Predictor Age 5                     | Reading Comprehension |             |             |             |             |             |
|-------------------------------------|-----------------------|-------------|-------------|-------------|-------------|-------------|
|                                     | English               |             |             | Spanish     |             |             |
|                                     | 6                     | 7           | 8           | 6           | 7           | 8           |
| Non-verbal IQ                       | .176                  | .114        | .233        | .073        | <b>.240</b> | <b>.274</b> |
| English expressive vocabulary       | <b>.419</b>           | <b>.321</b> | <b>.388</b> | .179        | .141        | -.043       |
| English oral language comprehension | <b>.505</b>           | <b>.388</b> | <b>.484</b> | <b>.375</b> | <b>.413</b> | <b>.248</b> |
| English receptive vocabulary        | <b>.285</b>           | .212        | <b>.312</b> | .234        | <b>.302</b> | .163        |
| Spanish expressive vocabulary       | .149                  | -.049       | .037        | <b>.315</b> | <b>.460</b> | <b>.523</b> |
| Spanish oral language comprehension | .191                  | .156        | <b>.349</b> | <b>.310</b> | <b>.422</b> | <b>.500</b> |
| Spanish receptive vocabulary        | -.033                 | .101        | .194        | .163        | <b>.464</b> | <b>.592</b> |

*Note.* Bold numbers indicate significant correlations ( $p < .05$ ); Reading comprehension is assessed by the passage comprehension subtest of the Woodcock-Muñoz Language Survey- Revised (Woodcock et al., 2005); Non-verbal IQ was assessed by the Primary Test of Nonverbal Intelligence (PTONI; Ehrler & McGhee, 2008); Expressive vocabulary was assessed by the EOWPVT = Expressive One-Word Picture Vocabulary Test– Spanish Bilingual Edition (EOWPVT; Brownell, 2001); Receptive vocabulary in English was assessed by Peabody Picture Vocabulary (PPPVT) and it in Spanish the Test de Vocabulario en Imagenes Peabody (TVIP); Oral language comprehension was assessed by the PLS4 = Preschool Language Scale, Fourth Edition (PLS-4; Zimmerman, Steiner, & Pond, 2002).

Table 9

*Estimates of Fixed and Random Effects from a Series of Multilevel Models Predicting English Reading Comprehension with Early English Oral Skills (N=72)*

|                              | Base Model   |     | Model 2      |      | Model 3      |      | Model 4      |      |
|------------------------------|--------------|-----|--------------|------|--------------|------|--------------|------|
|                              | $\gamma$     | SE  | $\gamma$     | SE   | $\gamma$     | SE   | $\gamma$     | SE   |
| Fixed effects                |              |     |              |      |              |      |              |      |
| Intercept                    | <b>447.9</b> | 3.4 | <b>317.4</b> | 29.5 | <b>315.9</b> | 25.5 | <b>254.0</b> | 41.1 |
| Age                          | <b>22.6</b>  | 1.7 | <b>22.2</b>  | 1.7  | <b>22.2</b>  | 1.7  | <b>67.2</b>  | 23.1 |
| Non-verbal IQ                |              |     | -.10         | 0.3  |              |      |              |      |
| Expressive vocabulary        |              |     | 0.3          | 0.2  |              |      |              |      |
| Receptive vocabulary         |              |     | -.13         | 0.1  |              |      |              |      |
| Language comprehension       |              |     | <b>2.4</b>   | 0.7  | <b>2.4</b>   | 0.5  | <b>3.5</b>   | 0.7  |
| Language comprehension X Age |              |     |              |      |              |      | -.80†        | 0.4  |
| Random effects               |              |     |              |      |              |      |              |      |
| Intercept                    | <b>241.2</b> |     | <b>181.6</b> |      | <b>190.1</b> |      | <b>184.4</b> |      |
| Slope (linear)               | <b>102.0</b> |     | <b>103.5</b> |      | <b>104.1</b> |      | <b>96.5</b>  |      |
| Goodness of fit              |              |     |              |      |              |      |              |      |
| -2LL                         | 1639         |     | 1615         |      | 1618         |      | 1614         |      |
| AIC                          | 1651         |     | 1635         |      | 1632         |      | 1630         |      |
| Number of parameters         | 6            |     | 10           |      | 7            |      | 8            |      |

*Note.* Bold numbers represent significant effects; † $p < .1$ ; The base model is an unconditional growth model. Model 2 adds the main effects of the English oral language predictors and non-verbal IQ. Model 3 dropped nonsignificant effects from model 2. Model 4 adds the language comprehension X Age interaction; this model is the most parsimonious best fitting model. -2LL = -2 log likelihood; AIC = Akaike information criteria.



