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RESEARCH ARTICLE

Linguistic interdependence between Spanish language and English language and reading: A longitudinal exploration from second through fifth grade

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ABSTRACT

This study explored effects of Spanish oral language skills (vocabulary and syntax) on the development of English oral language skills (vocabulary, morphology, semantics, syntax) and reading comprehension among 156 bilingual Latino children in second through fifth grade whose first language was Spanish and whose second language was English. Using a cohort-sequential design (Cohort 1: second–third grade; Cohort 2: third–fourth grade; Cohort 3: fourth–fifth grade), we estimated Grade 2–5 trajectories of English oral language skills and reading comprehension. We assessed whether early levels of Spanish vocabulary and syntax predicted: (a) students' fifth-grade English oral language skills and reading comprehension; and (b) students' Grade 2–5 growth in these skills. Results showed that Spanish syntax predicted all Grade 5 English oral language skills and reading comprehension. Spanish syntax was also positively related to growth in English semantic knowledge. Spanish vocabulary was not associated with any English oral language skills or reading outcomes. Theoretically, results suggest that explorations of "transfer" from Spanish to English are likely moderated by the constructs under study and the means by which they are operationalized. Instructionally, working with bilingual learners around issues related to Spanish and English syntax has implications for bilingually and metalinguistically oriented teaching approaches that may build linguistic knowledge and promote reading comprehension.

The educational and linguistic development of bilingual Latino children is of pressing concern in the United States. With immigration trends suggesting continued population growth (Fry & Gonzales, 2008; Passel & Cohn, 2008), research on bilingual Latino children's language and reading development reveals an important paradox. On the one hand, speaking a first language (L1) other than English (in this case, Spanish) presents clear challenges to developing English language skills and reading comprehension that are too often held to monolingual standards and expectations (Valdés, Captelli, & Álvarez, 2011). On the other hand, researchers in applied linguistics, educational

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psychology, and developmental psychology have long sought to understand whether and how proficiency in the L1 is of benefit to second language (L2) performance and growth.

While bilingualism is often characterized as both risk and asset, we, for the theoretical and empirical purposes of this study, view bilingualism as an inherently holistic phenomenon. For the bilingual learner, development of one language can be beneficial to development of the other (Grosjean, 2010; Snow, 1992), and the use of both in instructional settings is showing increasing potential for altering the linguistic landscapes of multilingual classrooms (e.g., García, Johnson, & Seltzer, 2016; Hopewell, 2016). However, most schooling for bilingual Latino students in the United States takes place in English only, which is an inherently subtractive phenomenon in which Spanish language and literacy development (and thus bilingualism) are not fostered. One result of this is broad range and variability in English proficiencies, and when English is the only language of schooling, that variability becomes a dramatic source of individual differences that often distinguishes bilingual Latino learners from many of their monolingual counterparts on language and literacy outcomes in English.

Yet even given the relative omnipresence of English monolingual schooling environments, a holistic bilingual hypothesis would posit that higher levels of Spanish language proficiency would be associated with stronger English outcomes, both in cross-sectional and developmental contexts. This is the heart of the enduring *linguistic interdependence* hypothesis (Cummins, 1979, 1991), but the reality of cross-linguistic associations, like bilingualism itself, is far more complex than Cummins's theoretical work initially suggested. Thus, the expanding research base of linguistic interdependence is in continual need of refinement, particularly with respect to the theoretical orientations that guide hypothesis testing and in considering the practical applications of the hypothesis to authentic and multilingual learning contexts.

Given the practical demand of understanding holistic bilingual development, alongside the theoretical need for continuous refinement of linguistic interdependence, we worked with 156 Spanish-English bilingual Latino children from second through fifth grade and examined whether initial levels of Spanish language skills (vocabulary and syntax knowledge) were associated with: (a) fifth-grade English language and reading outcomes, and (b) second–fifth-grade English language and reading development.

Theoretical framework

Linguistic interdependence

Linguistic interdependence (Cummins, 1979) is an established framework of second language acquisition. The central hypothesis of linguistic interdependence is that the L1 structures a child develops prior to L2 exposure at school will predict future L2 school-based outcomes. Specifically, in his seminal paper Cummins (1979) argues that if a child is able to use the L1 to represent conceptual understandings and is able to consciously manipulate language to represent thoughts and ideas, then these L1 skills ought to predict L2 language and literacy outcomes. This initial framing of linguistic interdependence has led educators and researchers alike to ponder what aspects of language and literacy are likely to be shared across the L1 and the L2 and whether those relationships vary by the languages in question. These questions have evolved our thinking around practice with bilingual learners beyond using the L1 to support the L2. Indeed, more recent theorists consider linguistic interdependence as a symbiotic relationship where language use varies by context and focus and thus may serve to promote linguistic awareness and literacy development from a multilingual perspective (MacSwan, 2017).

Three sets of cross-linguistic hypotheses have been put forth that help put a finer point on linguistic interdependence. Geva and Siegel (2000) proposed the *script-dependent* hypothesis, in which they argued that certain skills, notably early reading skills, are likely to be closely related across languages when the languages in question share a common orthography, such as Spanish and

English. Strong evidence in support of this hypothesis was provided by Bialystok, Luk, and Kwan (2005), who showed that word-reading skills were strongly related across languages for Spanish-English bilinguals (common orthography), moderately related for Hebrew-English bilinguals (alphabetic languages), but unrelated for Chinese-English bilinguals (no orthographic or alphabetic overlap).

Proctor, August, Snow, and Barr (2010) built on Geva and Siegel (2000) by additionally considering cross-linguistic associations between oral language skills and reading comprehension. They proposed an *interdependence continuum* in which the strength of cross-linguistic associations is dependent on both the languages and the linguistic skills in question. In this view, oral language skills are hypothesized to be less script dependent and more language specific than early reading skills. For example, while a Spanish reader might be perfectly able to decode the English word *trip*, in part due to alphabetic knowledge in Spanish, access to its meaning (i.e., vocabulary knowledge) cannot be established through any sort of cross-linguistic overlap with the Spanish word *viaje*. However, when oral language skills do share commonalities, then cross-language effects might be leveraged. As such, that same Spanish reader might be able to decode a low-frequency English word such as *rapid* and also have access to the word's meaning given the fact that it shares a cognate relationship with the relatively high-frequency Spanish word *rápido* (which it does not with *trip*; Carlo et al., 2004; Chen, Ramirez, Luo, Geva, & Ku, 2012; Hancin-Bhatt & Nagy, 1994; Nagy, Garcia, Durgunoğlu, & Hancin-Bhatt, 1993). Generally, however, the continuum model posits that lower-level text skills are more robust to cross-linguistic overlap, while oral language skills are subject to greater cross-linguistic variability and less dependent on orthography.

