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Language growth trajectories: does immigrant generation status moderate linguistic interdependence?

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ABSTRACT

This two-year longitudinal study examined the role of linguistic interdependence between Spanish and English among a group of first, second, and third generation immigrant Spanish-English bilingual children. Starting from a theoretical perspective on linguistic interdependence that takes into account linguistic constructs and their measurement, the study reports on the English developmental trajectories of 112 Latinx bilinguals in second, third, and fourth grade. Multilevel growth modeling was used to develop trajectories for English vocabulary, morphology, syntax, and semantics and assess the degree to which they were predicted by initial levels of Spanish vocabulary and Spanish syntax. Findings showed that Spanish syntax was a significant predictor for English intercepts for both syntax and morphology. These cross-linguistic effects were moderated by generation status such that the effect of Spanish syntax on English morphology and syntax was, in fact, negative for first-generation students, while positive for second and third generation students. The finding that more metalinguistically focused constructs (syntax and morphology) are robust to cross-linguistic association is consistent with current theories on linguistic interdependence. Because the groups were comparable on Spanish syntax performance, the effect of generation status has some implications for levels of English proficiency necessary in order for linguistic interdependence to manifest.

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Over 60 million people in the United States speak a language other than English in the home (Ryan 2013) and with an increasing number of bilingual and immigrant families, cultural and linguistic diversity in the United States have been on the rise. Among these families, 10.7 million households are Latinx (U.S. Census Bureau 2010); nearly a quarter of all school age children come from these primarily Spanish-speaking homes (Fry and Passal 2009). Recent data on Latinx academic performance have suggested that the Latinx population performs below national averages (National Center for Education Statistics [NCES], 2011). Thus, it is not surprising that in the United States, educational efforts at both policy and pedagogical levels have largely focused on supporting the English language development for young bilingual and immigrant children, particularly for Spanish-English speaking Latinx students (Shin 2013).

Implicit in progressive policy and pedagogy for bilingual children is a presumed understanding that proficiency developed in one language (L1) will be beneficial for later acquisition of another language (L2; Berthele and Vanhove 2017). That is, L1 skills can 'transfer' to the L2. This notion of

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linguistic interdependence is supported by the principle of a Common Underlying Proficiency (CUP; Cummins 1979, 1991) which suggests that, for bilinguals, there exists a common store of language knowledge that can be applied across the bilingual's languages provided the learner has reached sufficient thresholds of proficiency in both languages. While this is a vaguely articulated notion, one way researchers have sought to index these relationships is through correlational research designs where indicators of language and literacy are taken in both languages of a bilingual sample and correlated with one another through traditional, regression-based designs.

Findings from these lines of inquiry suffer from three challenges. First, they typically underspecify language, using broad indicators (e.g. vocabulary knowledge) to explore associations, thus yielding mixed and attenuated findings. Second, studies are typically cross sectional and as such do not speak to whether L1 proficiency indeed accelerates L2 acquisition. Finally, studies are limited with respect to the levels of proficiency necessary to activate or foster linguistic associations (i.e. thresholds), which results in unreliable data. Indeed Berthele and Vanhove (2017) contend that 'no one so far has shown empirically that there is a non-linear developmental slope whose shape would be evidence for such thresholds' (4).

In the current study, we present longitudinal linguistic data collected with Spanish-English bilingual children in the United States whose L1 was Spanish. These data were collected specifically to address the shortcomings in the linguistic interdependence research identified above. First, we assessed multiple constructs of English language proficiency (i.e. vocabulary, semantic, morphological, and syntactic knowledge) and modeled their growth over two years and four time points (T1, T2, T3, T4) in elementary school. We also collected initial status data on two Spanish language indicators – vocabulary and syntactic knowledge and used those as predictors of both intercept and growth in English language outcomes. Finally, we tested the main and moderating effects of immigrant generation status (1st, 2nd, or 3rd generation) as a unique means by which to theorize about thresholds. Our thinking was that first-generation immigrant students would be more likely to have stronger Spanish and weaker English, whereas their second and third generation counterparts would more likely be stronger in English than Spanish (e.g. Alba et al. 2002), thus establishing a categorical means by which to investigate whether cross-language associations co-vary with immigrant status as a proxy for bilingual proficiency.

We started from the perspective that we do not need to prove whether this type of linguistic interdependence exists. Given foundational sociolinguistic and sociocultural views on the matter of bilingualism (e.g. García, Johnson, and Seltzer 2017; Grosjean 2010; Hopewell and Butvilofsky 2016) we believe that it does. Thus, the questions we ask are meant to deal with learning more about the nature of linguistic interdependence, rather than questioning its existence. In so doing, we hope to add some linguistic nuance to the debate that could potentially inform future pedagogical and policy efforts relative to bilingual education practice.

Early work on linguistic interdependence

For bilingual children, linguistic structural knowledge is relevant to not one, but two languages and the relationship between these two languages may be developmental (Snow 1998). Cummins' (1979) linguistic interdependence hypothesis suggests that the knowledge of one language (L1) is positively associated with another language (L2). Research examining these linguistic relationships suggests the existence of an 'interlanguage' among emergent bilingual children in which an established first language has considerably more influence on the development of the second language, given the relative paucity of linguistic resources available in the developing (i.e. second) language. Developmentally, this has been documented among young children where first language phonological awareness has been predictive of second language word reading (e.g. Durgunoglu, Nagy, and Hancin-Bhatt 1993; Lindsey, Manis, and Bailey 2003; Manis, Lindsey, and Bailey 2004; Quirogoa et al. 2002; Riccio et al. 2001; Sun-Alperin and Wang 2011). In contrast, as the L2 develops, the learner becomes less reliant on the L1, as well-developed second language proficiency represents

a more parsimonious route by which to comprehend and produce text in the second language. This stronger within-language relationship has also been documented empirically in research on dual-language models of reading (e.g. Leider, Proctor, Silverman, and Harring, 2013; Lesaux et al. 2010; Mancilla-Martinez and Lesaux 2010; Manis, Lindsey, and Bailey 2004; Nakamoto, Lindsey, and Manis 2008; Swanson et al. 2008). Thus, there is some evidence that we might expect linguistic associations to be stronger among learners who are more proficient in the L1 than the L2 (i.e. first-generation students in the current study).