Table 10

*Estimates of Fixed and Random Effects from a Series of Multilevel Models Predicting Spanish Reading Comprehension with Early Spanish Oral Skills (N=72)*

|                              | Base Model   |     | Model 2      |      | Model 3      |      | Model 4      |      | Model 5      |      |
|------------------------------|--------------|-----|--------------|------|--------------|------|--------------|------|--------------|------|
|                              | $\gamma$     | SE  | $\gamma$     | SE   | $\gamma$     | SE   | $\gamma$     | SE   | $\gamma$     | SE   |
| Fixed effects                |              |     |              |      |              |      |              |      |              |      |
| Intercept                    | <b>402.4</b> | 4.5 | <b>307.9</b> | 31.0 | <b>303.7</b> | 29.9 | <b>304.6</b> | 30.0 | <b>303.0</b> | 42.0 |
| Age                          | <b>21.3</b>  | 2.2 | <b>20.9</b>  | 2.2  | <b>20.9</b>  | 2.2  | <b>20.0</b>  | 3.4  | <b>21.6</b>  | 25.9 |
| Non-verbal IQ                |              |     | 0.4          | 0.4  |              |      |              |      |              |      |
| Expressive vocabulary        |              |     | 0.37†        | 0.2  | <b>0.6</b>   | 0.2  | <b>0.5</b>   | 0.2  | <b>0.6</b>   | 0.2  |
| Receptive vocabulary         |              |     | 0.5          | 0.3  |              |      |              |      |              |      |
| Language comprehension       |              |     | 1.09†        | 0.6  | <b>1.6</b>   | 0.6  | <b>1.6</b>   | 0.6  | <b>1.6</b>   | 0.8  |
| Expressive vocabulary X Age  |              |     |              |      |              |      | 0.0          | 0.1  |              |      |
| Language comprehension X Age |              |     |              |      |              |      |              |      | -.01         | 0.5  |
| Random effects               |              |     |              |      |              |      |              |      |              |      |
| Intercept                    | <b>271.5</b> |     | <b>242.3</b> |      | <b>229.8</b> |      | <b>229.2</b> |      | <b>229.8</b> |      |
| Slope (linear)               | <b>111.7</b> |     | <b>110.2</b> |      | <b>111.8</b> |      | <b>112.0</b> |      | <b>111.8</b> |      |
| Goodness of fit              |              |     |              |      |              |      |              |      |              |      |
| -2LL                         | 1725         |     | 1691         |      | 1694         |      | 1694         |      | 1694         |      |
| AIC                          | 1737         |     | 1711         |      | 1710         |      | 1712         |      | 1712         |      |
| Number of parameters         | 6            |     | 10           |      | 8            |      | 9            |      | 9            |      |

*Note.* Bold numbers represent significant effects; † $p < .1$ ; The base model is an unconditional growth model. Model 2 adds the main effects of the Spanish oral language predictors and non-verbal IQ. Model 3 dropped nonsignificant effects from model 2. Model 4 adds the expressive vocabulary X Age interaction. Model 5 adds the language comprehension X Age interaction; Model 3 is the most parsimonious best fitting model. -2LL = -2 log likelihood; AIC = Akaike information criteria.

Table 11

*Estimates of Fixed and Random Effects from a Series of Multilevel Models Predicting Spanish Reading Comprehension with Early English Oral Skills, while Controlling for Spanish Oral Skills (N=72)*