Building further on the continuum model, Prevoo, Malda, Mesman, and Van Ijzendoorn (2015) recently conducted a comprehensive meta-analysis of cross-linguistic effects across multiple language pairs. Their results suggested that cross-linguistic relations were moderated not just by the skill in question but also by the ways in which different oral language skills and reading outcomes were measured. Based on their results, the authors proposed a *task-dependent bidirectional transfer hypothesis* in which the strength of cross-linguistic associations "depends on the type of oral proficiency task and the type of outcome" (pp. 26–27).

To study the development of English oral language skills and reading comprehension in a theoretically driven fashion, we chose two Spanish oral language skills that map to Cummins's (1979) original notions of L1 proficiency. First, we chose to model Spanish vocabulary knowledge as a reflection of conceptual understandings. If a student is able to accurately name an image, then one presumes there exists a conceptual foundation for the word (Woodcock, Muñoz-Sandoval, Ruef, & Alvarado, 2005). Second, we chose Spanish syntactic knowledge to reflect students' abilities to consciously manipulate language to represent thoughts and ideas specifically because syntax knowledge is commonly operationalized as an understanding of how sentences are structured (e.g., Mokhtari & Thompson, 2006; Nagy, 2007). We also chose to focus on these constructs because vocabulary and syntax are instructionally malleable skills that can be addressed by curricula in schools. In the following, we review studies that have examined how Spanish vocabulary and syntax have predicted English oral language skills and reading comprehension among Latino bilingual learners.

Associations between Spanish and English oral language skills

A good deal of recent research has shown that the different English language skills modeled in the present study are predictive of English reading outcomes among Spanish-English bilingual children. These include: vocabulary knowledge (Kieffer, 2012; Proctor, Carlo, August, & Snow, 2005), semantics (Proctor et al., 2012; Silverman et al., 2015), morphology (Goodwin, 2011; Kieffer & Lesaux, 2008; Ramirez, Chen, Geva, & Luo, 2011), and syntax (Proctor et al., 2012; Silverman et al., 2015; Swanson, Rosston, Gerber, & Solari, 2008). Interestingly, outside of a series of studies conducted in the latter decades of the 20th century (see Castilla, Restrepo, & Perez-Leroux, 2009 for a review) and a plethora of studies targeting cross-linguistic relationships of phonological awareness (see Genesee

& Geva, 2006), relatively few recent cross-linguistic studies have focused on the role of L1 oral language skills predicting L2 oral language skills. This has left the research base relatively sparse (Kaushanskaya, Yoo, & Marian, 2011).

Spanish vocabulary

Aligned with the interdependence continuum, most research on Spanish and English vocabulary knowledge shows nonsignificant cross-linguistic associations between Spanish and English, particularly among bilingual children in the upper elementary grades (e.g., Carlisle, Beeman, Davis, & Spharim, 1999; Gottardo & Mueller, 2009; Lesaux, Crosson, Kieffer, & Pierce, 2010; Ordoñez, Carlo, Snow, & McLaughlin, 2002; Proctor, Silverman, Harring, & Montecillo, 2012; Swanson et al., 2008; Swanson, Sáez, Gerber, & Leafstedt, 2004). This is logical when one considers that vocabulary measures typically capture single-word representations of pictured images (receptive or productive) that target a comparable set of lexical constellations (or lexical breadth, e.g., Woodcock et al., 2005). Thus, absent native language instruction, i.e., in most U.S. educational contexts, many bilingual children's vocabularies are presumed to be *situationally autonomous* (De Groot, 2011) and are typically uncorrelated or negatively correlated with one another.

Among younger bilingual learners, between kindergarten and second grade, some cross-linguistic vocabulary relationships have been documented. Kieffer (2012) and Nakamoto, Lindsey, and Manis (2008) found cross-sectional associations among Spanish and English vocabulary knowledge, while developmental research (Jackson, Schatschneider, & Leacox, 2014; Pendergast, Bingham, and Patton-Terry, 2015) has also found that early levels of Spanish vocabulary knowledge predict development of English vocabulary knowledge. In the present study, we followed Spanish-English bilingual students from Grade 2 to Grade 5 and thus have the opportunity to add to the longitudinal research base on Spanish-English associations with Spanish vocabulary.

Spanish syntax

Syntax is an intriguing oral language construct that, along an interdependence continuum, would be hypothesized to be more robust to cross-linguistic associations. Since the majority of core syntactic knowledge is acquired relatively early in the L1 (Castilla et al., 2009), syntax measures on which performance in either language relies on comparable sentence structures (e.g., subject-verb-object) are hypothesized to be related to one another.

However, the scant cross-linguistic work that examines the role of Spanish syntax predicting English syntax and other oral language skills is limited and mixed. Some correlational studies (e.g., Gottardo, 2002; Swanson et al., 2008) report low, nonsignificant correlations between Spanish and English syntax. Other work, however, ranging from preschool (Castilla et al., 2009), to kindergarten and first grade (Uccelli & Páez, 2007), to the upper elementary grades (Proctor et al., 2012), has documented positive cross-linguistic associations. Castilla et al. (2009) also documented that Spanish grammatical skills were associated with both English morphosyntax and semantics.

Applied linguistics work with bilingual adults has also yielded cross-linguistic evidence. Dussias (2003) and Dussias and Sagarra (2007) found that Spanish-English bilinguals, immersed in an English language environment, tended to parse Spanish language sentences as they would have done in English, their second language. Hartsuiker, Pickering, and Veltkamp (2004) had subjects participate in a dialogue game in which illustrated cards were described between two interlocutors. When subjects heard a descriptive sentence in Spanish, they were more likely to use the same syntactic construction when next describing an English card, despite the fact that such use was less than native-like. Other applied linguistic work has also noted cross-linguistic interactions between syntax and morphology (Deuchar & Quay, 1998).

Associations between Spanish oral language skills and English reading comprehension

Many reading researchers have directly asked whether Spanish oral language skills are associated with English reading development. In their meta-analysis, Prevoo, Malda, Mesman, et al. (2015) identified 14 cross-sectional and developmental studies that specifically addressed this question among Spanish-English bilinguals. Effect sizes for associations between L1 Spanish oral language skills and L2 English reading comprehension ranged dramatically, from a low of −0.17 (Swanson et al., 2008) to a high of 0.35 (Manis, Lindsey, & Bailey, 2004), with an average effect size of 0.08. However, the Prevoo, Malda, Mesman, et al. (2015) work did not disentangle the construct of language proficiency in calculating these associations. Like the previous section, we review cross-linguistic studies of Spanish vocabulary and Spanish syntax but here focus on associations with English reading comprehension outcomes.