Other work with Spanish-English bilinguals in the United States, however, paints a different picture. Proctor et al. (2006) cross-sectionally examined bilingual predictors of English reading comprehension among Spanish-English bilingual fourth graders. After controlling for language of instruction, English word reading, fluency, vocabulary, and listening comprehension, they tested the effects of Spanish word reading, fluency, and vocabulary on English reading comprehension. Their final model showed a main effect for Spanish vocabulary along with an interaction between Spanish vocabulary and English fluency, suggesting the effect of Spanish vocabulary on English reading was stronger for those students with better English word reading fluency. In contrast, the work of Swanson et al. (2008) examined the relationship between oral language and phonological processes skills as predictors for reading performance in both Spanish and English. With the inclusion of both Spanish and English components, the final model did not provide evidence for a Spanish-English relationship.

Similar work informed by a linguistic interdependence framework has provided evidence that both supports (e.g. Manis, Lindsey, and Bailey 2004; Nakamoto, Lindsey, and Manis 2008) and challenges (e.g. Gottardo and Mueller 2009; Lesaux et al. 2010; Mancilla-Martinez and Lesaux 2010) Spanish-English relationships. Further, this line of inquiry has also suggested that associations between Spanish and English can be negative or positive depending on both Spanish and English proficiency (e.g. Leider et al. 2013). Indeed, the research on the relationship between Spanish and English is mixed, suggesting that while linguistic interdependence has been useful in unpacking bilingualism, particularly among Spanish-English bilinguals, a more sophisticated framework for understanding the nuances of linguistic interdependence is warranted.

Refining linguistic interdependence

Recognizing the need to better understand how linguistic interdependence might be operating, Proctor et al. (2010) proposed an *interdependence continuum* as a way to refine understandings of linguistic interdependence. They suggested that linguistic relationships would vary depending on the specific language or literacy skill being modeled.

Building on that continuum model, Prevoo et al. (2016) proposed a *task-dependent bidirectional transfer hypothesis* which specifies that the relationship between languages (e.g. linguistic interdependence) depends on the 'type of oral language proficiency task and the type of school outcome' (263). This task-dependent bidirectional transfer hypothesis suggests that both the construct (i.e. type of oral language proficiency task) and assessment (e.g. outcome) will affect linguistic interdependence. Both the interdependence continuum perspective and the task-dependent bidirectional transfer hypothesis provide a framework for designing research seeking to explore linguistic interdependence.

As an example, Proctor, Harring, and Silverman (2017) conducted a longitudinal study to examine second through fifth grade trajectories of English oral language and reading comprehension, and hypothesized that Spanish vocabulary and syntax would be differentially related to these English outcomes as a function of the construct itself (Proctor et al. 2010) and the means by which those constructs were operationalized (Prevoo et al. 2016). Consistent with the continuum hypothesis, Spanish syntax was significantly associated with all Grade 5 English outcomes while Spanish vocabulary showed non-significant associations with English. Thus, the relationship between Spanish and English varied depending on the construct of oral language proficiency (i.e. vocabulary vs. syntax).

The notion that both conceptualization (i.e. construct of oral language proficiency) and operationalization (i.e. assessment) may influence if (i.e. whether or not a relationship exists) and how (i.e. the degree of relationship) linguistic interdependence is captured begs the question of when, that is under what conditions is linguistic interdependence stronger or weaker?

Immigrant generation status

Examination of the environment of bilingual children on language proficiency and development is not novel. As Berthele and Vanhove (2017) point out, 'one common design for investigating the CUP is to compare the linguistic development of children receiving bilingual instruction or first language support to that of children not receiving such instruction or support (3).' Indeed, a number of non-experimental empirical studies have compared language proficiencies of children receiving dual-language instruction to those in English-only programs in the United States (see: August, Goldenberg, and Rueda 2010; Galloway and Lesaux 2017; Gándara and Escamilla 2017; Rossell and Baker 1996; Slavin and Cheung 2005). The school environment, however, is not the only space where children are exposed to language and additional research in the United States has also examined the role of home language use on English language development (e.g. Bridges and Hoff 2014; Mancilla-Martinez and Lesaux 2011). Conceptualizing and operationalizing home language use, and language use in general, is challenging with researchers often indexing (home) language use through the use of caregiver report surveys. Self-report surveys, however, can be subject to bias and error and, thus, we propose immigrant generation status as a proxy for bilingual proficiency. Specifically, for the Spanish-English speaking Latinx population in the United States, we suggest that immigrant generation status can serve as a categorical variable representing bilingual proficiency (i.e. both Spanish and English language use).

We follow a host of immigration researchers (e.g. Alba and Silberman 2009; Hernandez, Denton, and McCartney 2006; Portes and Rumbaut 2001) in identifying first-generation immigrants as those who have migrated to the United States from their country of birth; second-generation immigrants are those born in the United States and having at least one parent who migrated to the United States; and third generation or higher are the children and subsequent descendants of the second generation. Indeed, both empirical research (e.g. Alba et al. 2002; Portes and Hao 1998) and US census bureau data (e.g. Fry and Passal 2009; Shin and Bruno 2003) have documented intergenerational differences such that, among the Latinx population, first-generation children are more likely to speak Spanish and third generation children are more likely to be native English speakers. Given these documented trends of distinct language use, we use immigrant generation status as a categorical variable to examine patterns of linguistic interdependence.