| Predictors                       | Final model of Spanish-only predictors |     | Model 2      |      | Model 3      |      | Model 4      |      | Model 5      |     | Model 6      |      | Model 7      |            |
|----------------------------------|--|-----|--------------|------|--------------|------|--------------|------|--------------|-----|--------------|------|--------------|------------|
|                                  | $\gamma$                               | SE  | $\gamma$     | SE   | $\gamma$     | SE   | $\gamma$     | SE   | $\gamma$     | SE  | $\gamma$     | SE   | $\gamma$     | SE         |
| Fixed effects                    |  |     |              |      |              |      |              |      |              |     |              |      |              |            |
| Intercept                        | <b>304</b>                             | 30  | <b>303</b>   | 29.9 | <b>307.1</b> | 30.5 | <b>255.6</b> | 36.4 | <b>217</b>   | 40  | <b>229.2</b> | 42.5 | <b>188.0</b> | 55.0       |
| Age                              | <b>20.9</b>                            | 2.2 | <b>20.9</b>  | 2.2  | <b>20.9</b>  | 2.2  | <b>20.8</b>  | 2.2  | <b>33.0</b>  | 5.9 | <b>28.2</b>  | 6.5  | <b>71.1</b>  | 30.5       |
| Spa Expressive vocabulary        | <b>0.6</b>                             | 0.2 | <b>0.6</b>   | 0.2  | <b>0.6</b>   | 0.2  | <b>0.6</b>   | 0.2  | <b>0.6</b>   | 0.2 | <b>0.6</b>   | 0.2  | <b>0.6</b>   | 0.2        |
| Spa Language comprehension       | <b>1.6</b>                             | 0.6 | <b>1.5</b>   | 0.6  | <b>1.4</b>   | 0.7  | 0.8          | 0.7  | 0.6          | 0.7 | 0.9          | 0.7  | 0.7          | 0.7        |
| Eng expressive vocabulary        |  |     | 0.0          | 0.2  |              |      |              |      |              |     |              |      |              |            |
| Eng receptive vocabulary         |  |     |              |      | 0.1          | 0.1  |              |      |              |     |              |      |              |            |
| Eng language comprehension       |  |     |              |      |              |      | <b>1.6</b>   | 0.7  | <b>2.5</b>   | 1.1 | <b>2.0</b>   | 0.8  | <b>2.9</b>   | 1.1        |
| Eng expressive vocabulary X Age  |  |     |              |      |              |      |              |      | <b>-0.25</b> | 0.1 |              |      |              |            |
| Eng receptive vocabulary X Age   |  |     |              |      |              |      |              |      |              |     | -0.08        | 0.1  |              |            |
| Eng language comprehension X Age |  |     |              |      |              |      |              |      |              |     |              |      |              | -0.089 0.5 |
| Random effects                   |  |     |              |      |              |      |              |      |              |     |              |      |              |            |
| Intercept                        | <b>229</b>                             |     | <b>227.7</b> |      | <b>228.2</b> |      | <b>214.4</b> |      | <b>212</b>   |     | <b>212.8</b> |      | <b>211.3</b> |            |
| Slope (linear)                   | <b>112</b>                             |     | <b>111.6</b> |      | <b>112.0</b> |      | <b>112.8</b> |      | <b>108</b>   |     | <b>111.2</b> |      | <b>108.0</b> |            |
| Goodness of fit                  |  |     |              |      |              |      |              |      |              |     |              |      |              |            |

|                      |      |      |      |      |      |      |      |
|----------------------|------|------|------|------|------|------|------|
| -2LL                 | 1694 | 1694 | 1694 | 1690 | 1685 | 1689 | 1688 |
| AIC                  | 1710 | 1712 | 1712 | 1708 | 1705 | 1709 | 1708 |
| Number of parameters | 8    | 9    | 9    | 9    | 10   | 10   | 10   |

*Note.* Bold numbers represent significant effects; † $p < .1$ ; The first model is the best fitting model of Spanish-only predictors (Model 3 in Table 10). Model 2 builds on this model by adding a main effect of English expressive vocabulary. Model 3 adds a main effect of English receptive vocabulary. Model 4 adds a main effect of English language comprehension. Model 5 adds the interaction between English expressive vocabulary and Age. Model 6 adds the interaction between English receptive vocabulary and Age. Model 7 adds the interaction between English language comprehension and Age. Model 5 is the best fitting and most parsimonious model; Eng = English; Spa = Spanish; -2LL = -2 log likelihood; AIC = Akaike information criteria.