Spanish vocabulary and English reading

Studies that examine the role of Spanish vocabulary knowledge on English reading outcomes are mixed, but they generally suggest limited associations, as would be predicted with the continuum model. Lesaux et al. (2010) and Mancilla-Martínez and Lesaux (2010, 2017) both found no developmental effects of Spanish vocabulary breadth on English reading outcomes,[1] while both Proctor, August, Carlo, and Snow (2006) and Nakamoto et al. (2008) found an interaction between English decoding and Spanish vocabulary knowledge in predicting English reading comprehension, such that strong English decoders exhibited better English reading outcomes from "having higher Spanish oral language abilities, whereas less skilled [English] decoders did not" (Nakamoto et al., 2008, p. 364). Kieffer (2012) found that kindergarten Spanish oral language skills were significantly associated with third-grade English reading comprehension, but only if English oral language skills were not part of the model; thus Spanish language predicted English reading, but not uniquely.

Spanish syntax and English reading

A similarly small set of cross-linguistic reading studies has focused on whether Spanish syntax predicts English reading comprehension, with some findings suggesting potential cross-linguistic associations. Swanson et al. (2008) found that only English syntax predicted English reading, and Proctor et al. (2012) found positive but nonsignificant effects of Spanish syntax on English reading comprehension during a single school year. Analyzing oral narratives among bilingual children in kindergarten to third grade, Miller, Heilmann, Nockerts, Iglesias, Fabiano, and Francis (2006) found that English oral language measures predicted Spanish reading scores, and Spanish oral language measures predicted English reading scores. Notably, however, Miller et al. (2006) did not disentangle the unique contributions of different L1 oral language skills in predicting L2 reading outcomes.

The present study

In the present study we explore the role of Spanish vocabulary and syntax as they predict English oral language skills and reading comprehension from Grades 2–5. We asked the following research questions:

RQ1: *Do Spanish vocabulary and/or Spanish syntax predict end points and growth in second- through fifth-grade English oral language skills?*

RQ2: *Do Spanish vocabulary and/or Spanish syntax predict end points and growth in second- through fifth-grade English reading comprehension?*

Based on the continuum model, and extant research summarized previously, we hypothesized that Spanish vocabulary breadth, given the nature of the skill, would have fewer overall effects on English language and reading comprehension outcomes, and significant associations were likely to be negative. We further hypothesized that Spanish syntax would be more likely to show stronger positive associations with English syntax and, by extension, with English reading comprehension. Beyond these initial hypotheses, however, it was our intent to explore emergent relationships in an effort to contribute to theory and practice in the domain of linguistic interdependence among bilingual Latino children in elementary school.

Methods

Setting

Students were enrolled in six public schools. Three schools were in the Northeast region of the United States, and three schools were in the mid-Atlantic region of the United States. The Northeast schools were part of a single district that operated under a legal framework that required rapid mainstreaming of bilingual students who were categorized as English language learners (ELLs). Thus, the vast majority of bilingual students in the Northeast schools received instruction in mainstream settings and with few additional language services. Recently arrived immigrants received instruction in Sheltered English Immersion (SEI) classrooms in which students were exposed to the same curriculum as in mainstream settings but with instruction delivered by a certified English as a Second Language Teacher. Across all classrooms, a published reading program guided all English language arts (ELA) instruction, which teachers supplemented using a readers' and writers' workshop model and additional resources.

The Mid-Atlantic schools were also part of a single district, which similarly included all ELL students in mainstream settings and provided additional support for these students through English for Speakers of Other Languages (ESOL) services. Students received a certain amount of additional support from an ESOL teacher depending on their levels of English language proficiency. ESOL support typically included supplemental reinforcement of material from the mainstream context. As in the Northeastern site, a published reading program guided ELA instruction with teachers supplementing using a readers' and writers' workshop model and additional resources. Thus, across sites, ELL and non-ELL bilingual students were instructed in English-only, using mainstream language arts curricula, and classroom observations confirmed these language instructional models.

Participants

At the outset of the study, we worked with each of the six participating schools to identify children in second, third, and fourth grade whose home language survey identified Spanish as the primary home language. Parents were contacted and signed a consent form for their child to participate in the work. Included with the parent consent form for the study was a brief home language questionnaire that asked respondents to identify the child's first language. The total pool of permissioned Spanish-English bilingual students was 172, and among that group, 16 parents identified their child as having learned English as the L1. For the remaining 156, Spanish was reported as the L1. Given the focus of the current research on linguistic interdependence as a theoretical backdrop for second language acquisition, those 16 L1 English students were removed from the data set, resulting in a sample of 156 participating students who were learning English as their second language.

A more detailed home language questionnaire was sent out to parents once data were being collected and resulted in an 87% return rate (n = 135). Parent information from the survey revealed that the majority of students (81%) were born in the United States to mothers who spoke Spanish as their first language. Students who were born outside of the United States came from the Dominican

Republic, Mexico, El Salvador, Guatemala, and Honduras. Spanish was the dominant home language. When asked how often English and Spanish were spoken in the home (*never, rarely, sometimes, a lot*, or *always*) respondents reported that English was rarely or never spoken 33% of the time. English was sometimes spoken 48% of the time. English was spoken a lot or always only 19% of the time. Ratings of maternal language use with children (*only Spanish, mostly Spanish, equal use, mostly English, only English*) indicated that 80% of mothers' language with their children was only or mostly in Spanish. Thirteen percent reported that English and Spanish were used equally, while only 7% reported that English was used mostly or exclusively. However, parent reports of children's language use indicated that only 54% of children used mostly or exclusively Spanish, with 30% of children's language use being bilingual and 16% mostly or exclusively in English.

Fully 88% of the students received free and reduced-fee meals (FARMS). See Table 1 for additional demographic information about the student participants. We controlled for FARMS in answering all research questions, particularly because recent cross-linguistic research demonstrates the important role of socioeconomic status in understanding L1–L2 relations (Prevoo, Malda, Emmen, Yeniad, & Mesman, 2015).

English measures

Reading comprehension

We used three measures of reading comprehension to inform a latent construct of English reading comprehension in our analyses. These measures included the Woodcock-Muñoz Language Survey Passage Comprehension subtest (WMLS; Woodcock et al., 2005), the Gates-MacGinitie Reading Test, Fourth Edition (Gates; MacGinitie, MacGinitie, Maria, & Dreyer, 2002), and the Test of Sentence Reading Efficiency and Comprehension (TOSREC; Wagner, Torgesen, Rashotte, & Pearson, 2010). The WMLS subtest requires students to read increasingly difficult cloze passages and to provide a missing word for each passage. Student responses are scored as correct (1) or incorrect (0), and raw scores are calculated. The internal reliability of the PC assessment for children between 7 and 12 years old is 0.80 to 0.94 (Woodcock et al., 2005). The Gates is a group-administered measure in which students are given 35 minutes to read a series of grade-matched passages and answer inferential and literal multiple-choice comprehension questions. Test–retest reliability coefficients of the Gates are 0.89 to 0.93 for second through fifth grade (MacGinitie et al., 2002). The TOSREC is also a group-administered assessment in which students are given three minutes to read a series of single sentences (e.g., A doughnut is made of very hard steel) and determine whether a given sentence is true or false. The TOSREC manual reports high alternate-form reliability for Grades 2 through 5 (r = 0.93–0.89).