The present study

The present study does not seek to validate the existence of linguistic interdependence, but rather to investigate how patterns of linguistic interdependence among Spanish-English bilinguals might vary. Drawing from continuum model (Proctor et al. 2010; Proctor, Harring, and Silverman 2017) and task-dependent bidirectional transfer hypothesis (Prevoo et al. 2016), we first examine how conceptualization and operationalization of oral language can impact linguistic interdependence. We do this by examining the predictive power of two different constructs of Spanish oral language, Spanish vocabulary (SVoc) and Spanish syntax (SSyn) on the initial status and growth for the following four English oral language variables: vocabulary, semantics, syntax, and morphology (EVoc, ESem, ESyn, and EMor, respectively. The use of 4 different English oral language components also allows us to examine linguistic interdependence as a function of how English oral language is operationalized. Next, we ask whether patterns of linguistic interdependence (i.e. our established growth trajectories) vary by bilingual proficiency, which we operationalize by immigrant generation status. We accomplish this by adding immigrant generation status as

a categorical variable to our growth model. Our analytic approach was guided by the following question:

> *What are the main and moderating effects of Spanish oral language (i.e. SVoc, Syn) and immigrant generation status on the initial status and growth of English language components (i.e. EVoc, ESem, ESyn, EMor)?*

We expect linguistic interdependence (i.e. statistically significant associations) between our Spanish language constructs and English oral language to vary by the construct (i.e. the linguistic component at hand) and by the means by which those constructs were operationalized (i.e. the actual assessment at hand). In line with the continuum perspective of linguistic interdependence (Proctor, Harring, and Silverman 2017) we also speculate the relationships between SSyn and English trajectories to be positive. In contrast, expect SVoc to be negative notably because research on bilingual populations tends to converge on the notion that vocabulary knowledge across languages situational for bilinguals, and as such words are more likely to be known in either English or Spanish, but not necessarily in both, depending on the context (De Groot 2011).

We also expect generation status to differentially impact the linguistic interdependence such that Gen1 will negatively moderate the relationships specified, as stronger Spanish coupled with less time in the United States (e.g. less English schooling) is likely to create an inverse relationship between English and Spanish. In contrast, we predict Gen2 and Gen3 to have little to null effects for linguistic interdependence as Gen2 and Gen3 are more likely to be English dominant; thus, potentially washing away the influence of Spanish on English.

Participants

Participants ($n = 112$) for this study were part of a larger, four-year study examining comprehension, language acquisition, and vocabulary development among English monolinguals and Spanish-English bilinguals from 2009 to 2013. Participants were recruited from the northeast and the mid-Atlantic regions of the United States. Spanish and English permission forms were distributed to all second, third, and fourth graders in the six participating schools. A brief questionnaire that included two questions about language (i.e. *What is the child's **first language**? If applicable, What is the child's **second language**?*) was provided with the permission form. The sub-sample for this study consisted of those children whose parents reported that Spanish was spoken in the home. Participants were recruited from the second, third, and fourth grade population and simultaneously followed into third, fourth, and fifth grade. For the purpose of analyses we then identified each grade level as a distinct cohort: Cohort 1 represents students in second grade at the inception of the study; Cohort 2 represents students in third grade at the inception of the study; and Cohort 3 represents students in fourth grade at the inception of the study. Table 1 displays the sample demographics disaggregated by cohort.

Home language survey

The Home Language and Literacy Questionnaire was distributed to all participating families in the study. The 44-item survey, designed by the project research team, was divided into three sections: child background, family background, and language/literacy status. This questionnaire paralleled domains that have also examined the home environment for similar purposes (e.g. Gonzalez & Uhing, 2008). The survey was first developed in English by the larger research team and was

Table 1. Sample demographics disaggregated by Cohort.

	Sample ($n = 112$)	Cohort 1 ($n = 40$)	Cohort 2 ($n = 39$)	Cohort 3 ($n = 33$)
Female	50.9%	57.5%	56.4%	42.9%
Free and reduced meals	89.3%	90.0%	89.7%	87.9%
English language learner	59.8%	77.5%	43.6%	57.6%

translated into Spanish by a sub-team of Spanish-English bilinguals that included native Spanish speakers and native English speakers. The parents were given the choice of completing the survey in either Spanish or English and given the option of completing the questionnaire orally (i.e. in person or on the phone), online or by hand. The vast majority completed the survey by hand and those who returned the survey were compensated with a gift card to a local bookseller.

Child immigrant status was determined by the Child and Family Background section of the questionnaire which included questions specific to parental and child country of birth. The questionnaire asked where the child was born (*In what country or US Territory was the child born? / En qué país o territorio Americano nació el niño/niña?*). If a parent reported that the child was born outside the United States the child was considered to be the first generation. A separate section for each parent asked about country of birth (*If not born in the US, at what age did the child's MOTHER/ FATHER come to the US? / A qué edad llegó a los Estados Unidos la MAMÁ / el PADRE del niño?*). If a parent reported that the child was born in the United States and at least one parent was born outside the United States the child was considered to be the second generation. If parents reported that their child and both parents were born in the United States, the child was considered to be the third generation. The countries of birth of the 17 first-generation children included El Salvador, Guatemala, and Mexico. While the overall sample size is small, the majority of the Latinx bilinguals are second generation. Table 2 displays the sample demographics disaggregated by immigrant generation status.

Assessment of English and Spanish language proficiency

In this section, the English language assessments are described. The assessments were administered over 4 waves for 2 years, each spaced 6 months apart: fall 2009, spring 2010, fall 2010, and spring 2011. When available, alternate forms were administered. Spanish assessments were administered at the outset of data collection to serve as in indicator of initial status at the time longitudinal English data collection began. The students in the sample did not receive Spanish language or literacy instruction in the US schools they attended.

A team of trained research assistants individually administered the assessments in a quiet room; each administration was also audio-recorded. The English assessments lasted about 30–40 minutes depending on the student's ability. A team of Spanish-English bilingual research assistants administered the Spanish language assessments, which lasted between 10 and 30 minutes depending on student's ability. The Spanish assessment administration was conducted entirely in Spanish, and if at any time any student protested the assessment or displayed discomfort due to lack of Spanish proficiency they were given the option to discontinue.