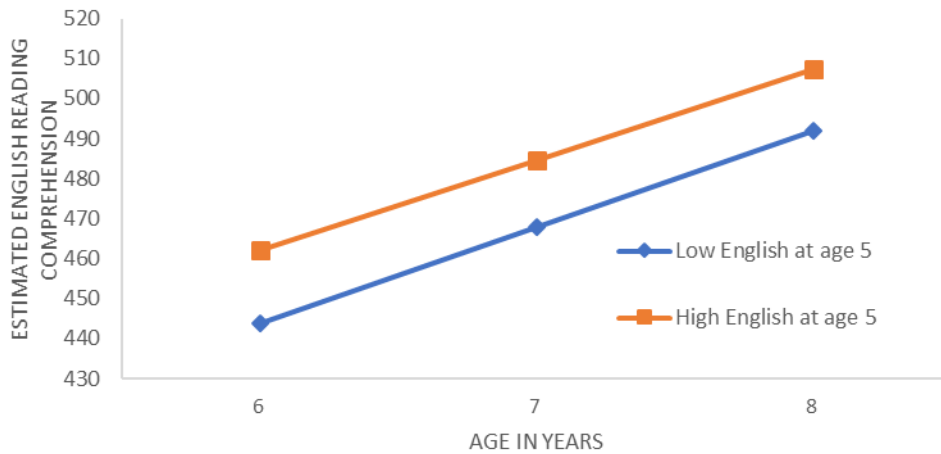
Table 12

*Estimates of Fixed and Random Effects from a Series of Multilevel Models Predicting English Reading Comprehension with Early Spanish Oral Skills, while Controlling for English Oral Skills (N=72)*

| Predictors                       | Final model of English-only predictors |      | Model 2     |     | Model 3     |     | Model 4     |     | Model 5     |     | Model 6     |     | Model 7     |     |
|----------------------------------|--|------|-------------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|
|                                  | $\gamma$                               | SE   | $\gamma$    | SE  | $\gamma$    | SE  | $\gamma$    | SE  | $\gamma$    | SE  | $\gamma$    | SE  | $\gamma$    | SE  |
| Fixed effects                    |  |      |             |     |             |     |             |     |             |     |             |     |             |     |
| Intercept                        | <b>254</b>                             | 41.1 | <b>254</b>  | 41  | <b>253</b>  | 41  | <b>257</b>  | 41  | <b>254</b>  | 41  | <b>255</b>  | 41  | <b>254</b>  | 41  |
| Age                              | <b>67.2</b>                            | 23.1 | <b>67.3</b> | 23  | <b>67.4</b> | 23  | <b>67.9</b> | 23  | <b>67.7</b> | 23  | <b>67.8</b> | 23  | <b>67.2</b> | 24  |
| Eng Language comprehension       | <b>3.5</b>                             | 0.7  | <b>3.5</b>  | 0.7 | <b>3.5</b>  | 0.7 | <b>3.6</b>  | 0.8 | <b>3.5</b>  | 0.7 | <b>3.5</b>  | 0.7 | <b>3.5</b>  | 0.7 |
| Eng Language comprehension X Age | -0.80†                                 | 0.4  | -0.80†      | 0.4 | -0.80†      | 0.4 | -0.80†      | 0.4 | -0.80†      | 0.4 | <b>-0.9</b> | 0.4 | -0.80†      | 0.4 |
| Spa expressive vocabulary        |  |      | -0.01       | 0.1 |             |     |             |     |             |     |             |     |             |     |
| Spa receptive vocabulary         |  |      |             |     | -0.03       | 0.1 |             |     |             |     |             |     |             |     |
| Spa language comprehension       |  |      |             |     |             |     | -0.20       | 0.4 |             |     |             |     |             |     |
| Spa expressive vocabulary X Age  |  |      |             |     |             |     |             |     | -0.03       | 0.1 |             |     |             |     |
| Spa receptive vocabulary X Age   |  |      |             |     |             |     |             |     |             |     | 0.1         | 0.1 |             |     |
| Spa language comprehension X Age |  |      |             |     |             |     |             |     |             |     |             |     | 0.0         | 0.3 |
| Random effects                   |  |      |             |     |             |     |             |     |             |     |             |     |             |     |
| Intercept                        | <b>184</b>                             |      | <b>184</b>  |     | <b>183</b>  |     | <b>183</b>  |     | <b>184</b>  |     | <b>185</b>  |     | <b>18</b>   |     |
| Slope (linear)                   | <b>96.5</b>                            |      | <b>96.5</b> |     | <b>96.5</b> |     | <b>96.3</b> |     | <b>95.4</b> |     | <b>94.9</b> |     | <b>96.5</b> |     |
| Goodness of fit                  |  |      |             |     |             |     |             |     |             |     |             |     |             |     |

