JSLHR

Research Article

# The Impact of the Spanish-to-English Proficiency Shift on the Grammaticality of English Learners

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**Purpose:** The general aim of this study is to enhance our understanding of the patterns of language growth in Spanish and English during the school years. In this study, we used a longitudinal retrospective approach to explore the growth of the percentage of grammatical utterances (PGU) in both Spanish and English in 2 groups of English learners (ELs): ELs attending English-only instruction and ELs attending Spanish–English bilingual instruction.
**Method:** The participants included 1,080 ELs. ELs produced at least 3 story retells in both Spanish and English between kindergarten and 2nd grade. All stories were transcribed and coded for errors, and PGU was calculated for each story.
**Results:** At the onset of the study, children showed higher PGU in Spanish and lower PGU in English. Growth curve analysis indicated that PGU in English improved over time, whereas PGU in Spanish declined in both instructional groups. However, those children who were in bilingual programs showed a slower rate of decline in Spanish PGU and a slower rate of improvement in English PGU. By the age of 9 years, children in English-only programs had approximately a Spanish PGU of 65% in Spanish, whereas children in bilingual instruction had an average Spanish PGU of 80%. The improvement in English PGU was steady with a small difference in the rate of growth benefiting children in English-only programs.
**Conclusion:** The results of this study document a shift in language proficiency from Spanish to English during the school years. This study offers evidence of a temporary period of relatively low grammaticality in both languages that seems to be the result of a shift in proficiency from Spanish to English.

Hispanics are currently the fastest growing population in the United States, and the projections indicate that this ethnic group will continue to grow in the years to come (U.S. Census Bureau, 2010). Hispanic children are often disproportionally represented in special education programs, particularly in the early grades, and are less likely than other children to be identified as having speech and/or language disorders (Artiles, Rueda, Salazar, & Higareda, 2002; Morgan et al., 2015; Samson & Lesaux, 2009). Accurate identification of bilingual children with language disorders continues to be a difficult task for researchers and clinicians. The main challenge in correctly identifying language disorders in Spanish–English–speaking children lies in our limited understanding of the dual language learning processes during the early school years.

Typically, Spanish-speaking children in the United States acquire Spanish as their first language at home and begin learning English formally when they enroll in preschool or kindergarten; these children are referred to as English learners (ELs) in the school system. The shift in language exposure from Spanish (the predominant language at home) to English (the predominant language at school) allows children to significantly gain English skills but also has important consequences on the development of Spanish (Fillmore, 1991).

This shift from the minority language (Spanish) to the majority language (English) has been well described as a sociolinguistic phenomenon commonly occurring in the United States (e.g., Anderson, 2004; Fillmore, 1991; Montrul, 2011; Silva-Corvalán, 1994). Children whose parents were Hispanic immigrants report to have higher proficiency skills in English than in Spanish during the adolescent years (Tran, 2010). Similarly, immigrant parents report that their bilingual

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Editor-in-Chief: Sean Redmond
Editor: Geralyn Timler
Received August 10, 2018
Revision received October 18, 2018
Accepted December 20, 2018
https://doi.org/10.1044/2018_JSLHR-L-18-0324

***Disclosure:*** *The authors have declared that no competing interests existed at the time of publication.*

children show a strong preference for English early on, with a clear shift for preference for English at school entry (Lutz, 2008). This shift in preference and proficiency is the result of complex cultural, educational, and sociolinguistic circumstances (e.g., Rothman, 2007). The linguistic profiles of adults who grew up speaking Spanish at home in the United States vary, but a large percentage of these adults end up with native-like English proficiency and limited Spanish skills (Montrul, 2011).

This shift in language proficiency has important consequences for child bilingual language development: These children often experience a decline in their Spanish skills (Anderson, 1999a, 1999b, 2001, 2004), whereas their English skills improve over time (Kohnert, 2010). This shift (a) is not explained by limitations in language learning abilities, (b) seems to be the result of changes in language experiences (e.g., schooling, language use, language status in the community; Anderson, 1999b, 2004), and (c) may affect areas of language (e.g., grammar, vocabulary, syntax) in different ways (Anderson, 2004; Wood Jackson, Schatschneider, & Leacox, 2014). In this study, grammaticality (the ability to use the grammar rules of a language) is used as an indicator of language proficiency because grammaticality has traditionally been part of definitions of language proficiency and it is one of the factors that determines a speaker's ability to converse in a language (e.g., Bedore et al., 2012; Cummins, 1984; Johnson & Newport, 1989). The purpose of this investigation is to examine the growth of Spanish and English grammatical skills in ELs attending either English-only instruction program or bilingual programs that include instruction in both Spanish and English.

### *Grammatical Characteristics of ELs*

In general, the language development of ELs is similar to the language development of monolingual children in that initially the same language acquisition patterns take place in the children's home language: gradual increase in the number of words and combination of words produced, followed by an increase in the complexity of the word combinations. Differences in language development between monolingual children and ELs arise when exposure to English begins. Although monolingual children continue to develop their home language skills exclusively, ELs are now learning two languages at the same time.

This new pattern of language learning and language exposure has consequences for the continued development of grammatical skills in children. Although continued development of both languages is possible under the right circumstances (e.g., community support, availability of bilingual schools, high language status.; Collins, 2014; Paradis, 2010; Rolstad, Mahoney, & Glass, 2008), the sociolinguistic environment in the United States might not be ideal to support continued bilingual development within and among generations. For example, intergenerational studies of Spanish maintenance in the United States suggest the use of Spanish in a family is lost after two to three generations (e.g., Bills, Hudson, & Hernandez-Chavez, 2000; Rumbaut, Massey, & Bean, 2006). Intragenerational studies also suggest that adults who grew up speaking a minority language often have lower grammatical skills in the minority language.

There is consensus in the literature that there are differences in the grammatical development of ELs in comparison to monolingual children (e.g., Castilla-Earls et al., 2015; Meisel, 2007; Shin, 2018). For example, Shin (2018) completed a review of the literature on grammatical development in Spanish-speaking children. She summarized the extant literature on grammaticality in ELs and concluded that ELs with restricted Spanish input develop Spanish morphosyntax at a slower rate compared to Spanish monolingual children. The difference in the rate of acquisition between ELs and monolingual children was related to the limitations in language exposure.

This difference between ELs and monolingual children on the rate of acquisition of their home language is often described in the literature as incomplete acquisition (Montrul, 2008; Rothman, 2007), language loss (e.g., Anderson, 1999a, 1999b, 2001, 2004), or bilingual effects (e.g., Paradis & Genesse, 1996). These terms all refer to the differences seen in the language development between monolingual and ELs but have slightly different connotations. For example, Montrul (2008) and Rothman (2007) describe the grammatical differences seen in ELs as elements of grammar that do not reach full development due to limitations in input (e.g., their acquisition is incomplete). The direct implication for incomplete acquisition is that certain grammatical features (e.g., direct object pronouns), which were previously developing, plateau. Language loss has a slightly different connotation in that it is often defined as a reduction of language abilities with the assumption that such abilities were previously acquired (Anderson, 1999a, 1999b, 2001, 2004). Alternatively, bilingual effects are described as differences in developmental patterns that emerge as a result of having input in two languages (Castilla-Earls et al., 2015; Grüter & Paradis, 2014; Paradis & Genesse, 1996; Pirvulescu, Pérez-Leroux, Roberge, Strik, & Thomas, 2013). These effects can take the form of acceleration, deceleration, or stagnation, but it is assumed that with time and continued input bilingual development is possible. Importantly, all these terms refer to the same developmental difference seen between monolingual and ELs but are only distinguishable from each other over time. Therefore, longitudinal studies that inform language development in ELs are crucial to further understand and describe dual language acquisition.

Few studies have examined Spanish grammatical development over time in Spanish-speaking ELs. Anderson (1999a) examined gender agreement in a longitudinal study with two typically developing bilingual children. Her results suggest that bilingual children with typical language skills produced errors of gender agreement that were not present earlier, suggesting that grammatical morphology is vulnerable to language loss. In another study, Anderson (1999b) examined the language production of a Spanish–English bilingual child and reported difficulties with the Spanish subjunctive and overregularization of verbs that appear over time. Using a broader measure of grammaticality, Guiberson,

Barret, Jancosek, and Itano (2015) examined grammatical development in a longitudinal study with 10 children. They divided children between those who maintain their grammatical skills ($n = 8$) and those who were experiencing language loss ($n = 2$). The results of their study suggested that children who were experiencing language loss had a higher number of utterances with grammatical errors than children who were maintaining their Spanish skills. This pattern of language loss has also been reported in other areas of language. For example, Wood Jackson et al. (2014) examined the longitudinal receptive vocabulary development of 64 dual language learners from prekindergarten until second grade. These investigators reported that the children's Spanish vocabulary declined over time while their English vocabulary was growing.