Sample reliability for the latent construct of reading comprehension across the eight established time points (Fall and Spring of second, third, fourth, and fifth grades) were established by calculating Coefficient H (Hancock, 2001), which represents the proportion of variability in latent reading comprehension explained by its three indicators. This was computed for each time point, with strong

Table 1. *N* (percentage of sample) of students by demographic variables. Percentages in parentheses reflect percentages for the specific sample in the column.

Cohort	Mid-Atlantic	Northeast	Total
1	42 (37)	19 (45)	61 (39)
2	43 (38)	12 (29)	55 (35)
3	29 (25)	11 (26)	40 (26)
Sample Totals	114 (73)	42 (27)	156 (100)
Free and Reduced Price Meals (FARMS)	100 (88)	38 (90)	138 (88)
Male	52 (46)	15 (10)	67 (43)
Female	62 (54)	26 (17)	88 (57)

Table 2. Cohort-sequential design for two-year data collection routine.

	Fall Grade 2	Spring Grade 2	Fall Grade 3	Spring Grade 3	Fall Grade 4	Spring Grade 4	Fall Grade 5	Spring Grade 5
Cohort 1 (n = 61)	Year 1			Year 2				
Cohort 2 (n = 55)				Year 1		Year 2		
Cohort 3 (n = 40)						Year 1		Year 2

Note. N = 145. Read horizontally to interpret each cohort. Read diagonally to interpret overlap in data collection by cohort.

estimates across all measurement occasions (Fall second grade H = 0.844, n = 50; Spring second grade: H = 0.882, n = 48; Fall third grade H = 0.807, n = 109; Spring third grade: H = 0.834, n = 108; Fall fourth grade H = 0.828, n = 90; Spring fourth grade H = 0.841, n = 91; Fall fifth grade H = 0.833, n = 36; Spring fifth grade H = 0.799, n = 37). Note that the sample size changes reflect that only certain cohorts add information at particular time points. For example, at Time 1 (Fall second grade) only Cohort 1 is used (see Table 2).

Vocabulary breadth

The WMLS Picture Vocabulary subtest (Woodcock et al., 2005) is an expressive task in which students provide the names of pictured objects. The images are ordered by difficulty such that, after a student incorrectly identifies six items consecutively, testing is discontinued. The internal reliability for children between 7 and 12 years old on the picture vocabulary test is .88 through .92 (Woodcock et al., 2005). Sample reliability for the final time point of measurement for all students was calculated at 0.853. *W*-scores were used for all analyses.

Semantics

The Clinical Evaluation of Language Fundamentals, Fourth Edition (CELF; Semel, Wiig, & Secord, 2003) Word Classes 2 subtest was used to measure students' awareness of conceptual relations between words. In this task, examiners read aloud a set of four words, two of which are semantically related (e.g., *fence, window, glass, rug*). Students are asked to repeat aloud the two semantically related words from each set of four. Testing is discontinued after a student makes five consecutive errors. The CELF has only one form; therefore, the same form was given in the fall and spring each year of the study. Stability coefficients as indicated in the CELF manual range from .72 to .84 for children ages 7 through 12 years old. The manual also reports internal consistency for these same ages as .72 to .82. Sample reliability for the final time point of measurement for all students was calculated at 0.73. Raw scores were used in analyses.

Morphology

The Extract the Base test (August, Kenyon, Malabonga, Louguit, Caglarcan, & Carlo, 2001) was used to evaluate awareness of derivational morphology. The test requires a student to segment the base of a derived word (e.g., *elect* from *election*) to logically complete a given sentence (e.g., *Election: How many women did they ____?*). The examiner reads the target word and corresponding sentence aloud, while students follow along and independently write their responses in the blank space. Scoring proceeds on a 0–2 coding scheme, where 0 indicates an incorrect response, 1 indicates a misspelled but phonologically plausible response (e.g., *empti* instead of *empty*), and 2 indicates a correct and correctly spelled response. As with the semantics measure, Extract the Base has only one form; hence the same form was given in the fall and spring each year of the study. Rasch-based reliability for Extract the Base is reported at .98 (August et al., 2001). Sample reliability for the final time point of measurement for all students was calculated at 0.939. Raw scores were used in all analyses.

Syntax

Consistent with Geva and Farnia (2012), Proctor et al. (2012), and Silverman et al. (2015), the CELF Formulated Sentences subtest (Semel et al., 2003) was used to measure syntax knowledge. Students

are prompted to orally provide a sentence to describe a given picture while using a given target word. Each response is scored on a scale of 0 to 2. A score of 1 is given for complete sentences with only one or two errors. A score of 2 is given for correct and complete sentences. Stability coefficients as reported for this measure are 0.74 to 0.62 for children ages 7.0 through 12.11 and internal consistency is 0.82 to 0.76 for these same ages (Semel et al., 2003). Sample reliability for the final time point of measurement for all student was calculated at 0.884. Raw scores were used in all analyses.

Spanish measures

Vocabulary breadth

The WMLS *Vocabulario sobre dibujos* subtest (Woodcock et al., 2005) was a parallel measure to the English Picture Vocabulary subtest described previously. Because growth in Spanish was not being modeled, standard scores (mean = 100, *SD* = 15) were used for all analyses.

Syntax

The CELF *Formulación de Oraciones* subtest (Semel et al., 2003) was a parallel measure to the English Formulated Sentences subtest described previously. As with the English version, examiners administered all 28 items of the assessment, and scoring procedures were the same. Raw scores were used in all analyses.

Procedure and analytic plan

We worked with three cohorts of children for two years, collecting data in the Fall and Spring of each year. Cohort 1 (n = 61) was followed from the Fall of second through Spring of third grade. Cohort 2 (n = 55) was followed from the Fall of thirrd grade through the Spring of fourth grade. Finally, Cohort 3 (n = 40) was followed from the Fall of fourth grade through the spring of fifth grade. See Table 2 for a visual overview of how data were collected. This approach allowed us to combine cohorts and model development of English oral language skills and reading comprehension from Grades 2–5 (Duncan, Duncan, & Stryker, 2006).