English and Spanish vocabulary

English and Spanish vocabulary (EVoc and SVoc, respectively) were indexed via the English and Spanish versions of the WMLS-R Picture Vocabulary (PV) (Woodcock et al. 2005). The internal reliability for subjects between the ages of 7 and 21 is .88–.92. Students were asked to identify pictures of objects of increasing difficulty, and the assessment continued until they made 6 consecutive errors. W-scores were used for analyses because W-scores allow for an interpretable growth metric. The W-scale is centered on a value of 500 for the average performance of 10-year-olds; the distance between two points on the scale has the same interpretation regardless of age or grade

Table 2. Sample demographics disaggregated by generation status.

	Sample ($n = 112$)	Gen1 ($n = 17$)	Gen2 ($n = 81$)	Gen3 ($n = 14$)
Female	52.3%	53.3%	48.7%	71.4%
Free and reduced meals	89.3%	87.5%	91.5%	78.6%
English language learner	59.8%	100%	52.4%	85.7%

level. Thus, whether a student is in Grade 2, 3 or 4, a score of 490 carries the same meaning; both students scored 10 points below the average performance of 10-year-olds. Since students in the sample were in Grades 2–5, the use of W-scores allowed for easier interpretation.

English morphology

Morphological awareness (EMor) was assessed with the researcher-designed Extract the Base Test (ETB; August, Kenyon, Malabonga, Louguit, Caglarcan, & Carlo, 2001). This assessment consisted of 28 items, each of which counted for 1 point. For each item, students were given a word (e.g. *publicity*) and asked to identify the base word to logically complete a sentence (e.g. *The _____ was happy with the show.*). The administrator read both the target word and sentence aloud and students were asked to write their response in the blank space provided. Since this was a test of morphological ability and not literacy (i.e. spelling) so long as the student response was phonologically plausible (e.g. *empti* instead of *empty*) misspellings did not result in an incorrect response. This test is not normed therefore we report the local sample alpha, which is .843. Raw scores were used for analyses.

English and Spanish syntax

The English and Spanish (ESyn and SSyn, respectively) version of CELF Formulated Sentences subtest was used to index syntactical awareness. For this assessment, students were presented with a picture and corresponding target word. Students were then asked to generate a complete sentence about the picture using the target word. Target words becoming increasingly difficult as students progressed through the test.

The subtest administration for English and Spanish versions are identical, however, pictures and target words did vary between the two versions. Stability coefficients for the English measure are .74–.62 and internal consistency is .82–.76 for children ages 7.0–12.11 (Semel, Wiig, and Secord 2003). Raw scores were used for analyses.

English semantics

Semantic awareness (ESem) was evaluated with the CELF Word Class 2 subtest (WC). For this task, students were read increasingly difficult sets of four words, two of which were semantically related (e.g. *teacher, school, street, cake*). Students identified the two related words within each respective set. Testing was discontinued after five consecutive misidentifications. For children ages 7–12 reported stability ranges from .72 to .84, and internal consistency ranges from .72 to .82. Raw scores were used in all analyses.

Scoring

With the exception of morphology, initial scoring occurred in real time during administration. All assessments were subsequently double-scored by a second administrator whose responsibility was to verify that points were correctly added, ceilings were appropriately met, and that no items or measures were inaccurately omitted.

Analytic plan

Four English language growth trajectories (i.e. EVoc, EMor, ESyn, ESem) were developed. We used HLM 7 Hierarchical Linear and Nonlinear Modeling (Raudenbush, Bryk, and Congdon 2010) to develop longitudinal growth models where Level 1 represented intra-individual differences in initial status and change, and Level 2 represented student-level differences (Radenbush and Byrk 2002; Singer and Willett 2003). Time was coded such that interpretation of the intercept would refer to the inception of the study (i.e., Time 0, or fall of the first academic year); data collection was evenly spaced over two academic years, thus Time 1 represents six months following Time 0 and so forth. For both research questions, we first established the unconditional means model for

our outcome variable of interest; we iterated to the best fitting model and tested each trajectory for a linear and quadratic shape. The full combined model was as follows:

$$Y_{ti} = \beta_{00} + \beta_{10}(Time)_{ti} + \beta_{20}(Time)_{ti}^2 + r_{0i} + r_{1i}(Time)_{ti} + r_{2i}(Time)_{ti}^2 + e_{ti},$$

where, β_{00} represented the grand-mean across all students (i.e. population true mean), β_{01} represented the predicted change (i.e. slope) across all students for each time point, β_{20} represented the predicted rate of change and r_{0i}, r_{1i}, and r_{2i} represented Student i's deviation from the population true mean, the population variance due to time, and the between-student rate of change variance. All growth trajectories utilized the same model building process. After establishing the unconditional model, we established Model 1. *Model 1* included control variables: Site and Cohort. The Site variable was only included if ANOVA revealed significant differences by site, thus warranting inclusion; when included, Site was dummy coded such that Mid-Atlantic served as the referent group; in order to adjust estimates for cohort differences cohort covariates were included in all subsequent model iterations, even if their fixed effects were null with Cohort 3 (e.g. Grade 4) serving as the referent group. *Model 2* added grand-mean centered values for the Spanish variables (i.e. SVoc and SSyn); Spanish variables with null effects were dropped in subsequent models. *Model 3* added immigrant generation status (i.e. dummy coded such that Gen2 served as the referent group); if Model 3 contained significant effects for Spanish variables and immigrant generation status then a Model 4 was established. *Model 4* examined moderating effects for immigrant generation status on linguistic interdependence by testing interactions between significant Spanish and immigrant generation status variables from Model 4.

Results

Preliminary descriptive analyses

Table 3 displays the sample mean and standard deviation scores for all EOL variables, as well as SVoc and SSyn across all time points, disaggregated by generation status. Preliminary analyses revealed

Table 3. Mean scores[1] for English and Spanish variables disaggregated by generation status.