The literature on morphosyntactic development in English suggests that ELs acquire English with exposure, but that this process is relatively slow. For example, Paradis (2016) suggested that it might take up to 3 years of English language exposure for ELs to score similar to monolingual English-speaking children in standardized tests. Similarly, Gusewski and Rojas (2017) suggest that after 2 years of exposure to English, children in English-only instruction achieve high accuracy in verb marking (around 85%). Other areas of language, such as academic language, might take up to 7 years of English exposure to completely develop (Hakuta, Goto, & Witt, 2000). There is variability in language learning profiles, as expected, but the general consensus is that English exposure results in children learning English.

### *Developmental Language Disorders in ELs*

Children with developmental language disorders (DLD), sometimes referred to as specific language impairment, experience language learning difficulties in vocabulary, phonology, pragmatics, and, particularly, morphosyntax (Leonard, 2014; Leonard, Eyer, Bedore, & Grela, 1997). A hallmark of DLD is the protracted developmental trajectories for the productive and correct use of morphosyntax (Rice, Redmond, & Hoffman, 2006). ELs with DLD show difficulties with morphosyntax in both Spanish and English, although the manifestations of the morphosyntactic difficulties vary by language. Noun phrase errors characterize DLD in Spanish, whereas errors with verb tense and agreement are a distinctive pattern in English (Bedore & Leonard, 2001, 2005). Importantly, ELs with DLD produce more overall grammatical errors than typically developing children in both English and Spanish (Bedore & Leonard, 2005; Restrepo, 1998; Simon-Cereijido & Gutiérrez-Clellen, 2007).

Because of the grammatical profiles of these children, various grammaticality measures have been developed to describe their profiles. General indices of grammaticality, such as the percentage of grammatical utterances (PGU) over total utterances derived from spontaneous language samples, show clear differential patterns between children with and without DLD (Eisenberg & Guo, 2013; Guo & Schneider, 2016; Souto, Leonard, & Deevy, 2014). PGU in Spanish has been shown to differentiate ELs with typical language development from those with DLD (Restrepo, 1998; Simon-Cereijido & Gutiérrez-Clellen, 2007). Furthermore, cross-sectional data suggest that PGU in both typically developing children and children with DLD increase with age, with DLD consistently lagging behind their peers in studies of monolingual children (Auza & Castilla-Earls, 2015; Castilla-Earls & Eriks-Brophy, 2012; Eisenberg & Guo, 2013; Guo & Schneider, 2016; Souto et al., 2014). For example, English monolingual children with typical language development at the age of 3 years have an average PGU of about 70%, whereas 7-year-olds are at about 95% (Eisenberg & Guo, 2013; Guo & Schneider, 2016). It is not surprising that the developmental pattern of PGU suggests an increase in grammaticality over time, and this will be expected from children as they mature. Developmental information on the patterns of language growth for PGU for ELs with and without DLD is very limited. However, the expectation is for bilingual children to follow the same pattern of monolingual development: As children mature, their grammaticality improves.

Current recommendations for the identification of DLD in ELs prescribe that DLD be indicated by low performance in both languages (e.g., Bedore & Leonard, 2001; Gutiérrez-Clellen & Simon-Cereijido, 2009; Kohnert, 2010; Peña, Gutiérrez-Clellen, Iglesias, Goldstein, & Bedore, 2014). However, low indices of grammaticality in both languages could be a manifestation of a DLD or a typical pattern of language development in children who are going through a shift in language proficiency. Therefore, an important problem in language development in ELs is to differentiate children with typical language who might be experiencing a shift in language proficiency from children with true language impairments. There is consensus among researchers that longitudinal data that inform the language development of bilinguals are sorely needed, in particular for bilingual children with DLD (e.g., Ebert, Kohnert, Pham, Disher, & Payesteh, 2014; Kohnert, 2010; Lesaux, 2006; Paradis, 2016). Typically developing ELs make grammatical errors as they have not fully acquired English yet. Therefore, it is crucial to also conduct language assessment in Spanish to document deficits in both languages. One of the measures that is used to identify ELs with DLD is PGU in Spanish (Restrepo, 1998; Simon-Cereijido & Gutiérrez-Clellen, 2007). A cutoff of 80% of grammatical utterances in Spanish is recommended for appropriate identification of DLD in 5- to 7-year-old ELs (Restrepo, 1998). However, the developmental patterns of Spanish grammaticality in ELs with and without DLD are not yet well understood.

### *Language of Instruction*

The onset of formal schooling is often associated with the Spanish-to-English shift in language preference and proficiency (Lutz, 2008; Tse, 2001). Educational instruction for ELs in the United States can be either in English only or a combination of Spanish–English, although English-only instruction is the most common type of instruction. Various

studies have documented the effectiveness of bilingual programs on the development of both Spanish and English (for a review, see Rolstad et al., 2008). Current evidence suggests that children enrolled in bilingual programs continue to develop their home language while also making significant gains in English. For example, Collins (2014) followed a group of 163 children from preschool to second grade who were attending either English-only instruction or bilingual programs. The results of this study suggested that children in bilingual programs showed significant gains in both Spanish and English as demonstrated by their score on the Oral Language Battery of the Woodcock–Muñoz (Woodcock, 1991; Woodcock & Muñoz-Sandoval, 1995), whereas children in English-only instruction made gains in English but not in Spanish. Similarly, Restrepo et al. (2010) examined the effects of a 16-week supplemental Spanish language instruction program. Their results suggest that even 16 weeks of Spanish instruction had a positive effect on the development of Spanish. Children on the supplemental Spanish instruction programs made significantly greater gains in sentence length and sentence complexity in Spanish in comparison with children in English-only programs. However, their supplemental Spanish instruction program showed no differences in children's grammaticality in Spanish. The effectiveness of bilingual programs extends to other areas closely related to language. For example, Proctor, August, Carlo, and Barr (2010) investigated the development of Spanish reading skills from second to fifth grade. They found that those children who were instructed in Spanish outperformed children in English-only classrooms over time. Interestingly, Proctor and colleagues reported a pattern of decline in performance in Spanish reading even for those children instructed in both languages. Children who were not instructed in Spanish were nonliterate in Spanish.

In summary, the evidence suggests that the language of instruction plays a significant role on the language development of the ELs, and children in bilingual programs seem to have greater gains in both languages than children in English-only programs. The evidence is, however, limited in that very few studies have investigated the effect of bilingual instruction on the grammaticality of ELs. Restrepo et al. (2010)'s findings suggest that children in Spanish instruction produced longer utterances that were also more complex, but their Spanish grammaticality did not improve significantly in comparison with children in English-only programs. Examining the effect of language instruction is important because grammatical development in ELs is a function of development, language exposure, and bilingual effects.

### *This Study*

In this study, we used a longitudinal approach to explore the growth of PGU in both Spanish and English in ELs. This is a retrospective study utilizing a large database of ELs that allowed the examination of PGU in both Spanish and English simultaneously. The implementation of retrospective approaches represents an innovative way to increase the research capacity in the field of communication sciences and disorders to keep up with the growing clinical needs to provide services to bilingual children (Justice, Breit-Smith, & Rogers, 2010). The general aim is to enhance our understanding of the differences in patterns of language growth between language acquisition during shifts in proficiency and language impairments in bilingual children. We believe this study is the first large-scale longitudinal study to examine the effect of instructional approach on grammaticality in Spanish and English bilinguals.

The goal of this study was to examine the growth patterns of PGU in both Spanish and English from the beginning of kindergarten until the end of second grade in bilingual children attending either English-only or bilingual Spanish–English instruction (hereinafter referred only as *bilingual instruction*) in children. We predicted that, for students in English-only instruction, the general indices of grammaticality in Spanish would decrease over time, while they would increase in English. We predicted that this pattern of Spanish decline would not be observed in children receiving bilingual instruction. In addition, we predicted that, regardless of instructional approach, children with low grammaticality in both languages at the onset of the study would lag behind their peers.

## Method

### *Database and Participants*

The parent database used in this study was developed with research support from the U.S. Department of Education and the National Institute for Child Health and Human Development for the projects Biological and Behavioral Variations in the Language Development of Spanish-Speaking Children and Oral/Literacy Development in Spanish-Speaking Children (PI: David Francis). All data were collected between 2003 and 2007. The parent database includes 1,951 children who produced narrative language samples (story retells and unique stories) in both Spanish and English on more than one occasion. Children were assessed in the fall and spring of each school year from kindergarten until second grade using a narrative protocol and a series of standardized reading and language assessments in both English and Spanish. This database was considered unique and appropriate for the purpose of this study because it includes (a) longitudinal data for dual language learners in early school years, (b) language testing in both Spanish and English across multiple waves of data, (c) data from children with a wide variety of language skills, and (d) data from a wide range of schools reflecting the diversity of the schooling experiences of Spanish-speaking ELs in the United States.