We first established Grades 2–5 developmental trajectories for the observed English oral language variables (vocabulary, morphology, semantics, and syntax) and for a latent English reading comprehension construct comprised by the three reading measures (WMLS, Gates, and TOSREC). Once we established the fit of the latent reading comprehension construct, we fit developmental trajectories to all four observed English oral language variables and to the latent reading comprehension construct. Having established growth slopes and fifth-grade end points for all outcome variables, we used the two indicators of Spanish vocabulary breadth and Spanish syntax, taken at the outset of data collection, as predictors of fifth-grade performance and second- through fifth-grade growth in English language skills and reading comprehension. Structural equation modeling (Blozis, 2004; Hancock, Kuo, & Lawrence, 2001; Sayer & Cumsille, 2001) was used to establish developmental links between the cohorts and to then estimate effects of Spanish vocabulary and syntax on those trajectories.

Results

Initial analyses

Table 3 displays descriptive statistics for the English oral language skills and reading comprehension variables (disaggregated by time point). Table 4 shows the standard scores (mean = 100, *SD* = 15) for Spanish expressive vocabulary and raw scores for Spanish syntax, disaggregated by cohort. Note that no cohort differences were detected for Spanish predictors.

Table 3. Means and standard deviations for reading comprehension and English language proficiency measures disaggregated by time point.

	Fall Grade 2	Spring Grade 2	Fall Grade 3	Spring Grade 3	Fall Grade 4	Spring Grade 4	Fall Grade 5	Spring Grade 5
Reading								
WMLS	467.78 (17.13)	475.38 (14.65)	477.61 (15.68)	484.71 (13.57)	483.29 (26.32)	489.99 (15.86)	487.85 (27.47)	490.94 (15.81)
Gates	390.94 (30.17)	410.54 (40.05)	445.21 (33.84)	452.30 (32.05)	462.24 (27.65)	470.64 (32.41)	471.81 (28.77)	480.97 (26.05)
TOSREC	13.57 (8.06)	20.79 (8.9)	17.61 (8.57)	19.79 (7.9)	18.37 (9203)	26.23 (11.47)	17.53 (10.91)	20.5 (10.5)
Language								
Expressive Vocabulary	474.25 (13.94)	477.51 (13.04)	484.56 (13.88)	486.4 (14.44)	489.33 (17.33)	492.2 (17.6)	490.68 (18.38)	492.67 (17.42)
Semantics	4.7 (1.81)	6.41 (2.43)	6.95 (2.33)	8.41 (2.39)	8.4 (2.96)	9.27 (3.25)	9.85 (3.47)	10.56 (3.61)
Morphology	21.18 (11.95)	30.08 (7.5)	29.5 (8.32)	34.79 (8.32)	43.67 (10.65)	44.81 (10.37)	37.38 (10.31)	39.72 (8.97)
Syntax	26.32 (8.96)	29.05 (10.35)	30.56 (10.05)	33.33 (9.19)	33.69 (9.68)	36.66 (9.47)	35.74 (10.44)	36.78 (9.85)

Note. WMLS-Passage Comprehension and Expressive Vocabulary results are presented as W-scores, Gates-MacGinitie results are presented as extended scale scores. All other results are presented as raw scores.

Table 4. Means (*SD*) for Spanish language variables by cohort.

	Expressive Vocabulary		Syntax	
	Mean (*SD*)	Min–max	Mean (*SD*)	Min–max
Cohort 1	80.52 (22.14)	28–140	21.07 (9.11)	0–36
Cohort 2	69.71 (24.37)	1–123	18.98 (9.15)	0–38
Cohort 3	68.10 (33.85)	1–127	25.31 (8.74)	2–43
Totals	73.33 (26.94)	1–140	21.51 (9.31)	0–43

Table 5. Model comparisons for varying levels of factorial longitudinal invariance (RC).

Model	−2lnL	*df*	RMSEA [90% CI]	BIC	CFI	χ^2
1	13441.4	132	[0.08, 0.12]	14151.7	0.94	225.8 (< 0.001)
2	13502.7	146	[0.10, 0.14]	14141.0	0.91	287.2 (< 0.001)
3	13697.8	160	[0.14, 0.18]	14263.9	0.82	482.2 (< 0.001)

Note. Model 1 denotes configural invariance. Model 2 represents weak invariance with equal factor loadings, unequal observed variable intercepts, and unequal unique variances. Model 3 denotes strong invariance with equal factor loadings, equal observed variable intercepts, and unequal unique variances. The baseline model on which CFI is based is a model for which the covariances between temporally adjacent observed variables are nonzero.

As a preliminary step, we first sought to determine if our three English reading comprehension indicators (WMLS, Gates, and TOSREC) would comprise a single latent factor of reading comprehension whose development could be modeled from Grades 2–5. To this end, we conducted a series of confirmatory factor analyses of the reading comprehension construct at each time point. Table 5 presents the results of these confirmatory factor analyses, in which we used both the comparative fit index (CFI) and the Bayesian Information Criterion (BIC) as primary indicators of best model fit (Bentler, 1990). With CFI, values above .90 are considered strong, while with the BIC, lower values are desired. Table 5 shows Model 2 as the best fitting model for latent reading comprehension, with a CFI of .91 and the lowest of the BIC indicators. Model 2 suggests "weak longitudinal invariance" (Widaman, Ferrer, & Conger, 2010), that is, the loadings from scores on the three observed English reading comprehension measures load appropriately to the English reading comprehension latent factor and can be equated over time. This allowed us to proceed with estimating a trajectory for a latent construct of English reading comprehension.

Primary analyses

Having established the appropriate latent construct of English reading comprehension, we next took steps to fit a series of first (observed English language variables) and second (latent English reading comprehension) order linear growth models (LGMs). Once these were established, we derived a correlation matrix between the estimated English intercepts and Spanish vocabulary and syntax. We then moved to testing whether Spanish vocabulary and syntax knowledge were associated with Grade 2–5 growth and Grade 5 performance on the first and second order LGMs for English language and reading comprehension.

Unconditional models

Growth in latent English reading comprehension and measured linguistic skills was initially examined through the fitting of a series of unconditional models to each of the outcomes. To determine model fit, we drew on the CFI (Bentler, 1990) and the root mean square error of approximation (RMSEA; Steiger, 1990). CFI acceptable model fit is indicated by a CFI value of 0.90 or greater (Hu & Bentler, 1999). Conversely, smaller RMSEA values (0.08 or less) indicate better model fit (Hu & Bentler, 1999).

All trends were linear. Latent reading comprehension showed adequate fit, X^2 (175) = 355.1, $p < 0.001$, CFI = .90, and RMSEA = .12 with 90% confidence interval (.10, .14). Observed English language variables' fit statistics were also acceptable: semantics, X^2 (19) = 33.2, $p = 0.069$, CFI = .94,

and RMSEA = .09 with 90% confidence interval (.04, .15); Expressive vocabulary, X^2 (30) = 53.2, p = 0.006, CFI = .95, and RMSEA = .11 with 90% confidence interval (.06, .17); syntax, X^2 (22) = 31.2, p = 0.091, CFI = .98, and RMSEA = .07 with 90% confidence interval (.00, .14). Morphology showed relatively poor fit, X^2 (30) = 91.3, p < 0.001, CFI = .86, and RMSEA = .21 with 90% confidence interval (.19, .23). There were significant mean levels for all intercepts and slopes (all ps < .05).