	Sample ($n = 112$)	Gen1 ($n = 17$)	Gen2 ($n = 81$)	Gen3 ($n = 14$)
Spanish				
Vocabulary	22.31 (7.90)	26.08 (8.72)[a]	21.92 (7.82)	19.75 (4.59)
Syntax	20.95 (9.23)	8.72 (1.38)[a]	9.07 (.585)	8.09 (1.35)
English vocabulary				
Time 0	482.68 (13.52)	477.07 (15.76)	484.59 (12.71)	477.79 (13.61)
Time 1	486.42 (13.57)	477.13 (14.32)	488.68 (13.17)[b]	483.23 (10.44)
Time 2	488.71 (15.69)	476.07 (23.83)	492.51 (11.83)[c]	481.67 (14.12)
Time 3	491.99 (14.45)	481.93 (17.40)	494.71 (13.09)[b]	487.33 (13.05)
English semantics				
Time 0	6.46 (2.56)	6.57 (2.61)	6.66 (2.49)	5.30 (2.71)
Time 1	8.03 (2.83)	7.73 (3.17)	8.18 (2.83)	7.46 (2.50)
Time 2	8.69 (3.13)	7.69 (3.36)	9.03 (3.04)	8.00 (3.22)
Time 3	9.63 (3.03)	8.75 (3.45)	10.09 (2.87)[a]	7.92 (2.84)
English morphology				
Time 0	28.96 (11.64)	29.00 (10.25)	29.96 (11.30)	23.14 (14.03)
Time 1	34.32 (8.86)	31.22 (11.20)	35.61 (8.04)	29.92 (9.21)
Time 2	36.57 (9.18)	33.50 (12.33)	38.33 (7.73)[c]	30.08 (9.28)
Time 3	38.72 (8.74)	35.25 (11.57)	40.41 (7.43)[c]	32.67 (8.87)
English syntax				
Time 0	30.87 (8.80)	28.60 (10.25)	31.88 (7.94)	27.57 (11.07)
Time 1	33.98 (9.35	32.53 (7.28)	34.61 (9.54)	31.77 (10.39)
Time 2	34.34 (10.19)	34.25 (11.78)	35.17 (9.40)	29.50 (12.01)
Time 3	36.29 (9.54)	33.88 (12.08)	37.43 (8.85)	32.25 (9.11)

[a]Gen1 significantly outperforms Gen2 and Gen3; [b]Gen2 significantly outperforms Gen1; [c]Gen2 significantly outperforms Gen 1 and Gen3.

our data to follow the empirical trend of intergenerational decline in Spanish: Gen1 significantly outperformed Gen2 and Gen3 for both SVoc and SSyn Spanish use. ANOVA for site warranted inclusion of the Site covariate in the EVoc and ESyn growth trajectories.

Growth modeling results

Our stepwise approach to the model building process allowed us to focus on ongoing, overall improvement in the model fit for each respective language component. Results for each growth trajectory are presented separately.

English vocabulary

The model building process for vocabulary is summarized in Table 4. For *initial status* (i.e. intercept), in Model 1, we find a significant initial status where Cohort 3 significantly outperforms Cohort 1. Model 2 tests the effects for SVoc and SSyn, with positive but non-significant effects. Module 3 shows significant effects of Gen2 outperforming Gen1 ($\beta_{03} = -20.57$, $p < .001$), but not Gen3 . For *growth* (i.e. slope*)*, in Module 1 , we see a significant effect for time and site. Models 2 and 3 show no effects of Spanish or generational status on growth slope for English vocabulary.

English semantics

The model building process for semantics is summarized in Table 5. For *initial status*, in Model 1, we find a significant initial status where Cohort 3 significantly outperforms Cohort 1. Model 2 tests the effects for SVoc and SSyn, with positive but non-significant effects. Module 3 shows significant effects of Gen2 outperforming Gen1 ($\beta_{03} = -1.76$, $p < .001$), but not Gen3. For *growth* (i.e. slope*)*, in Module 1, we see a significant effect for slope. Models 2 and 3 show no effects of Spanish or generational status on growth for English vocabulary.

English morphology

The model building process for the morphology growth trajectory is summarized in Table 6. For *initial status*, in Model 1, we find a significant initial status where Cohort 3 significantly outperforms Cohort

Table 4. Model building process for vocabulary growth trajectory.

		Fixed effects	Model 1	Model 2	Model 3
Level 1 Predictor		**Intercept**	486.67 (3.42)***	487.13 (2.87)***	491.98 (2.69)***
Level 2 Predictors	Control variables	Cohort 1	−11.24 (3.85)***	−12.24 (4.01)***	−15.90 (3.49)***
		Cohort 2	−1.64 (4.00)	−2.19 (4.02)	−3.59 (3.51)
		Site	−.454 (3.58)	_	_
	Spanish language	Vocabulary		−.385(.287)	_
		Syntax		.200 (.216)	_
	Immigrant status	Generation 1			−20.57 (4.38)***
		Generation 3			−7.15 (4.67)
Level 1 Predictor		**Time**	4.44 (.742)***	4.26 (.759)***	3.51 (.666)***
Level 2 Predictors	Control variables	Cohort 1	.360 (.838)	.010 (.903)	−.075 (.865)
		Cohort 2	−1.64 (4.00)	.840 (.899)	.552 (.867)
		Site	−.454 (3.58)*	−1.27 (.780)	_
	Spanish language	Vocabulary		−.096 (.075)	_
		Syntax		.067 (.056)	_
	Immigrant status	Generation 1			−.262 (1.08)
		Generation 3			−.572 (1.16)
		Random effects			
		Intercept	161.43 (31.58)***	159.19 (31.37)***	119.64 (24.44)***
		Time	.144 (.000)	.149 (.000)	.379 (.000)
		Residual variance	44.56 (4.28)***	45.44 (4.47)***	44.24 (4.16)***
		Deviance statistic	2234.76	2244.91	2206.67

Note: *$p < .05$, **$p < .01$, ***$p < .001$.

Table 5. Model building process for semantics growth trajectory.