The participants in this study were chosen from the parent database. We selected only those participants with at least three story retell transcripts per language to better describe individual trajectories of change (Singer & Willet, 2003). Using this inclusion criterion, 1,080 children were selected to be included in all analyses for this study. Forty-nine percent of these children were girls, and 51% were boys. The average age at the onset of the study was 69 months

(*SD* = 7 months). Regarding language of instruction, 33% of the children were enrolled in English-only programs, whereas 67% were enrolled in bilingual programs. These children were recruited from 40 schools in 12 school districts in Texas and California (Austin 14%, Brownsville 25%, Houston 23%, and Los Angeles 38%). Over a period of 3 years, children produced, on average, 9.6 story retells (range: 6–12 in English and Spanish).

Children in this study were identified as ELs by their school and were attending either English-only instruction programs or bilingual programs. Bilingual programs included transitional bilingual, dual language, and maintenance programs at the classroom level. The majority of the children in bilingual programs were in transitional bilingual programs. Importantly, in the early grades (i.e., kindergarten through Grade 2), differences among these programs are relatively minor in terms of reading language arts instruction, with the exception of dual language programs where reading language arts instruction is offered in both English and in Spanish. The differences between maintenance programs and transition programs emerge as children become proficient in English. In maintenance programs, there is an explicit effort to maintain children's proficiency in Spanish, whereas in transitional programs, there is no continued effort to develop Spanish proficiency once children become proficient in English and are able to fully participate in English instruction without linguistic support. As a result, bilingual programs tend to become more differentiated in the later elementary school years beyond the grades that were part of this study. For of this study, we simply distinguish bilingual programs (transitional, dual language, and maintenance programs) from English-only programs (structured English immersion).

### *Measures*

All measures used in this study were extracted from the Systematic Analysis of Language Transcripts (SALT) software (Miller & Iglesias, 2010) standard measures. These measures include mean length of utterances in word (MLUw), number of different words (NDW), subordination index (SI; ratio of total number of clauses [main and subordinate] to the total number of utterances), and total number of utterances. In addition, the standard measure report form SALT provides a calculation of the percentage of utterances in the sample with coded errors and omissions. We used this measure produced by SALT to calculate the PGU in Spanish and English (the inverse of the percentage of utterances with grammatical errors produced by SALT). Utterances that included code switching were excluded from all analyses to ensure that code switching did not influence the coding of errors in this study.

### *Procedure*

Detailed description of all procedures for the parent study is provided in Miller et al. (2006). All children produced story retells using one of the Mayer's frog stories with a script as a model. All story retells were audio-recorded and later transcribed using SALT. Samples were segmented into modified C-units and coded using the standard SALT procedure for errors: [EO:_] to mark overgeneralization errors, [EW:_] to mark other errors at the word level, [EU:_] to mark errors at the utterance level, and * to code for omissions of words and bound morphemes. These coded errors are used by SALT to estimate the percentage of ungrammatical utterances in the analysis set.

Children were administered all testing in Spanish first and in English approximately a week later. The language sample transcription of all language samples produced for the parent study was completed by research laboratories at the University of Wisconsin and Temple University using SALT. A strict protocol for the transcription and coding of the language samples was developed and closely monitored by the investigators of the parent study. All samples were transcribed and coded by a research assistant and reviewed by a second research assistant. In addition to this protocol, the first author of this study reviewed 100 randomly chosen samples to establish agreement in error coding. Agreement was calculated at 97% for coding of errors.

### *Analysis*

Growth curve modeling was used to analyze the growth in the PGU in English (English PGU) and Spanish (Spanish PGU) over time with time nested within participants. All models were estimated with the MIXED command in Stata Version 15 (StataCorp, 2017). PGU in both Spanish and English was transformed to the log of odds of PGU (PGUL = $\log_{(PGU/1\ -\ PGU)}$) to normalize the distribution of its residuals. This was particularly important for Spanish PGU, which was distributed with negative skew with a high frequency of observations at 100%. For all analyses, age was centered at the mean age of the sample (83 months). See descriptive data by language and language of instruction in Tables 1 and 2. To structure the data in this study appropriately, we constructed a data file in hyperunivariate form (i.e., one where all observed scores for all individuals are stacked into a single variable and the observation is coded with respect to the individual who generated the score, the language in which the score was measured, and the age at which the observation was made). We first estimated a model that partitioned the variance in PGUL by language of the outcome (Spanish and English) and language of instruction (bilingual and English-only; Model 1). In Model 1, the variance was allowed to differ as a function of the language of the outcome and according to language of instruction groups. This is a three-level model with individual observations at Level 1, time in months at Level 2, and the child at Level 3. Thus, the language in which the observation is measured is modeled at Level 1. In Model 1, we also partitioned the variance in scores by allowing the intercepts to vary by language of the outcome and language of instruction, which resulted in two intercepts for each child in each instructional group: English-PGUL and Spanish-PGUL for each child in English-only instruction and English-PGUL

**Table 1.** English descriptive statistics for story retell measures by language of instruction and grade.

| | | English instruction | | | | | Bilingual instruction | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Term** | **Variable** | **Obs** | ***M*** | ***SD*** | **Min** | **Max** | **Obs** | ***M*** | ***SD*** | **Min** | **Max** |
| Fall K | Age | 222 | 66.2 | 3.9 | 58.0 | 81.0 | 299 | 67.6 | 4.1 | 59.0 | 82.0 |
| | NUT | 222 | 26.3 | 11.3 | 1.0 | 76.0 | 299 | 22.9 | 11.3 | 1.0 | 58.0 |
| | NDW | 222 | 54.1 | 21.8 | 1.0 | 128.0 | 299 | 47.7 | 23.0 | 2.0 | 110.0 |
| | MLUw | 222 | 5.5 | 1.2 | 1.0 | 9.0 | 299 | 5.4 | 1.3 | 1.6 | 8.6 |
| | SI | 222 | 1.0 | 0.2 | 0.0 | 1.4 | 299 | 1.0 | 0.2 | 0.0 | 1.4 |
| | PGU | 222 | 47.8 | 17.6 | 5.6 | 100.0 | 299 | 44.3 | 20.5 | 0.0 | 100.0 |
| Spring K | Age | 248 | 73.1 | 3.9 | 65.0 | 89.0 | 440 | 74.1 | 4.0 | 65.0 | 88.0 |
| | NUT | 248 | 29.2 | 10.6 | 4.0 | 65.0 | 440 | 25.4 | 11.5 | 1.0 | 90.0 |
| | NDW | 248 | 69.0 | 22.3 | 10.0 | 129.0 | 440 | 59.3 | 25.8 | 4.0 | 159.0 |
| | MLUw | 248 | 6.6 | 1.2 | 2.6 | 9.4 | 440 | 6.3 | 1.4 | 1.0 | 10.5 |
| | SI | 248 | 1.1 | 0.1 | 0.4 | 1.5 | 440 | 1.1 | 0.2 | 0.0 | 1.6 |
| | PGU | 248 | 49.7 | 18.5 | 10.0 | 94.7 | 440 | 39.9 | 19.6 | 0.0 | 100.0 |
| Fall 1st | Age | 347 | 78.8 | 5.1 | 69.0 | 102.0 | 643 | 80.5 | 5.2 | 69.0 | 101.0 |
| | NUT | 347 | 37.9 | 12.7 | 4.0 | 85.0 | 643 | 33.6 | 13.5 | 3.0 | 90.0 |
| | NDW | 347 | 77.3 | 24.4 | 14.0 | 156.0 | 643 | 68.4 | 28.1 | 10.0 | 164.0 |
| | MLUw | 347 | 6.4 | 0.9 | 2.6 | 10.6 | 643 | 6.3 | 1.2 | 1.9 | 9.3 |
| | SI | 347 | 1.1 | 0.1 | 0.6 | 1.6 | 643 | 1.0 | 0.2 | 0.0 | 1.4 |
| | PGU | 347 | 53.6 | 19.1 | 5.0 | 91.7 | 643 | 40.6 | 19.1 | 0.0 | 100.0 |
| Spring 1st | Age | 348 | 86.0 | 4.8 | 78.0 | 108.0 | 701 | 86.7 | 4.9 | 77.0 | 108.0 |
| | NUT | 348 | 40.0 | 14.5 | 10.0 | 116.0 | 701 | 35.6 | 13.3 | 2.0 | 102.0 |
| | NDW | 348 | 81.8 | 20.8 | 19.0 | 153.0 | 701 | 70.8 | 22.8 | 8.0 | 152.0 |
| | MLUw | 348 | 7.0 | 0.9 | 4.7 | 10.8 | 701 | 7.0 | 1.1 | 3.8 | 10.8 |
| | SI | 348 | 1.1 | 0.1 | 0.7 | 1.5 | 701 | 1.1 | 0.1 | 0.0 | 1.6 |
| | PGU | 348 | 65.6 | 16.3 | 15.4 | 97.1 | 701 | 49.9 | 19.3 | 0.0 | 100.0 |
| Fall 2nd | Age | 293 | 90.5 | 4.8 | 82.0 | 114.0 | 600 | 91.7 | 4.4 | 82.0 | 111.0 |
| | NUT | 293 | 40.6 | 9.4 | 22.0 | 86.0 | 600 | 37.1 | 10.4 | 7.0 | 81.0 |
| | NDW | 293 | 88.5 | 18.8 | 41.0 | 138.0 | 600 | 80.2 | 21.8 | 15.0 | 157.0 |
| | MLUw | 293 | 6.8 | 0.8 | 3.9 | 9.1 | 600 | 6.8 | 0.8 | 4.3 | 10.4 |
| | SI | 293 | 1.1 | 0.1 | 0.7 | 1.4 | 600 | 1.1 | 0.1 | 0.5 | 1.5 |
| | PGU | 293 | 65.4 | 15.2 | 13.8 | 94.7 | 600 | 50.9 | 18.1 | 5.6 | 92.1 |
| Spring 2nd | Age | 267 | 97.5 | 4.5 | 89.0 | 115.0 | 586 | 98.2 | 4.3 | 89.0 | 118.0 |
| | NUT | 267 | 39.7 | 9.4 | 21.0 | 103.0 | 586 | 38.3 | 10.8 | 6.0 | 125.0 |
| | NDW | 267 | 104.5 | 19.9 | 52.0 | 196.0 | 586 | 100.5 | 23.4 | 28.0 | 198.0 |
| | MLUw | 267 | 7.9 | 1.0 | 5.5 | 11.4 | 586 | 8.1 | 1.1 | 4.8 | 12.4 |
| | SI | 267 | 1.3 | 0.1 | 1.0 | 1.8 | 586 | 1.3 | 0.1 | 0.8 | 1.9 |
| | PGU | 267 | 70.5 | 14.1 | 19.1 | 98.2 | 586 | 55.5 | 18.8 | 5.6 | 93.0 |