To draw valid inferences regarding growth parameters from accelerated longitudinal or cohort-sequential designs requires no cohort differences among the cohort-specific trajectories. Following the model comparison paradigm for testing the convergence in trajectories outlined by Miyazaki and Raudenbush (2000), we tested trajectory convergence by comparing the fit of a full model allowing growth factors to differ by cohort against a reduced model in which cohort-specific growth factors were constrained to be equal. A nonsignificant p value from a chi-square difference test would indicate trajectory convergence. Each outcome measure was tested and found to be for Syntax, X^2 (6) = 9.36, p = 0.155; Morphology, X^2 (6) = 11.12, p = 0.085; Semantics, X^2 (6) = 12.73, p = 0.050; Vocabulary Breadth, X^2 (6) = 8.31, p = 0.216; and latent Reading Comprehension, X^2 (6) = 10.97, p = 0.089. Visually, Figure 1 displays the cohort trajectories for the observed oral language variables

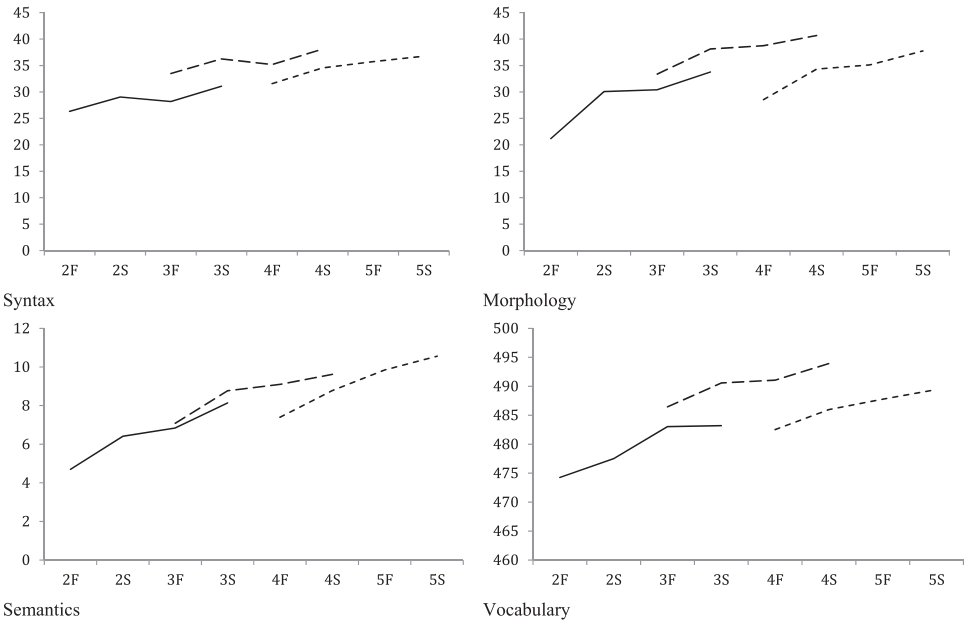

Figure 1. Cohort-sequential trajectories for observed English language outcome variables. Notation on the *x*-axis refers to grade level and season (e.g., 2F = Fall of second grade; 4S = spring of fourth grade); *y*-axis reflects the scale used in growth modeling.

Table 6. Pearson correlations among reading comprehension and four linguistic measures' intercepts and two Spanish vocabulary measures below diagonal. Correlations with effects of FARMS partialled appear above the diagonal.

	1	2	3	4	5	6	7
1. Reading Comprehension	–	.747**	.742**	.186*	.746**	.243**	.059
2. Expressive Vocabulary	.744**	–	.750**	.078	.769**	.103	−.026
3. Semantics	.727**	.726**	–	.224**	.683**	.039	.021
4. Morphology	.178*	.041	.212**	–	.159	.037	.017
5. Syntax	.759**	.771**	.679**	.118	–	.171*	.092
6. Spanish Syntax	.256**	.143	.086	.048	.196	–	.446**
7. Spanish Vocabulary	.046	−.039	.056	.039	.044	.450**	–

Note. * p <.05, **p <.01.

(syntax, morphology, vocabulary, semantics) overlaid with one another, which can be referenced in conjunction with the chi-square statistics reported previously.

Correlations

Correlations between the intercepts of observed English oral language skills, latent English reading comprehension, and Spanish vocabulary and syntax are presented in Table 6. Below the diagonal, the bivariate correlations are reported. Above the diagonal, these same correlations are reported with the effects of free and reduced meal participation partialled.

Generally, differences between the correlations above and below the diagonal were minimal. Intralinguistic associations between the English oral language skills and reading comprehension were strong. Only the association between English morphology and English reading comprehension did not rise to a level above .7 ($r = .178$ and .186, $p < .05$, below and above the diagona, respectively). Spanish syntax was significantly associated only with English reading comprehension ($r = .256$ and .243, $p < .05$, above and below respectively), while Spanish vocabulary was not significantly associated with any English variables, with nonsignificant correlations hovering near 0. Spanish vocabulary and Spanish syntax were moderately and significantly associated, both above and below the diagonal ($r = .450$ and .446., $p < .05$).

Conditional models

Controlling for the effects of free and reduced-price meals (FARMS), we next assessed the effects of Spanish vocabulary and syntax on development and end points of all English oral language skills and reading comprehension. For each outcome variable, random intercept variance and homogenous error variance was estimated. A measure of explained variance (see, e.g., Raudenbush & Bryk, 2002) can be computed to gauge how well the conditional model, with the six predictors (three for the intercept and three for the slope), fits compared to that of the unconditional model (with no predictors)

Results are presented in Table 7. There were no significant effects of Spanish vocabulary on Grade 5 English outcomes nor on growth in English outcomes from Grades 2–5. By contrast, Spanish syntax was significantly associated with Grade 5 performance across all five measured English variables, indicating that stronger performance in Spanish syntax was associated with stronger Grade 5 English reading comprehension, vocabulary, syntax, morphology, and semantics.

Spanish syntax was also significantly and positively associated with Grades 2–5 growth in English semantics but not with growth of any other English outcome. The combined effects of Spanish syntax on English semantics intercept and growth is presented in Figure 2. Here the lines represent

Table 7. Unstandardized parameter estimates (standard error) of intercept, linear, and nonlinear slope and time-invariant Spanish language and literacy predictors on intercept and slope of fitted growth trajectories for latent reading comprehension and observed oral language components.