		Fixed effects	Model 1	Model 2	Model 3
Level 1 Predictor		**Intercept**	7.52 (.444)***	7.56 (.474)***	8.04 (.481)***
Level 2 Predictors	Control variables	Cohort 1	−2.44 (.615)***	−2.48 (.661)***	−2.82 (.627)***
		Cohort 2	.108 (.687)	.107 (.661)	−.085 (.627)
	Spanish language	Vocabulary		.042 (.053)	_
		Syntax		.034 (.039)	_
	Immigrant status	Generation 1			−1.76 (.782)*
		Generation 3			−1.07 (.857)
Level 1 Predictor		**Time**	1.29 (.179)***	1.28 (.192)***	1.42 (.199)***
Level 2 Predictors	Control variables	Cohort 1	−.168 (.248)	−.134 (.267)	−.247 (.259)
		Cohort 2	−.544 (.257)*	−.516 (.267)^{t}	−.593 (.259)*
	Spanish language	Vocabulary		.006 (.021)	_
		Syntax		.011 (.016)	_
	Immigrant status	Generation 1			−.384 (.323)
		Generation 3			−.328 (.353)
		Random effects			
		Intercept	2.81 (.873)***	3.20 (.365)***	2.55 (.840)***
		Time	.181 (.153)	.196 (.157)	.179 (.154)
		Residual variance	3.20 (.365)***	3.20 (.365)***	3.20 (.365***
		Deviance statistic	1392.88	1413.31	1377.70

Note: *$p < .05$, **$p < .01$, ***$p < .001$.

1. Model 2 tests the effects for SVoc and SSyn, with significant, positive effect for SSyn. Module 3 shows significant effects for Gen2 outperforming Gen1, but not Gen3. Model 4 reveals a significant interaction for SSyn and Gen1, suggesting that for Gen1, students with higher SSyn began the study with significantly less EMorph ($\beta_{06} = -.70$, $p < .01$). For *growth,* initial deviance testing for the unconditional means model warranted the inclusion of the quadratic term fit [χ^2 (2, $N = 448$) = 38.55, $p < .001$)], suggesting that while significant morphology growth occurred for all students this growth was predicted to slow over time. In Module 1 we see a significant effect for slope and rate of growth with a significant effect for Cohort 1. Models 2 and 3 show no effects of Spanish or generational status on slope or rate of growth.

English syntax

The model building process for the syntax growth trajectory is summarized in Table 7. For *initial status*, in Model 1, we find a significant initial status where Cohort 3 significantly outperforms Cohort 1. Model 2 tests the effects for SVoc and SSyn with significant, positive effect for SSyn ($\beta_{05} = .47$, $p < .001$) and significant, negative effect for SVoc ($\beta_{04} = -.48$, $p < .05$); this inversion effect is illustrated in Figure 1. Module 3 shows significant effects of Gen2 outperforming Gen1 and Gen3. Model 4 reveals a significant interaction for SSyn and Gen1, suggesting that Gen1 moderated the Spanish-English relationship ($\beta_{06} = -.67$, $p < .01$) such that among Gen1 higher levels of SSyn was positively associated ESyn. For *growth,* in Module 1, we see a significant effect for slope. Models 2 shows no effects for Spanish. Module 3 reveals a significant positive effect for Gen 1 generational status on slope; this is displayed in Figure 2.

Discussion

Our study sought out to investigate nuances linguistic interdependence by establishing trajectories of English language development and then examining whether linguistic interdependence varied by construct and immigrant generation status. Regarding the Spanish-English relationships our findings provide positive, significant effects for Spanish syntax on both English morphology and English syntax and negative, significant effects for Spanish vocabulary on English syntax. Regarding immigrant generation status, our results revealed a significant, negative effect for Gen1 on all English language trajectories; further, Gen1 significantly moderated linguistic interdependence such that

Table 6. Model building process for morphology growth trajectory.

		Fixed effects	Model 1	Model 2	Model 3[1]	Model 4
Level 1 Predictor		**Intercept**	33.20 (2.02)***	34.29 (1.94)***	35.62 (1.79)***	35.09 (1.75)***
Level 2 Predictors	Control variables	Cohort 1	−11.92 (2.81)***	−12.36 (2.70)***	−12.46 (2.31)***	−11.76 (2.25)***
		Cohort 2	.801 (2.94)	.102 (2.72)	.240 (2.31)	1.12 (2.26)
	Spanish language	Vocabulary		−.163 (.215)	_	_
		Syntax		.367 (.160)*	.200 (.086)*	.294 (.090)**
	Immigrant status	Generation 1			−8.41 (2.86)**	−4.99 (3.03)
		Generation 3			−3.72 (3.05)	−3.21 (2.96)
		Gen 1*SPN Syntax				−.701 (.251)**
Level 1 Predictor		**Time**	1.96 (1.90)***	1.92 (1.66)	3.95 (.857)***	3.95 (.857)***
Level 2 Predictors	Control variables	Cohort 1	7.04 (2.65)*	6.59 (2.31)**	2.62 (.615)***	2.62 (.616)***
		Cohort 2	2.89 (2.76)	2.93 (2.32)	.644 (.620)	.645 (.620)
	Spanish language	Vocabulary		−.167 (.184)	_	_
		Syntax		.083 (.137)	_	_
	Immigrant status	Generation 1			.278 (.769)	.278 (.769)
		Generation 3			−1.31 (.818)	−1.31 (.818)
Level 1 Predictor		**Quadratic**	−1.71 (.725)*	.029 (.458)	−.667 (.235)**	−.667 (.235)**
Level 2 Predictors	Control variables	Cohort 1	−1.71 (.724)*	−1.43 (.640)**	_	_
		Cohort 2	−.919 (.753)	−.775 (.216)	_	_
	Spanish language	Vocabulary		.046 (.051)	_	_
		Syntax		.025 (.038)	_	_
		Random Effects				
		Intercept	91.15 (17.38)***	74.24 (14.31)***	51.17 (10.62)***	47.54 (10.05)***
		Time	54.17 (16.64)**	31.30 (11.72)**	1.25 (.868)	1.25 (.858)
		Quadratic	2.98 (1.36)*	1.63 (1.01)	_	_
		Residual Variance	16.08 (2.60)***	12.67 (2.06)***	16.82 (1.93)***	16.82 (1.93)***
		Deviance Statistic	2000.99	1936.55	1926.71	1919.13

Note:[1] Model fitted the Spanish language variables in the model, but without the random quadratic effect; $^{t} < .10$ $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Table 7. Model building for syntax growth trajectory.