*Note.* NUT = number of utterances; NDW = number of different words; MLUw = mean length of utterance in words; SI = subordination index; PGU = percentage of grammatical utterances.

and Spanish-PGUL for each child in bilingual instruction. Model 1 also included two Level 3 variances and one covariance per group to capture differences in the child-level means across children and the tendency for scores in English and Spanish to covary while also allowing the variances and covariance to differ based on the language of instruction. In addition, separate Level 1 (i.e., residual) variances were also estimated by language of the outcome and language of the instructional group. See Table 4 for random effects by model.

The equation for Model 1 is

$$\mathrm{PGUL}_{itlg} = \gamma_{001\mathrm{g}} + \cup_{0ilg} + \in_{itlg}, \quad (1)$$

where PGUL is the log-odds of the proportion of grammatically correct utterances in language $l$ for person $i$ in instructional group $g$ at time $t$. Thus, $l$ is an index designating the language of the outcome (Spanish or English) and $g$ is an index designating the language of instruction grouping (bilingual instruction or English-only instruction), $i$ is an index designating the individual and ranging from 1 to $N_g$, and $t$ is an index designating time that ranges from 1 to 6. In Equation 1, the variables define a person-specific intercept, $\cup_{0i}$, which varies randomly across people, and a random error residual, $\in_{it}$, which captures the extent to which the log-odds for person $i$ at a time $t$ deviate from the expected log-odds plus the person specific residual. The model in Equation 1 is estimated in such a way as to allow for the intercept $\gamma_{00}$ to be specific to each language and each instructional group, hence the additional subscripts $l$ and $g$ on the intercept, as well as to allow that the variance in the random person residual is a function of the language of the outcome and the instructional program, as is the variance in the random error residual. Consequently, both the random person residual and the random residual at each time point have variances that differ across language and instructional groups. Taken together, the approach to estimating Equation 1 allows for distinct predicted values of PGUL by

**Table 2.** Spanish descriptive statistics for story retell measures by language of instruction and grade.

| | | Bilingual instruction | | | | | English instruction | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Term** | **Variable** | **Obs** | ***M*** | ***SD*** | **Min** | **Max** | **Obs** | ***M*** | ***SD*** | **Min** | **Max** |
| Fall K | Age | 479 | 66.8 | 4.0 | 58.0 | 82.0 | 239 | 66.1 | 3.9 | 57.0 | 81.0 |
| | NUT | 479 | 25.5 | 10.1 | 2.0 | 73.0 | 239 | 23.5 | 10.5 | 2.0 | 71.0 |
| | NDW | 479 | 55.7 | 19.5 | 4.0 | 117.0 | 239 | 50.2 | 19.0 | 4.0 | 108.0 |
| | MLUw | 479 | 4.7 | 0.9 | 1.9 | 7.9 | 239 | 4.6 | 0.8 | 2.2 | 7.6 |
| | SI | 479 | 1.1 | 0.1 | 1.0 | 1.6 | 239 | 1.1 | 0.1 | 1.0 | 1.5 |
| | PGU | 479 | 95.9 | 6.6 | 12.5 | 100.0 | 239 | 94.9 | 8.4 | 40.0 | 100.0 |
| Spring K | Age | 536 | 73.9 | 4.1 | 65.0 | 92.0 | 252 | 72.8 | 3.9 | 65.0 | 89.0 |
| | NUT | 536 | 31.2 | 10.2 | 6.0 | 106.0 | 252 | 26.8 | 9.9 | 7.0 | 78.0 |
| | NDW | 536 | 73.8 | 19.9 | 20.0 | 177.0 | 252 | 63.6 | 19.2 | 22.0 | 123.0 |
| | MLUw | 536 | 5.7 | 1.0 | 3.2 | 9.0 | 252 | 5.5 | 1.0 | 2.9 | 8.7 |
| | SI | 536 | 1.2 | 0.1 | 1.0 | 1.7 | 252 | 1.2 | 0.1 | 1.0 | 1.8 |
| | PGU | 536 | 91.0 | 9.3 | 28.6 | 100.0 | 252 | 89.0 | 10.4 | 42.9 | 100.0 |
| Fall 1st | Age | 707 | 79.8 | 5.1 | 69.0 | 101.0 | 342 | 78.4 | 5.2 | 69.0 | 101.0 |
| | NUT | 707 | 39.0 | 13.3 | 7.0 | 112.0 | 342 | 34.6 | 12.9 | 4.0 | 92.0 |
| | NDW | 707 | 82.8 | 23.1 | 15.0 | 184.0 | 342 | 71.3 | 22.3 | 17.0 | 146.0 |
| | MLUw | 707 | 5.6 | 0.9 | 2.5 | 8.7 | 342 | 5.3 | 0.8 | 2.8 | 7.8 |
| | SI | 707 | 1.2 | 0.1 | 1.0 | 1.6 | 342 | 1.1 | 0.1 | 1.0 | 1.5 |
| | PGU | 707 | 90.3 | 10.4 | 27.0 | 100.0 | 342 | 87.6 | 13.5 | 25.0 | 100.0 |
| Spring 1st | Age | 727 | 86.3 | 4.8 | 77.0 | 107.0 | 346 | 85.6 | 4.8 | 78.0 | 108.0 |
| | NUT | 727 | 38.2 | 13.9 | 2.0 | 130.0 | 346 | 35.0 | 14.3 | 6.0 | 115.0 |
| | NDW | 727 | 79.0 | 18.9 | 6.0 | 152.0 | 346 | 69.4 | 19.2 | 15.0 | 135.0 |
| | MLUw | 727 | 6.1 | 1.0 | 2.9 | 9.6 | 346 | 5.7 | 1.0 | 3.0 | 8.9 |
| | SI | 727 | 1.2 | 0.1 | 1.0 | 1.7 | 346 | 1.2 | 0.1 | 1.0 | 1.6 |
| | PGU | 727 | 89.6 | 11.8 | 8.3 | 100.0 | 346 | 83.1 | 15.8 | 21.1 | 100.0 |
| Fall 2nd | Age | 608 | 91.3 | 4.4 | 82.0 | 111.0 | 298 | 90.3 | 4.8 | 82.0 | 114.0 |
| | NUT | 608 | 37.6 | 8.4 | 10.0 | 67.0 | 298 | 33.4 | 9.5 | 2.0 | 68.0 |
| | NDW | 608 | 82.7 | 17.3 | 16.0 | 135.0 | 298 | 71.6 | 19.2 | 8.0 | 146.0 |
| | MLUw | 608 | 5.9 | 0.8 | 3.5 | 8.9 | 298 | 5.6 | 0.9 | 3.4 | 12.5 |
| | SI | 608 | 1.2 | 0.1 | 1.0 | 1.9 | 298 | 1.2 | 0.1 | 1.0 | 1.5 |
| | PGU | 608 | 91.7 | 9.6 | 34.5 | 100.0 | 298 | 88.8 | 13.6 | 25.0 | 100.0 |
| Spring 2nd | Age | 583 | 97.9 | 4.3 | 89.0 | 117.0 | 261 | 97.2 | 4.5 | 89.0 | 115.0 |
| | NUT | 583 | 37.5 | 9.0 | 7.0 | 82.0 | 261 | 33.1 | 10.1 | 1.0 | 84.0 |
| | NDW | 583 | 95.7 | 18.3 | 31.0 | 160.0 | 261 | 82.4 | 21.1 | 11.0 | 152.0 |
| | MLUw | 583 | 7.2 | 1.1 | 3.8 | 11.1 | 261 | 6.7 | 1.1 | 4.1 | 12.0 |
| | SI | 583 | 1.4 | 0.2 | 1.0 | 2.0 | 261 | 1.3 | 0.2 | 1.0 | 1.9 |
| | PGU | 583 | 77.1 | 12.1 | 15.8 | 100.0 | 261 | 69.0 | 18.7 | 0.0 | 100.0 |