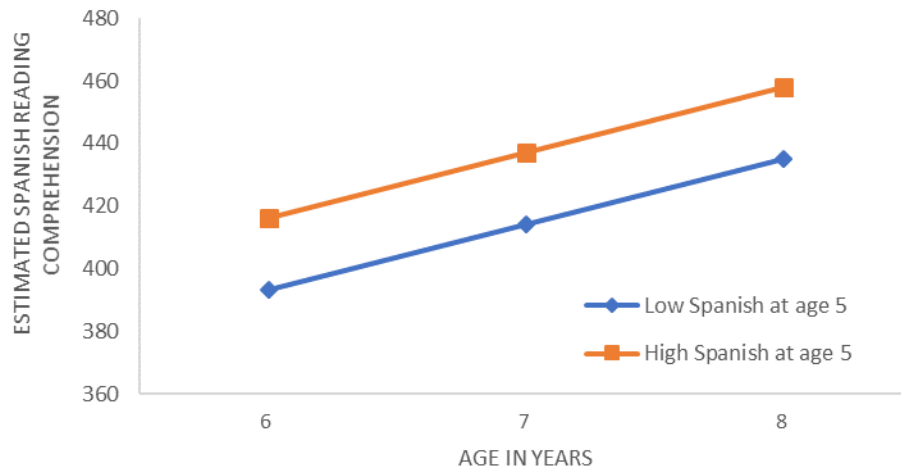
|                      |      |      |      |      |      |      |      |
|----------------------|------|------|------|------|------|------|------|
| -2LL                 | 1614 | 1614 | 1614 | 1614 | 1614 | 1613 | 1614 |
| AIC                  | 1630 | 1632 | 1632 | 1632 | 1632 | 1631 | 1632 |
| Number of parameters | 8    | 9    | 9    | 9    | 9    | 9    | 9    |

*Note.* Bold numbers represent significant effects; † $p < .1$ ; The first model is the best fitting model of English-only predictors (Model 4 in Table 9). Model 2 builds on this model by adding a main effect of Spanish expressive vocabulary. Model 3 adds a main effect of Spanish receptive vocabulary. Model 4 adds a main effect of Spanish oral language comprehension. Model 5 adds the interaction between Spanish expressive vocabulary and Age. Model 6 adds the interaction between Spanish receptive vocabulary and Age. Model 7 adds the interaction between Spanish oral language comprehension and Age. The first model with only English predictors is the best fitting and most parsimonious model; Eng = English; Spa = Spanish; -2LL = -2 log likelihood; AIC = Akaike information criteria



*Figure 1.* Estimated trajectories of English reading comprehension growth from 6 to 8 years for children with high and low levels of English skill at age 5 ( $N = 72$ ).

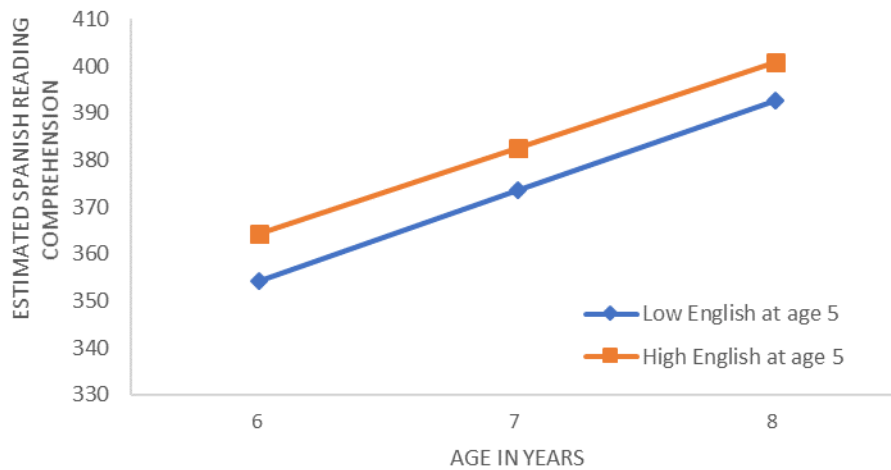
*Note.* The orange line represents the estimated growth trajectories of children with high English oral language comprehension at 5 years (75<sup>th</sup> percentile). The blue line represents the estimated growth trajectories of children with low English oral language comprehension at 5 years (25<sup>th</sup> percentile). The estimated scores were based on the following formula:  $\text{English\_Reading\_Comprehension}_{it} = 254 + 67.2 (\text{Age}) + 3.5 (\text{English oral language comprehension}) + -.8(\text{Age} \times \text{English oral language comprehension})$ .