		Fixed effects	Model 1	Model 2	Model 3	Model 4
Level 1 Predictor		**Intercept**	34.48 (2.12)***	33.71 (2.05)***	34.90 (1.69)***	34.39 (1.68)***
Level 2 Predictors	Control variables	Cohort 1	−4.46 (2.39)^{t}	−4.74 (2.42)*	−6.60 (2.22)**	−5.94 (2.21)**
		Cohort 2	1.93 (2.48)	1.92 (2.41)	.863 (2.20)	1.69 (2.20)
		Site	−3.79 (2.22)^{t}	−2.02 (2.16)	_	_
	Spanish language	Vocabulary		−.483 (.202)*	−.400 (.169)*	−.381 (.163)*
		Syntax		.469 (.152)***	.481 (.124)***	.553 (.129)***
	Immigrant status	Generation 1			−9.20 (2.75)***	−.673 (.275)*
		Generation 3			−5.22 (2.90)^{t}	.008 (.027)^{t}
		Gen 1*SPN Syntax				−.673 (.275)*
Level 1 Predictor		**Time**	2.67 (.517)***	2.11 (.434)***	1.96 (.453)***	1.94 (.439)***
Level 2 Predictors	Control variables	Cohort 1	−.862 (.583)	−.677 (.601)	−.626 (.589)	−.584 (.608)
		Cohort 2	−.405 (.606)	1.92 (2.41)	−.423 (.591)	−.384 (.608)
		Site	−.581 (.543)	_	_	_
	Spanish language	Vocabulary		.076 (.049)	_	_
		Syntax		−.021 (.036)	_	_
	Immigrant status	Generation 1			1.57 (.738)*	1.57 (.751)*
		Generation 3			.093 (.787)	.133 (.802)
		Random Effects				
		Intercept	62.65 (12.26)***	54.77 (11.16)***	45.07 (9.57)***	43.25 (9.35)***
		Time	1.15 (.818)	1.11 (.817)	1.02 (.802)	1.07 (.815)
		Residual Variance	16.27 (1.86)***	16.2 (1.86)***	16.26 (1.86)***	16.26 (1.86)***
		Deviance statistic	1962.92	1966.62	1939.45	1939.76

Note: $^{t} < .10$ *$p < .05$, **$p < .01$, ***$p < .001$.

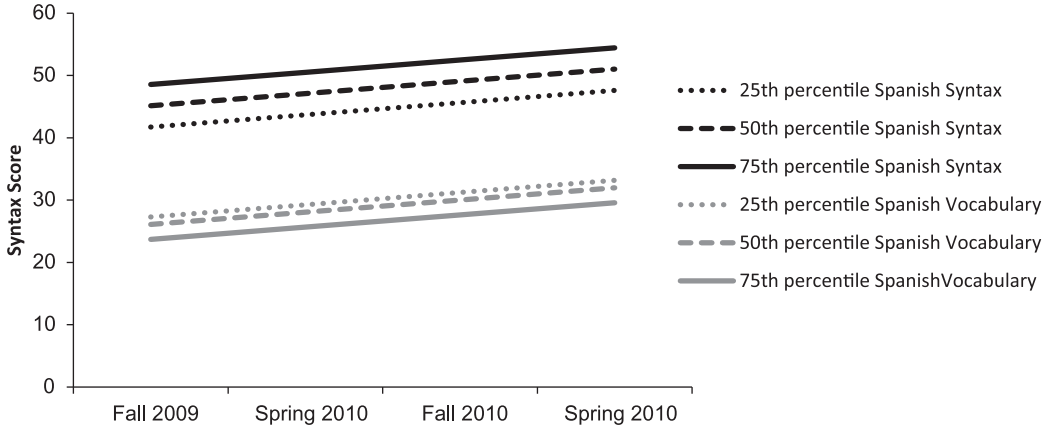

Figure 1 . Syntax growth trajectories disaggregated by Spanish performance.

significant effects for a positive Spanish-English relationship were washed away among Gen1 participants.

Linguistic interdependence: conceptualization and operationalization

Previous research that has examined linguistic interdependence among the bilingual Latinx population has provided evidence for a relationship between Spanish and English; thus, our goal was not to provide evidence in support of the existence of linguistic interdependence, but rather to examine how the Spanish-English relationship might vary depending on the linguistic construct. Similar to previous work, the present study yielded results which provided null effects (Syn→EVoc; Syn→ESem; SVoc→EVoc; SVoc→ESem; SVoc→EMor), positive effects (Ssyn→EMor; Ssyn→SSyn), and negative effects (Svoc→ESyn). It is important to recognize that significant effects are not causal, but associations between the variables. Given our use of multiple constructs for both Spanish and English oral language, we are able to interpret our mixed results within Proctor et al.'s (2010) continuum model which suggests that the relationship across languages may vary depending on the language skill. More specifically, interpretations of the mixed results are especially interesting within the task-dependent bidirectional transfer hypothesis (Prevoo et al. 2016) which suggests that both the construct and assessment will affect interdependence. When examining

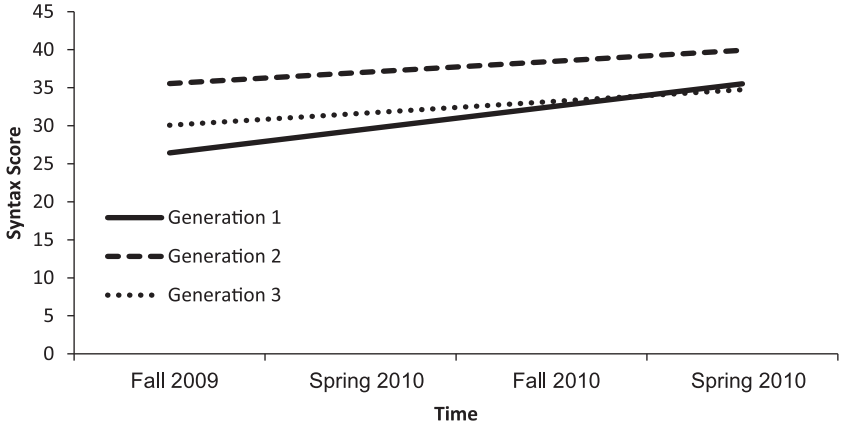

Figure 2. Syntax growth trajectories disaggregated by generation status.