*Note.* NUT = number of utterances; NDW = number of different words; MLUw = mean length of utterance in words; SI = subordination index; PGU = percentage of grammatical utterances.

language of the outcome and by group and allows that the variance components of the model to differ by language of the outcome and by group. The model does constrain the residual error variance to be constant and independent over time and independent of the random person residual. The random person residuals are allowed to correlate across languages, and the random error residuals are also allowed to correlate across languages, although the two types of residuals (person and error) are independent of one another.

Subsequent models aimed to further explain the variability in PGUL, first by introducing effects of age to model change over time. Models 2 and 3 introduced the growth parameters into the model with age measured in months. Model 2 estimated a common slope across individuals but allowed the slope to vary as a function of the language of the outcome and instructional group. Model 3 allowed the slope for age to vary randomly across subjects and for this variance to differ as a function of the language of the outcome and instructional group. Thus, Models 2 and 3 are both described by Equation 2, with the difference between them being that Model 2 constrains the variance of the person specific Age Slope ($\cup_{1ilg}$) to 0 and Model 3 allows the variance of this slope to be nonzero. In Models 2 and 3, random effects were allowed to differ by the language of the outcome and the instructional group, as were the intercept ($\gamma_{00lg}$) and the slope with respect to age ($\gamma_{10lg}$) as evidenced by their *l* and *g* subscripts in Equation 2.

$$\mathrm{PGUL}_{itlg} = \gamma_{00lg} + \cup_{0ilg} + \gamma_{10lg} \times \mathrm{Age}_{it} + \cup_{1ilg} \times \mathrm{Age}_{it} + \in_{itlg} \quad (2)$$

After the growth parameters were estimated in the model, we proceeded to examine between subject variables that could explain variance in the intercepts, the random slopes with respect to age, and also the within person residuals ($\in_{itlg}$). We included gender and low grammaticality in both languages at the onset of the study in Model 4.

Model 5, our final model, included MLUw and SI as time-varying covariates in the model to ensure that the growth of PGUL was not explained by the length of the utterance, the complexity of the utterance, or the NDWs used in the story. These time-varying covariates were entered into the model in two parts, a child-level mean component within each language that was centered at the grand mean for all children and at the time-specific deviation from the child-level mean. That is, the deviations were centered at the child-level mean within each language. In so far as these measures vary across children and within child over time, their inclusion in the model would be expected to account for both within-person, as well as between-persons, variation.

## Results

Descriptive statistics for PGU by language and language of instruction are provided in Tables 1 and 2. Random effects and fixed effects for all models are shown in Tables 3 and 4, respectively. The results of Model 1 suggested that intercepts varied randomly across individuals as a function of the outcome language and language of instruction. Variance estimates suggested that most of the variance in PGUL was within person, indicating the potential to account for this variability by modeling the effect of time. For children in bilingual programs, 68% of the variance in PGUL in English and 92% of the variance in Spanish was attributed to differences within children. For children instructed in English only, 66% of the variance in PGUL in English and 79% of the variance in PGUL in Spanish were attributed to differences within children. The fixed effects for Model 1 showed that, on average, children in both instructional groups had higher PGUL in Spanish than in English. Specifically, the mean PGUL in Spanish was 2.6 and 2.3 for Spanish and English instructional groups, respectively, whereas mean PGUL in English was −0.148 and 0.427. At the same time, the significant variability within child suggests that these child-level averages do not tell the whole story.

In Model 2, we included age both as a fixed and as a random factor to account for both the average and the child-specific developmental trends. The results of Model 2 show that the developmental trend is both a function of the language of the outcome and the instructional group. Specifically, the coefficients for age suggested that PGUL in English increased as children got older, whereas PGUL in Spanish decreased as children got older. Moreover, the strength of these effects differed across language of instruction groups, with the English-instructed students showing a faster rate of decline in PGUL in Spanish and faster rate of increase in PGUL in English. Model estimates shows that, at the onset of the study, PGUL in Spanish was 3.741 for children in bilingual instruction and 3.589 for children in English-only instruction, whereas PGUL in English was −0.568 for children in English-only instruction and −0.831 for children in bilingual instruction. Thus, children in both instructional groups had higher grammatical skills in Spanish than in English at that outset, with the coefficients for age indicating that Spanish grammatical skills declined over time whereas English grammatical skills improved. Although this pattern was true for children in both language of instruction groups, the rate of increase in English and the rate of decrease in Spanish were greater for children instructed in English as evidenced by the age slopes (mean age slope for PGUL in Spanish = −0.050 and −0.058 for Spanish and English instruction groups, respectively; mean age slope for PGUL in English = 0.027 and 0.041 for Spanish and English instruction groups, respectively). Importantly, performance in the two languages tended to be negatively related at the child level within instructional groups as evidenced by the covariance between random intercepts, which was −0.183 and −0.155 for English- and Spanish-instructed students, respectively.[1]

Visual inspection of the distribution of residuals by age for Model 2 suggested that including a quadratic term in the model could result in a better fit to the data. Therefore, Model 3 included a fixed quadratic term ($Age^2$). The likelihood deviance test statistic showed that a model including a quadratic term was better than the model without it. When a random quadratic effect was included, the model estimation failed to converge. Therefore, Model 3 was deemed as the best unconditional growth model to fit the data. This model explained 25% of the within-person variance for PGUL in Spanish in bilingual instruction, 33% for PGUL in Spanish in English instruction, 56% for PGUL in English in bilingual instruction, and 49% for PGUL in English in English instruction.

Model 3 also included a covariance matrix between intercepts and slopes. The covariances between intercepts and slopes were transformed into correlations, which resulted in large and positive correlations for PGUL in Spanish for Spanish-instructed (estimate = 0.939) and English-instructed students (estimate = 0.701), and smaller and negative correlations for PGUL in English (estimate = −0.177 for Spanish-instructed students; estimate = −0.380 for English-instructed students). These positive correlations in Spanish between the residuals of the intercept and the slope indicated a strong relationship between PGUL at 83 months and the growth rate for the children in this study. Visual inspection of scatter plots between the intercept at the first time of testing and slope revealed an interesting pattern for PGUL in Spanish: Children with the highest PGUL in Spanish declined the least.

We proceeded to examine between-subjects variables that could explain additional variance in the model. Gender was introduced into the conditional model at the intercept and slope (together and separately) using dummy coded variables, but the likelihood deviance test was not significant.

[1]When data are clustered, such as students within classrooms, the total covariance is a function of the covariance between the cluster means and the within-cluster covariance. These can be of the same sign or of opposite signs. The within-cluster covariance describes how scores for the same child within a cluster move together (positive covariance) or in opposite direction (negative covariance). In our model, this within-cluster covariance is measured by the covariance of the child intercepts.