Parameters	Reading Comp	Vocabulary Breadth	Semantics	Morphology	Syntax
Fixed effects					
Intercept	498.72 (4.58)*	495.59 (5.10)*	12.67 (1.24)*	44.33 (4.13)*	39.65 (3.45)*
FARMS	−5.41 (4.72)	−1.39 (5.40)	−1.07 (1.30)	0.31 (4.37)	−1.14 (3.59)
Spanish Vocab	0.02 (0.06)	−0.07 (.07)	−0.01 (.02)	0.03 (.04)	0.02 (.04)
Spanish Syntax	0.51 (0.18)*	0.51 (.21)*	0.13 (.05)*	0.28 (.12)*	0.45 (.14)*
Linear Slope	8.53 (1.49)*	3.28 (1.50)*	2.30 (0.50)*	6.49 (2.09)*	4.05 (1.29)*
FARMS	−2.58 (1.50)	2.33 (1.58)	−0.41 (.52)	−0.56 (2.16)	−0.75 (1.35)
Spanish Vocab	−0.01 (.02)	0.01 (.02)	−0.01 (<.01)	0.02 (.02)	0.01 (.02)
Spanish Syntax	0.06 (.06)	0.05 (.06)	0.04 (.02)*	−0.05 (.05)	0.05 (.05)
Variance Components					
Intercept	138.09 (25.28)*	246.69 (31.61)*	1.24 (.58)*	66.85 (10.95)*	47.76 (10.97)*
Residual	0.80 (2.79)	36.10 (4.70)*	3.46 (0.37)*	30.59 (5.05)*	20.12 (1.94)*
Unconditional Intercept	173.57	262.02	1.91	74.38	64.67
Conditional Intercept	138.09	246.69	1.24	66.85	47.76
Explained Variance	0.204	0.059	0.351	0.101	0.261

Note
*$p < .05$.

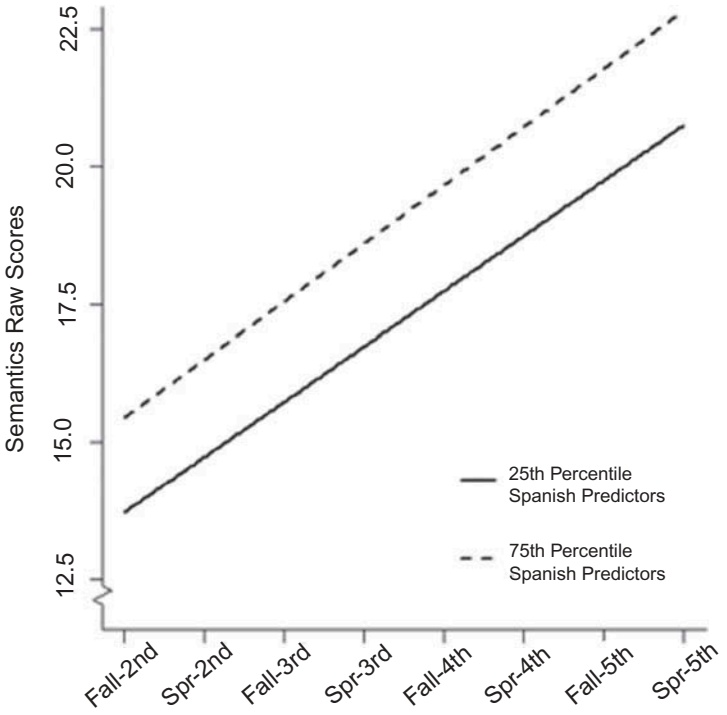

Figure 2. Combined effects of Spanish syntax on English semantics intercept and slope.

students at the 25th and 75th percentiles on Spanish syntax (15.0 and 29.0 respectively). As Figure 2 shows, students who were at the 75th percentile scored higher initially in second grade than did those students at the 25th percentile. The effect of Spanish syntax on slope resulted in slightly broader discrepancies in English semantics at Grade 5, though the effect is visually minimal.

Note that across all models in Table 7 intercept variance declines for all conditional models. Within these models, the addition of the Spanish variables to the unconditional model accounts for a high of 35.1% of explained variance in semantics and a low of 5.9% explained variance in vocabulary.

Discussion

This study was specifically designed to explore the role of Spanish language proficiency predicting Grade 5 performance and Grades 2–5 growth in English reading comprehension and English language skills that are known predictors of English reading. We operationalized Spanish language proficiency to align with Cummins's (1979) articulation of L1 concept knowledge (assessed via Spanish vocabulary knowledge) and L1 linguistic manipulation (via Spanish syntax). We further situated this investigation within recent cross-linguistic hypotheses that suggest that L1–L2 associations are mediated by the nature of the language skills being considered (the *interdependence continuum*; Proctor, August, Snow, et al., 2010) and the means by which those skills are operationalized (the *bidirectional transfer hypothesis*; Prevoo, Malda, Mesman, et al., 2015). Findings revealed that Spanish vocabulary was not predictive of any English outcomes, while Spanish syntax was associated with all Grade 5 English outcomes as well as with Grades 2–5 growth in English semantics. Given these findings, we couch our discussion in the context of the significant effects of Spanish syntax, focusing on research, theory, and practice.

Research

Results showed that Spanish syntax significantly predicted Grade 5 performance in English reading comprehension. This is a novel finding and one not previously reported in the cross-linguistic reading literature. In previous work, both Proctor et al. (2012) and Swanson et al. (2008) found nonsignificant results for Spanish syntax on English reading comprehension. However, those studies included English language controls, whereas the present study did not, due to constraints associated with the complexities of model building of LGMs using a cohort-sequential design (Silverman et al. 2015).

Spanish syntax was also positively and significantly associated with Grade 5 English vocabulary breadth, semantics, syntax, and morphology. These findings align in part with those reported by Castilla et al., (2009), who worked with preschool-age Spanish-English bilinguals. In their study, both Spanish morphosyntactic and semantic performance at the beginning of the school year significantly predicted English morphosyntax and semantics 8–9 months later. The findings from the current study add to this work. In neither this study nor in Castilla et al. (2009), however, were English controls included in predictive models. Future longitudinal research, using English controls, would allow us to test hypotheses about shared variance across Spanish and English syntax and other outcomes, something that previous longitudinal research using Spanish vocabulary breadth as a predictor has done (i.e., Kieffer, 2012).

Theory

The finding that Spanish syntax predicted English language and reading outcomes, alongside nonsignificant effects of Spanish vocabulary knowledge on those same outcomes, is consistent with both the interdependence continuum and the task-dependent bidirectional transfer hypothesis. From the continuum perspective, Spanish syntax would be hypothesized to share cross-linguistic overlap with English syntax given the fact that word ordering, particularly for simpler sentence production, is consistent across English and Spanish. Given such cross-linguistic overlap, and presumed intralinguistic associations between English syntax and other English oral language skills and reading, a second-order hypothesis would be that Spanish syntax would be associated with other English outcomes. Indeed in the current study, performance in Spanish syntax correlated with English syntax ($r = .171$, $p < .05$), which in turn was strongly associated with all other English outcomes (save for morphology).