significant effects, our hypotheses were generally supported: SSyn was a significant positive predictor for ESyn and EMor and SVoc was a significant negative predictor for ESyn. Of particular interest is the contradictory findings of SVoc and SSyn negatively and positively, respectively, predicting ESyn initial status. These findings could be interpreted by the bidirectional transfer hypothesis framework that suggests that the strength between languages is dependent on both the language task and outcome. As such, the positive relationship between SSyn and ESyn could be explained by (1) the fact that syntax in English and Spanish is comparable; and (2) the fact that these constructs were assessed via parallel measures that required a relatively shallow and comparable level of syntactic knowledge to perform on the task. By contrast, the negative relationship between SVoc and ESyn could be explained by the task: assessments for Spanish vocabulary breadth and English syntactical knowledge provide different outcomes. Thus, our growth models provide further support that linguistic interdependence can vary depending on the construct's conceptualization and operationalization.

Linguistic interdependence: thresholds and bilingual proficiency

The linguistic interdependence framework posits that higher levels of Spanish proficiency at inception should also aid in accelerated English language development, however, when examining the growth trajectories this hypothesis was not supported. Our analyses revealed null effects for SSyn and SVoc for the growth of all four English language variables. However, this may be due to the fact that overall Spanish proficiency was limited among this sample. While all participants were bilingual, they were not receiving formal instruction in Spanish language (or literacy), thus the relationship between Spanish and English over time might be attenuated. Alternatively, the finding could be related to formal English instruction (and exposure) as the majority of our sample was Gen2 and Gen3: potential positive effects for Spanish are washed away by English language instruction.

The notion of thresholds is also observable through our inclusion of immigrant generation status, which we use as a proxy for bilingual proficiency. Descriptively, our data fit the empirical trend of Gen1 demonstrating stronger Spanish when compared to their Gen2 and Gen3 peers and vice-versa for English, thus we interpret our results with the perspective that immigrant generation status serves as a distinctive marker of bilingual proficiency and language dominance. Our initial hypothesis that Gen1 would negatively moderate the relationship between Spanish and English was supported in the EMor and ESyn models: higher levels of SSyn were associated with lower levels of EMor and ESyn at initial status. These negative relationships suggest a certain threshold proficiency might be necessary in order for a positive Spanish-English relationship to be present. That is, for more English proficient students, higher levels of Spanish reveal a more balanced bilingual profile which is associated with interdependence.

Refining the linguistic interdependence conversation

This study sought out to expand on the field's understanding of linguistic interdependence by examining nuances in linguistic interdependence. Our work aimed to go beyond establishing relationships by investigating how relationships might vary across different linguistic groups. Consistent with previous work (Prevoo et al. 2016; Proctor et al. 2010; Proctor, Harring, and Silverman 2017), our findings suggested that the degree to which linguistic independence exists is contingent on the construct and operationalization of the construct at hand. Specifically, in our work, the linguistic interdependence varied depending on both how Spanish oral language and/or English oral language were operationalized; we also examined the impact of bilingual proficiency, which we operationalized through immigrant generation status.

Most notable in our analyses are the findings that in both our model building process and in our correlation work was that the linguistic interdependence for Gen1 was consistently different from Gen2 and Gen3. This finding highlights the importance of examining constructs beyond linguistic

components that support linguistic interdependence. Berthele and Vanhove (2017) suggested that 'finding positive correlations between measurements in two languages is not sufficient for strong claims about interdependence'. We agree with this idea and suggest that further research which draws on a linguistic interdependence framework to examine not just the L1–L2 relationship, but also address how conceptualization (e.g. Proctor et al. 2010; Proctor, Harring, and Silverman 2017), operationalization (Prevoo et al. 2016), and individual's linguistic context (e.g. bilingual proficiency) can contribute to how linguistic interdependence is captured. As stated earlier, our work does not aim to prove the existence of linguistic interdependence but rather seeks to examine how linguistic interdependence might manifest under different conditions.

Limitations

While our study provides useful insights for research and practice with the bilingual Latinx population, there are several limitations. First, while this study was longitudinal in nature, it collapsed three different cohorts of students, thus limiting interpretation of results within a two-year academic period. Second, this study relied on language data that were normed on a monolingual population, the language battery was administered outside of the norming sample, and Spanish and English measures were similar. Thus, findings should be interpreted with caution. Another limitation is due to the study design. This two-year longitudinal study collapsed three cohorts from two different school districts into one sample. Significant cohort and site effects in our analyses limit the interpretation of these findings. Further, while the present study accounted for multiple components of language in both English and Spanish, we were limited to a 'snapshot' of Spanish oral language proficiency. Finally, there are several factors that are related to English language development, beyond Spanish language and immigrant generation status that were not included in the present study that could have impacted our findings. Particularly given the dual-language focus of this study additional information regarding the Gen1 students, including previous instruction in Spanish language; primary language spoken in the home; initial age of English language acquisition; and Spanish language use, exposure, and instruction would inform future work.

Implications

The present study addressed the following question: Does immigrant generation status moderate linguistic interdependence? Our multilevel iterative approach not only provided empirical evidence for Spanish-English correlations but also demonstrated how these relationships vary by bilingual proficiency. In practice, this finding highlights the importance of differentiated language instruction, opposing a one-size-fits-all approach to instruction for bilingual students. For newcomers and Latinx children who are less likely to speak English, targeted support on multiple dimensions of English is clearly warranted; further, for US-born Latinx bilinguals, if Spanish might not be detrimental to English language development, then perhaps instructional efforts should also provide space for ongoing Spanish language development along with English language instruction. Finally, this study contributes to the broader discussion on linguistic interdependence. We propose that empirical work move beyond justification of its existence and instead focus more explicitly on why or how it is manifested.

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