**Table 3.** Random effects.

| Variance components | Model 1 | | Model 2 | | Model 3 | | Model 4 | | Model 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Estimate | *SE* | Estimate | *SE* | Estimate | *SE* | Estimate | *SE* | Estimate | *SE* |
| Level 1 | | | | | | | | | | |
| EB | 0.712 | 0.020 | 0.398 | 0.018 | 0.398 | 0.012 | 0.398 | 0.012 | 0.379 | 0.012 |
| SB | 1.458 | 0.039 | 1.147 | 0.031 | 1.090 | 0.032 | 1.050 | 0.030 | 0.983 | 0.028 |
| EE | 0.560 | 0.021 | 0.280 | 0.015 | 0.275 | 0.012 | 0.274 | 0.012 | 0.265 | 0.011 |
| SE | 1.592 | 0.061 | 1.133 | 0.047 | 1.070 | 0.046 | 1.043 | 0.044 | 0.956 | 0.041 |
| Level 2 | | | | | | | | | | |
| EB | 0.332 | 0.026 | 0.338 | 0.022 | 0.338 | 0.024 | 0.330 | 0.024 | 0.322 | 0.024 |
| SB | 0.127 | 0.025 | 0.236 | 0.028 | 0.251 | 0.027 | 0.192 | 0.023 | 0.149 | 0.020 |
| EB sl | | | 0.002 | 0.000 | 0.002 | 0.000 | 0.002 | 0.000 | 0.002 | 0.000 |
| SB sl | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| cov EB SB | –0.114 | 0.017 | –0.155 | 0.018 | –0.158 | 0.018 | –0.130 | 0.017 | –0.110 | 0.016 |
| cov ES, EB sl | | | –0.004 | 0.001 | –0.004 | 0.001 | –0.004 | 0.001 | –0.006 | 0.001 |
| cov EB, SB sl | | | –0.001 | 0.000 | –0.002 | 0.000 | –0.002 | 0.000 | –0.002 | 0.000 |
| cov SB, EB sl | | | 0.009 | 0.002 | 0.009 | 0.002 | 0.009 | 0.001 | 0.006 | 0.001 |
| cov SB, SB sl | | | 0.002 | 0.000 | 0.003 | 0.001 | 0.003 | 0.000 | 0.002 | 0.000 |
| cov EB sl, SB sl | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| EE | 0.285 | 0.031 | 0.373 | 0.033 | 0.364 | 0.033 | 0.360 | 0.033 | 0.341 | 0.032 |
| SE | 0.419 | 0.058 | 0.521 | 0.062 | 0.548 | 0.062 | 0.464 | 0.055 | 0.417 | 0.050 |
| EE sl | | | 0.001 | 0.000 | 0.001 | 0.000 | 0.001 | 0.000 | 0.001 | 0.000 |
| SB sl | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| cov EE, SE | –0.139 | 0.030 | –0.183 | 0.033 | –0.190 | 0.033 | –0.175 | 0.031 | –0.143 | 0.030 |
| cov EE, EE sl | | | –0.007 | 0.002 | –0.007 | 0.002 | –0.007 | 0.002 | –0.009 | 0.002 |
| cov EE, SE sl | | | –0.002 | 0.001 | –0.003 | 0.001 | –0.003 | 0.001 | –0.004 | 0.001 |
| cov SE, EE sl | | | 0.009 | 0.002 | 0.010 | 0.002 | 0.011 | 0.002 | 0.008 | 0.002 |
| cov SE, SE sl | | | 0.005 | 0.001 | 0.007 | 0.001 | 0.007 | 0.001 | 0.006 | 0.001 |
| cov EE sl, SE sl | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

*Note.* EE = English in English-only instruction; EB = English in bilingual instruction; SE = Spanish in English-only instruction; SB = Spanish in Bilingual instruction.

Therefore, we concluded that neither the intercept nor the slope of PGUL differed by gender.

In order to continue to explore between-subjects variables that could explain variability, Model 4 included a between-subjects variable related to low grammaticality in both languages at the onset of the study named *LowGram* in the model (coded 1 for children with LowGram and 0 for all other children). The LowGram variable represented those children who at the onset of the study had a PGU below 80% in both Spanish and English. There were 51 boys and 23 girls in this group for a total of 74 children in the sample (7% of children in the study). Twenty-nine of these children had instruction in English only (20 boys and nine girls), whereas 44 were instructed also in Spanish (31 boys and 13 girls). We considered whether these student characteristics explained variability in the intercepts and the slopes with respect to age.

LowGram had a negative impact on the intercept (centered at 83 months) for Spanish in both bilingual instruction and English-only instruction groups, indicating that PGUL in Spanish for these children continued to lag behind their peers at 83 months. It is important to note that the standard error around the intercept for LowGram was larger than the standard error for other estimates in the model indicating that these estimates are less precise. LowGram also interacted with age for PGUL in Spanish, indicating that the Spanish grammatical skills in these children develop at a rate that differed from the other children: Spanish showed a plateau effect, whereas English continued to grow in the children in the LowGram group in both instructional groups. The likelihood deviance test statistic showed that a model including LowGram was better than the model without it. Therefore, we concluded that having low grammaticality in both languages at the onset of the study was a significant factor on the PGUL performance over time.

Model 5 included MLUw and SI as time-varying covariates to control for the potential effect of these measures on the growth of PGUL. As described in the methods, these measures were entered into the model as a time-invariant child-level mean value to capture differences between children and as a time-varying deviation from the child-level mean to capture within-child variation due to MLUw and SI. As these measures are known to vary across children and within child over time, they explained additional within-person and between-persons variation. Model 5, the final model, explained 33% of the within-person variability for PGUL in Spanish in bilingual instruction, 40% for PGUL in Spanish in English instruction, 47% for PGUL in English in bilingual instruction, and 53% for PGUL in English in English instruction. Regarding between-persons variability, Model 5 explained more variability in the growth trajectories for PGUL in Spanish in Spanish-instructed students (41%) as compared to English-instructed students (24%). The percentage of between-persons variability in PGUL in

**Table 4.** Fixed effects.

| | Model 1 | | | Model 2 | | | Model 3 | | | Model 4 | | | Model 5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Estimate** | ***SE*** | **Sig** | **Estimate** | ***SE*** | **Sig** | **Estimate** | ***SE*** | **Sig** | **Estimate** | ***SE*** | **Sig** | **Estimate** | ***SE*** | **Sig** |
| PGUL | | | | | | | | | | | | | | | |
| SS | 2.614 | 0.024 | *** | 2.591 | 0.024 | *** | 2.704 | 0.030 | *** | 2.794 | 0.029 | *** | 2.763 | 0.027 | *** |
| SE | 2.310 | 0.046 | *** | 2.253 | 0.043 | *** | 2.375 | 0.051 | *** | 2.489 | 0.049 | *** | 2.513 | 0.049 | *** |
| ES | –0.148 | 0.026 | *** | –0.190 | 0.025 | *** | –0.213 | 0.026 | *** | –0.236 | 0.027 | *** | –0.227 | 0.027 | *** |
| EE | 0.427 | 0.033 | *** | 0.375 | 0.033 | *** | 0.434 | 0.035 | *** | 0.416 | 0.036 | *** | 0.405 | 0.036 | *** |
| Age | | | | | | | | | | | | | | | |
| SS | | | | –0.050 | 0.002 | *** | –0.050 | 0.002 | *** | –0.051 | 0.002 | *** | –0.032 | 0.002 | *** |
| SE | | | | –0.058 | 0.003 | *** | –0.058 | 0.003 | *** | –0.061 | 0.003 | *** | –0.042 | 0.003 | *** |
| ES | | | | 0.028 | 0.001 | *** | 0.027 | 0.001 | *** | 0.027 | 0.001 | *** | 0.034 | 0.002 | *** |
| EE | | | | 0.041 | 0.002 | *** | 0.040 | 0.002 | *** | 0.040 | 0.002 | *** | 0.046 | 0.002 | *** |
| Age × Age | | | | | | | | | | | | | | | |
| SS | | | | | | | –0.001 | 0.000 | *** | –0.001 | 0.000 | *** | –0.001 | 0.000 | *** |
| SE | | | | | | | –0.001 | 0.000 | *** | –0.001 | 0.000 | *** | –0.001 | 0.000 | *** |
| ES | | | | | | | 0.000 | 0.000 | * | 0.000 | 0.000 | | 0.000 | 0.000 | |
| EE | | | | | | | –0.001 | 0.000 | *** | –0.001 | 0.000 | *** | –0.001 | 0.000 | *** |
| LowGram | | | | | | | | | | | | | | | |
| SS | | | | | | | | | | –1.422 | 0.100 | *** | –1.426 | 0.094 | *** |
| SE | | | | | | | | | | –1.420 | 0.151 | *** | –1.435 | 0.146 | *** |
| ES | | | | | | | | | | 0.368 | 0.097 | *** | 0.339 | 0.094 | *** |
| EE | | | | | | | | | | 0.250 | 0.115 | * | 0.219 | 0.110 | * |
| Slope of LowGram | | | | | | | | | | | | | | | |
| SS | | | | | | | | | | 0.061 | 0.008 | *** | 0.054 | 0.008 | *** |
| SE | | | | | | | | | | 0.048 | 0.010 | *** | 0.043 | 0.010 | *** |
| ES | | | | | | | | | | 0.006 | 0.006 | | 0.004 | 0.006 | |
| EE | | | | | | | | | | –0.011 | 0.006 | | –0.011 | 0.006 | |
| MLU between | | | | | | | | | | | | | | | |
| SS | | | | | | | | | | | | | –0.012 | 0.041 | |
| SE | | | | | | | | | | | | | 0.077 | 0.064 | |
| ES | | | | | | | | | | | | | –0.089 | 0.049 | |
| EE | | | | | | | | | | | | | –0.060 | 0.082 | |
| SI between | | | | | | | | | | | | | | | |
| SS | | | | | | | | | | | | | 2.222 | 0.351 | *** |
| SE | | | | | | | | | | | | | 2.290 | 0.618 | *** |
| ES | | | | | | | | | | | | | 1.680 | 0.454 | *** |
| EE | | | | | | | | | | | | | 1.882 | 0.790 | * |
| MLU within | | | | | | | | | | | | | | | |
| SS | | | | | | | | | | | | | –0.153 | 0.044 | *** |
| SE | | | | | | | | | | | | | –0.203 | 0.067 | ** |
| ES | | | | | | | | | | | | | –0.152 | 0.056 | ** |
| EE | | | | | | | | | | | | | –0.352 | 0.090 | *** |
| SI within | | | | | | | | | | | | | | | |
| SS | | | | | | | | | | | | | –1.627 | 0.370 | *** |
| SE | | | | | | | | | | | | | –1.979 | 0.639 | ** |
| ES | | | | | | | | | | | | | –2.571 | 0.503 | *** |
| EE | | | | | | | | | | | | | –1.224 | 0.848 | |

*Note.* PGUL = percentage of grammatical utterances; MLU = mean length of utterance; SI = subordination index; EE = English in English-only instruction; EB = English in bilingual instruction; SE = Spanish in English-only instruction; SB = Spanish in Bilingual instruction.