*Figure 2.* Estimated trajectories of Spanish reading comprehension growth from 6 to 8 years for children with high and low levels of Spanish skill at age 5 ( $N = 72$ ).

*Note.* The orange line represents the estimated growth trajectories of children with high Spanish expressive vocabulary at 5 years (75<sup>th</sup> percentile), and high Spanish oral language comprehension at 5 years (75<sup>th</sup> percentile). The blue line represents the estimated growth trajectories of children with low Spanish expressive vocabulary at 5 years (25<sup>th</sup> percentile), and low Spanish oral language comprehension at 5 years (25<sup>th</sup> percentile). The estimated scores were based on the following formula:  

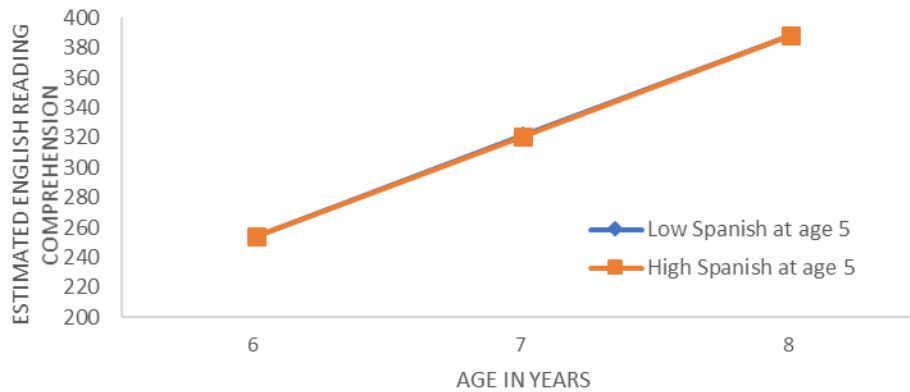
$$\text{Spanish\_Reading\_Comprehension}_{it} = 303.7 + 20.9 (\text{Age}) + .6 (\text{Spanish expressive vocabulary}) + 1.6 (\text{Spanish oral language comprehension}).$$



*Figure 3.* Cross-linguistic transfer of English oral language skill at age 5 on the trajectories of Spanish passage comprehension growth from 6 to 8 years for children with high and low levels of English skill at age 5 ( $N = 72$ ).

*Note.* The orange line represents the estimated growth trajectories of children with high English oral language comprehension at 5 years (75<sup>th</sup> percentile). The blue line represents the estimated growth trajectories of children with low English oral language comprehension at 5 years (25<sup>th</sup> percentile). The estimated scores were based on the following formula:  $\text{Spanish\_Reading\_Comprehension}_{it} = 216 + 33(\text{Age}) + 2.5(\text{English oral language comprehension}) + -.25(\text{Age} \times \text{English expressive vocabulary})$ .





*Figure 4.* Cross-linguistic transfer of Spanish oral language skill at age 5 on the trajectories of English reading comprehension growth from 6 to 8 years for children with high and low levels of Spanish skill at age 5 ( $N = 72$ ).

*Note.* The orange line represents the estimated growth trajectories of children with high Spanish expressive vocabulary at 5 years (75<sup>th</sup> percentile). The blue line represents the estimated growth trajectories of children with low Spanish expressive vocabulary at 5 years (25<sup>th</sup> percentile). The estimated scores were based on the following formula:  $\text{English\_Reading\_Comprehension}_{it} = 254 + 67.3 (\text{Age}) + -0.01 (\text{Spanish expressive vocabulary})$ .

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