The bidirectional transfer hypothesis adds to these findings, contextualizing them in the nature of the instrumentation used here. Specifically, the syntax measure used in the current study (the CELF Formulated Sentences subtest) requires students to take a semantically rich picture, a given word, and to then construct a syntactically accurate sentence. To perform on the measure, only a shallow syntactic structure (Clahsen & Felser, 2006) was necessary in either language, and rarely did student responses rarely move beyond a subject-verb-object structure, common in both Spanish and English (e.g., *Los niños están jugando en la calle*/*The children are playing in the street*).

A contending, but related, theoretical orientation to the proposed work is the Competition Model (Bates & MacWhinney, 1982, 1989). In this view, language operates as a functional grammar and is not viewed as a series of related but separate components. Contrary to the modeling approach undertaken in this study, language is considered as "highly interactive models of performance, that is, models in which different sources of information are integrated on equal footing, as rapidly as possible" (Bates & MacWhinney, 1989, p. 4). While this view is distinctive from the conceptual and empirical view of language articulated here, there are points of overlap, specifically with respect to how linguistic variation manifests both qualitatively (e.g., via sentence word order) and quantitatively (e.g., cross-linguistic differences in word ordering). The Competition Model suggests that, across languages, syntax is universal, yet the variations across languages affect how speakers interpret meaning. At more complex levels of syntax in Spanish, for example, the subject-verb-object rule is

violated (e.g., *Aquí, se habla español* ["Spanish is spoken here"]). This has implications for the naturalistic functioning of language in functional settings where language is used. By contrast, we argue here that the simplicity of the format of our syntax measure keeps the form and function of syntax consistent cross-linguistically and thus pushes on the likelihood of cross-linguistic overlap.

Practice

From the perspective of practitioners, the role of Spanish on English oral language skills and reading is relevant for both assessment and instruction. Information from assessment can drive instructional plans for students. As Castilla et al. (2009) note, "early language assessment in one language can predict success or lack of success in the other" (p. 569). Following the interdependence hypothesis, if Spanish proficiency predicts English performance, then practitioners can identify and support students who show difficulty in Spanish oral language skills and anticipate that such support may benefit English outcomes as well (and in turn support Spanish language maintenance). Extrapolating from results from the present study, assessing students, at least native Spanish-speaking students, in Spanish syntax may provide an indication of whether students will have difficulty not only in Spanish language skills but also in English language skills as well as English reading comprehension. Practitioners could assess students in Spanish even before they have developed proficiency in English to determine whether students may need extra support in navigating syntax, which is essential for comprehending increasingly complex texts in school. Then, practitioners could plan to work with students, as needed, to build their Spanish syntactical awareness. Results from the present study suggest that assessing students in Spanish vocabulary would not yield the same benefits for cross-linguistic instructional decision making.

Supporting students' syntactic awareness across languages aligns with findings of bidirectionality of cross-linguistic associations (Prevoo, Malda, Mesman, et al., 2015). As such, an extention of the current research might be to recommend *translanguaging* pedagogical approaches (García & Leiva, 2014; Hopewell, 2016). Translanguaging encourages students and teachers to flexibly draw on their linguistic repertoires across languages for teaching and learning. According to translanguaging theory, bilinguals' language practices are fluent and multiply determined (García & Leiva, 2014). Leveraging bilinguals' movement between languages seeks to leverage the communication of ideas for achieving academic purposes (Canagarajah, 2011). Applying a translanguaging perspective to the current results, teachers might support students in comparing and contrasting how syntax functions in Spanish and English and encouraging them to draw on their Spanish syntactical awareness as they participate in English oral language and reading comprehension tasks.

While encouraging students to apply Spanish skills to English tasks (or vice versa) may come more naturally to teachers in bilingual education settings, teachers who work with bilingual students in any setting can call students' attention to the structure of language and ask students to analyze how the structure is similar or different between their two languages. The present study suggests that asking students to make connections across languages in vocabulary may not be helpful to students (beyond cognate recognition, or providing quick access to meaning for an unknown English word), but guiding them to cross-linguistically analyze the structures of language might serve to build bilingual students' metalinguistic insights, which are hypothesized to accrue to stronger literacy outcomes (Hakuta & Díaz, 1985; Proctor & Silverman, 2011). Further empirical work is needed to determine whether such cross-linguistic instruction focused on syntax might lead to gains in English language and literacy skills.

Limitations and future directions

We note that it may be considered a singular limitation that the current study does not control for correlated English variables in predicting the outcomes. Indeed, Kieffer (2012) found that Spanish oral language proficiency in kindergarten predicted third-grade English reading, but when he included English oral language proficiency in his model, the effects of Spanish were eliminated.

Statistically, this argument makes a good deal of sense. If Spanish and English share common variance such that including them both in a model yields only a single significant predictor, then one might conclude that only English is important. But this statistical conclusion belies the linguistic realities of bilingualism. While it may be true that English predicts above and beyond Spanish, it is useful for us to know whether Spanish, *by itself*, predicts English outcomes. Latino bilingual children come to schools in the United States with broad ranges of English and Spanish linguistic knowledge, and knowing the predictive utility of both languages makes good linguistic sense, even if it might at times confound statistical sensibilities.

A second limitation to the study is that monolingual measures of Spanish and English oral language skills and reading comprehension were used, and bilingualism was modeled using a monolingual approach (see Grosjean, 2010). Such an approach is limiting, to be sure, and a growing focus on dynamic bilingualism yields a call for bilingual measures that are aligned to the unique linguistic experiences of the students with whom we, as practitioners, work on a daily basis (Proctor & Silverman, 2011).

Finally, we acknowledge that Spanish language gains and loss are possible given the sociolinguistic realities of bilingualism in the United States. For some children, growth is possible because of support at home, and loss is possible due to lack of such support. Both factors may serve to predict English outcomes for Spanish-English bilingual Latino children (see, e.g., Duursma et al., 2007), and recent work with younger Turkish-Dutch bilingual learners suggests that students who use their L1 more frequently show stronger L1–L2 associations in vocabulary breadth (Prevoo, Malda, Emmen, et al., 2015). More research should attend to these associations, particularly in the context of linguistic interdependence, for Spanish-English bilinguals in the United States. Generally, then, future research using longitudinal cross-linguistic models should consider the statistical and theoretical aspects of study design and student-level heterogeneity inherent to the linguistic experiences of bilingual children.

Note

1. Though we note that Mancilla-Martínez and Lesaux (2017) did in fact find developmental evidence of Spanish word reading predicting English reading comprehension even when English word reading was controlled.

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