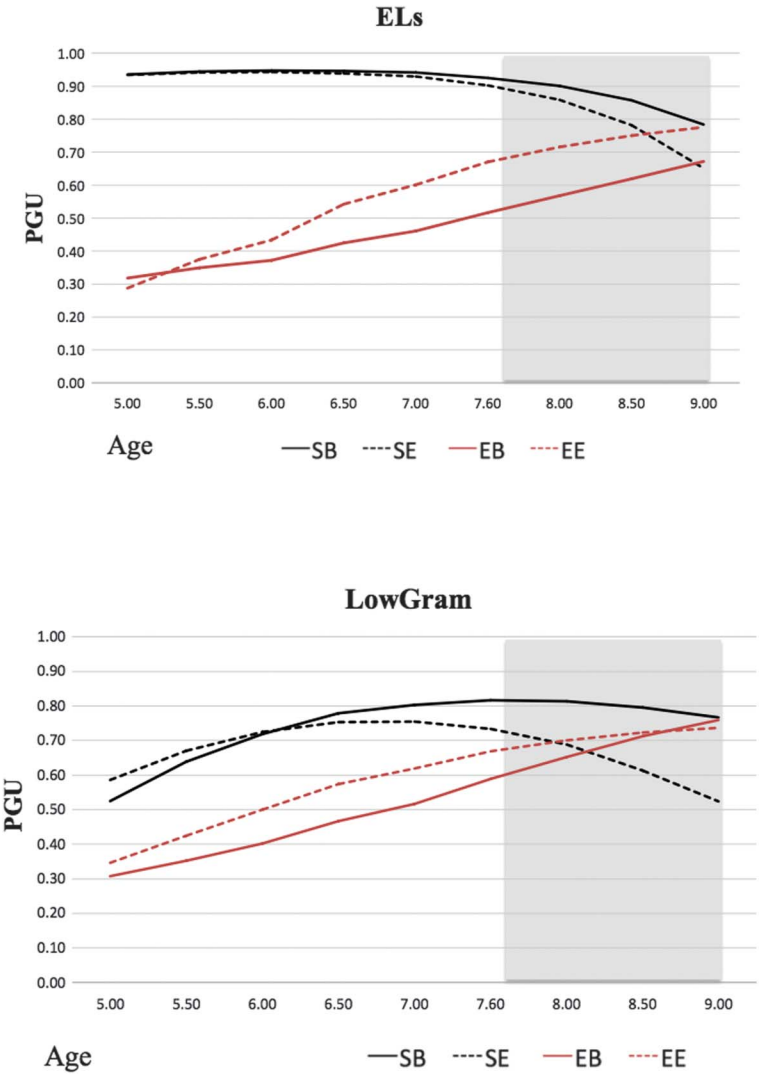
English that was explained by the model was considerably less. Specifically, the model accounted for only 6% of the between-persons variance in PGUL in English among English-instructed students and only 5% among Spanish-instructed students.

Figure 1 shows the results of Model 5 for ELs in the study (top) and for children in the LowGram group (bottom) after transforming the model results back onto the PGU scale from the log of the logit scale. This figure suggests that the children in the LowGram group were clearly differentiated from the other ELs before the age of 7 years. However, after the age of 8 years, the PGU curves in both Spanish and English are less differentiated between ELs and children in the LowGram group. In addition, Figure 2 depicts individual growth curves for all children in the study using the logit as the outcome scale to depict the variability seen in individual profiles.

## Discussion

The goal of this study was to examine the growth patterns of PGU in both Spanish and English in Spanish-speaking ELs attending either English-only or Spanish–English instruction. At the onset of the study, children

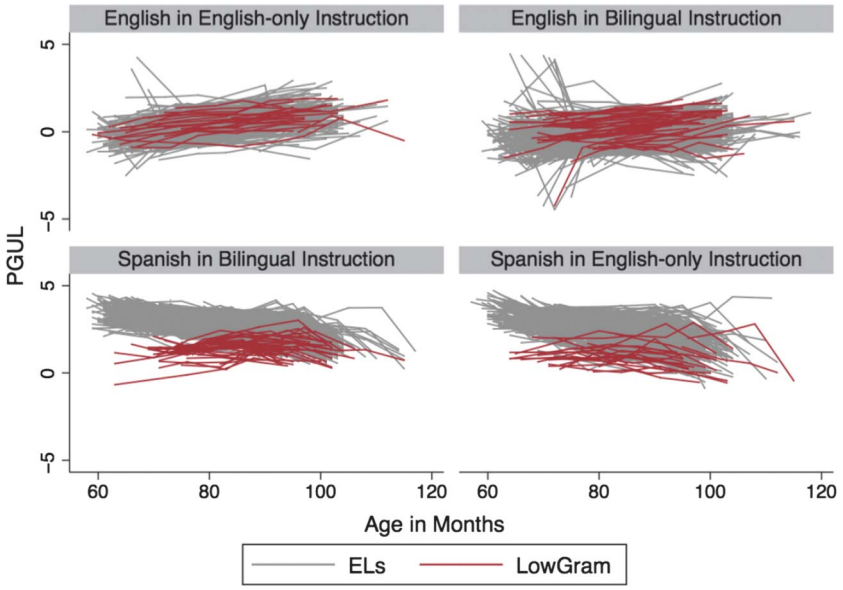
**Figure 1.** Fitted growth trajectories in Spanish and English percentage of grammatical utterances (PGU) by language of instruction for English learners (ELs) and LowGram. Shaded gray area represents overlapping between the two groups. EE = English in English-only instruction; EB = English in bilingual instruction; SE = Spanish in English-only instruction; SB = Spanish in bilingual instruction.




showed high grammaticality in Spanish (over 90% at the age of 5 years) and low grammaticality in English due to the limited knowledge of the language at that point in their development. Growth curve analysis indicated that PGU in English improved over time whereas PGU in Spanish declined in both instructional groups. However, those children who were attending bilingual programs showed a slower rate of decline in Spanish PGU and a slower rate of improvement in English PGU. The decline of Spanish PGU started approximately at the age of 7 years in both English-only and bilingual instruction programs. By the age of 9 years, children in English-only programs had approximately a PGU of 65% in Spanish whereas children in bilingual instruction had an average PGU of 80%. The improvement in English PGU seems to be steady from the age of 5 years until the age of 9 years with a small difference in the rate of growth benefiting children in English-only programs. At the end of the study, children had an average PGU in English below 80% for both instructional groups.

We predicted that PGU in Spanish was going to decrease over time whereas PGU in English would increase documenting the shift in language proficiency during the school years. Our results supported this hypothesis showing the initial phase of a shift in language proficiency, as indexed by grammaticality, for these children. These findings are in agreement with previous studies showing a decrease of Spanish skills (Anderson, 1999a, 1999b; Guiberson et al., 2015) whereas English skills improved (Wood Jackson et al., 2014). This shift in language proficiency has been previously reported in the literature (e.g., Anderson, 2004; Fillmore, 1991; Montrul, 2011; Silva-Corvalán, 1994), but this study is the first to show evidence of this shift in terms of grammatical

**Figure 2.** Growth curves in log of odds of percentage of grammatical utterances (PGUL). ELs = English learners.




productions between kindergarten and second grade. This shift occurred early during the school years, which is in agreement with the parental reports described in Lutz's (2008) study.

The decline in Spanish grammaticality skills evidenced in this study is in agreement with the results of Anderson (1999a, 1999b), who found an increase in Spanish errors over time for gender agreement of determiners, verbs, and the subjunctive mood. In addition, these results are in agreement with Guiberson et al. (2015), who observed an increase of Spanish grammatical errors per utterance over time in children who were not maintaining their home language.

Regarding the growth in English PGU, the results of this study are in agreement with Paradis (2016) and Gusewski and Rojas (2017) in that an important increase in English grammatical skills was evident over time. However, PGU in English at the end of this study was, on average, 80%, indicating that there was still further room for development since English monolingual children are at approximately 95% PGU at the age of 8 years (Guo & Schneider, 2016). Gusewski and Rojas (2017) reported tense marking accuracy at over 80% after 2 years of intensive English exposure in their study with younger children. The difference between these two studies might lie in that this study used a broad measure that includes all grammatical errors, whereas Gusewski and Rojas focused on verb tense accuracy. In addition, the children in Gusewki and Rojas' study were younger at the onset of the study and had more varied language profiles, whereas the children in this study were predominantly Spanish speakers at the onset of the study. The results of this study suggest that, to show mastery of a broad measure of grammaticality, such as PGU, more than 3 years of English exposure might be needed.

We predicted that the pattern of Spanish decline would not be observed in children who were receiving bilingual instruction. Our data, however, do not support this hypothesis. Despite evidence of the documented effectiveness of bilingual instructional programs for the language development of both Spanish and English (Rolstad et al., 2008), bilingual instruction was not enough to maintain general indices of grammaticality in the children in this study. In principle, our results are similar to those of Collins (2014) and Proctor et al. (2010), who showed significant gains in both Spanish and English for children in bilingual programs, with no gains in Spanish for children in English-only programs. Importantly, Proctor et al. observed a pattern of decline in reading performance in Spanish reading even for those children instructed in both languages. Our results suggest that a decline in Spanish grammatical skills is a characteristic of Spanish-speaking children growing up in the United States. In this study, bilingual instruction helped to make the decline less steep. Therefore, bilingual instruction seemed to offer a protective effect on the language skills of Spanish-speaking children. This effect in principle appears to be necessary for language maintenance (e.g., those in English instruction were worse), but it is not sufficient to maintain the grammaticality of the language. Restrepo et al. (2010) showed no effects of a 16-week 30-min per day supplemental Spanish language instruction on the PGU children produced in Spanish. Perhaps, more intensive programs are required to maintain or improve the grammaticality of the language. It is possible that larger protective effects will be seen in more intense bilingual instruction programs.

Are the effects seen in this study evidence of a period of first language loss? In principle, one can argue that the

patterns of high grammaticality in Spanish observed at the onset of this study with a decline over time are evidence of Spanish language loss. However, our current knowledge is limited to the fact that these children were producing more Spanish ungrammatical utterances, but the type of errors children were making is unknown at this time. Therefore, conclusions regarding language loss of specific Spanish grammatical structures cannot be made at this point. In addition, we cannot predict what occurs after the age of 9 years. It is possible that the grammatical domain is more vulnerable to shifts in proficiency during the ages of 7 and 9 years, but that a recovery effect in Spanish could be possible after the age of 10 years. It is likely that Spanish grammaticality will improve if these children are exposed to Spanish input of high quality and if the sociolinguistic characteristics of the environment change (e.g., environment where both Spanish and English are equally valued).

The pattern of decline in Spanish grammaticality with an increase in English grammaticality over time is better described in terms of bilingual effects than in terms of language loss (Castilla-Earls et al., 2015; Grüter & Paradis, 2014; Paradis & Genesse, 1996; Pirvulescu et al., 2013). Using the term *bilingual effect* to describe this shift offers an important advantage. The shift in language proficiency observed in this study seems to be the result of complex sociolinguistic circumstances and not of limitations in language learning abilities. In that sense, this process is completely normal among ELs growing up in language contexts such as the United States. The general assumption is that the English skills of these ELs will continue to grow, resulting in native-like English proficiency by adulthood.

Children in the LowGram group showed a different growth pattern than the other children in this study. Children in the LowGram group were identified as those children who had low PGU (< 80%) in both Spanish and English at the onset of the study. We believe that some of these children had DLD because their profile of low grammaticality in both languages is consistent with the widely reported findings of morphosyntactic difficulties characterizing this disorder (e.g., Bedore & Leonard, 2005; Restrepo, 1998; Simon-Cereijido & Gutiérrez-Clellen, 2007). In addition, children in the LowGram group represented about 7% of the sample, which is in line with current estimates of the prevalence of DLD (Tomblin et al., 1997). However, we cannot be certain that this is the case because only one measure of language skills was used in this study, and additional measures of language skills are needed to verify their language status (Peña, Bedore, & Kester, 2016).

The findings regarding language growth trajectories for children in the LowGram group offer important insights about language development and assessment in ELs. In Spanish, the PGU of children in the LowGram group improved to about 80% around the age of 8 years in bilingual instruction but showed a plateau effect in English-only instruction. Although there is an improvement in their grammaticality in comparison to the onset of the study, it is important to note that a PGU of 80% at the age of 8 years does not represent that these children have caught up with their peers (ELs are at about 90% PGU at the age of 8 years and about 95% PGU at the onset in Spanish). Although 80% has been proposed at the cutoff for identification of DLD in Spanish-speaking children, this cutoff applies only to younger children (Restrepo, 1998). It is expected that the cutoff at the age of 8 years will be higher than 80%, but there is currently no research evidence to establish a cutoff score at this age for Spanish-speaking children. Regarding English, ELs in the LowGram group in both bilingual instruction programs and in English-only instruction showed a continued increase in their English grammatical development closely following the developmental pattern of the ELs in the study. It seems, therefore, plausible that children in the LowGram group benefit from programs with bilingual instruction, at least for continued grammatical development in both languages.

The difference between the LowGram group and the other ELs in this study relied on their grammaticality at the onset of the study: Although children in the LowGram group had low PGU in both languages, the other ELs in this study had high grammaticality in Spanish and low grammaticality in English. However, by the age of 8 years, the grammaticality of these two groups of children was no longer clearly differentiated (e.g., the predicted PGU in both English and Spanish are in a similar range for ELs and for children in the LowGram group). This has important implications for the assessment of ELs during the school years because this shift might increase the possibility of overdiagnosis of language impairments in bilingual children. Therefore, it is important to consider earlier grammatical development to make diagnostic decisions because the difference between the two groups originated on their grammaticality at the age of 5 years. Those children in the LowGram group had room to improve over time and showed an increase. Assessment in Spanish seems to have a better chance at differentiating these two groups of ELs because they were indistinguishable from each other in English since all children improved over time.

We predicted that children in the LowGram group were going to lag behind their peers. The results of this study showed that ELs in the LowGram group showed gains in Spanish, whereas the other ELs showed a decline of Spanish skills. This might be explained by the initial difference in PGU, which determined different growth patterns because the children in the LowGram group could improve their Spanish skills whereas the other children had already reached high PGU in Spanish. This finding is of importance because it shows that ELs with low grammaticality in both languages, whom some are presumably children with DLD, have a different developmental pattern in that there is still language growth happening in both languages.

An important finding of this study is that there is a time in which ELs might show low PGU in both languages, although it is predicted that this period will be temporary. We use the term *temporary stage of low grammaticality* to describe this time in which grammaticality skills are relatively low in both languages compared to monolingual children, not due to a limitation of language ability, but because a

shift in language proficiency from Spanish to English is occurring. The prediction is that the English grammaticality skills will continue to develop over time in an environment such as the United States, where English is the majority language. Importantly, we recognize that grammaticality is only one of the indices of language proficiency (Cummins, 1984) and that other areas of language (syntax, vocabulary) might not show the shift seen in this study. The results of this study add to our current knowledge of patterns of language growth in the areas of grammaticality in ELs in the United States.

### *Limitations*

A potential limitation of this study is that PGU combines all errors to produce a broad measure of grammaticality at the utterance level. It is possible that the type of errors differed between the groups and that certain kind of errors that are indicators of clinical status (e.g., omission of clitic pronouns) would be seen in the LowGram group whereas developmental errors (e.g.., overregularization) can be more prevalent in the other children. Current research efforts at the laboratories of the authors of this article are underway to address this possibility. Another important limitation is that, due to the retrospective nature of this study, there was a limited number of language measures available on these children, which limits our knowledge of other aspects of language development (e.g., receptive language).

## Conclusion

This study is the first large-scale longitudinal study to our knowledge to investigate grammaticality as an index of grammatical development in Spanish and English in ELs. In terms of Spanish, this study found a decline in Spanish grammaticality over time. On the contrary, English grammaticality improved steadily for these children. During this shift in proficiency, a period of relatively low grammaticality in both languages was observed. Children with low grammaticality in both languages at the onset of the study differed from the other ELs in this study in their Spanish, but not in their English, growth. These findings highlight the importance of early language assessment in the home language before there is evidence of a shift in proficiency that might make the assessment process more difficult.

## Acknowledgments

Research reported in this publication was supported by National Institute on Deafness and Other Communication Disorders Award Number K23DC015835 granted to Anny Castilla-Earls. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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