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Impact of Academic Language of Instruction on Spanish and English Growth and Loss in Bilingual Children

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ABSTRACT

Purpose: This longitudinal study investigated the impact of different academic programs of primary language instruction (Spanish or English) on the dual language development of Spanish–English bilingual children. Types of academic settings offered to bilingual students as well as differing views and outcomes based on language of instruction are outlined.
Method: Narrative retell language samples from 90 typically developing Spanish–English bilingual children elicited across six consecutive academic semesters from the fall of kindergarten to the spring of second grade were used to estimate Spanish and English language skills (grammar and lexical diversity) longitudinally. Participants academically instructed primarily in English (n = 45) were matched to primarily Spanish-instructed participants by age, gender, maternal level of education, and family income level.
Results: The estimates of conditional growth curve models indicated that bilingual children differed in their rates of Spanish and English oral language development as a function of their primary academic language of instruction. Loss of Spanish grammatical skills was estimated for English- and Spanish-instructed participants.
Conclusions: A wide range of expressive language skills and differing rates and directions of growth is present in typically developing bilingual children. The language of instruction explains some of the variability seen. These take-home findings should be considered in clinical assessment of dual language learners to avoid misdiagnosis of language impairment.
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The Hispanic population is among the fastest growing populations in the nation. In the past decade, the Hispanic population in the United States grew 19% and made up more than half of the overall population growth over the same period (U.S. Census, 2020). Although not all Hispanic individuals speak Spanish, Hispanic Spanish speakers make up the largest proportion of speakers of languages other than English in the United States (76%; U.S. Department of Education, National Center for Education Statistics, 2019). While this rapid growth calls for an increase in research regarding this population, there is a relative lack of research that has examined the differential and longitudinal impact of language of academic instruction on bilingual children's dual language development (see Hammer et al., 2014, for a review). Differences in dual language development based on academic programs are likely, given the variability in language skills already observed (e.g., Hiebert & Rojas, 2021; Rojas & Iglesias, 2013). Additionally, a related area that has not received much attention concerns bilingual children who may experience language loss. For the purposes of this study, language loss is defined as the regression of previously acquired skills in one language (usually the heritage language) that co-occurs during the acquisition of another (usually English; see Anderson, 2012, for a review), as

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well as a lack of development of the heritage language over time (Hiebert & Rojas, 2021). Heritage language will be the term used to describe a non–English language spoken by bilingual children in their homes (Arinon & Jessner, 2014; Winsler et al., 2014), rather than first language, which may lead to the assumption that the heritage language was learned before exposure to English or is the more proficient of the child's spoken languages.

Bilingual children in U.S. public schools, who may have varying levels of proficiency or needs in each of their languages, are academically instructed either primarily in English, or in English *and* their heritage language (Spanish in the present study) during early elementary grades across a range of programs of academic language instruction, such as structured English immersion, dual language, and transitional bilingual programs (Delavan et al., 2023; Huang et al., 2011; McCarty, 2012; Roberts, 1995). For the purposes of the present study, academic settings that provide instruction primarily in Spanish will be referred to as "bilingual education." Participants who attend one of the bilingual education settings will be distinguished from English immersion programs, which aim to provide academic instruction in English only. These two types of academic programs, which will be described in detail, should not be confused with English as a new language (ENL) support, where although bilingual children are in the same classrooms with monolingual English speakers, they are pulled out of class during a portion of the day to have directed ENL instruction.

Although Spanish loss has not been extensively researched (see Anderson, 2012, for a review), it has been suggested to be a contributing factor in the learning of ENL, especially for children who are English instructed (Hiebert & Rojas, 2021; Menken & Kleyn, 2010; see also Guiberson, 2013, for a review). The potential effects of Spanish loss on English development are of particular importance for bilingual children, as English oral language skills have been shown to predict reading skills in English (Cárdenas-Hagan et al., 2007; Menken & Kleyn, 2010). Thus, in order to advance the limited evidence base of Spanish loss and its potential impact on English language development and overall academic performance, it is necessary to determine how it may differ in bilingual children who are academically instructed primarily in English or Spanish. Furthermore, bilingual children who experience loss while still learning English are at risk for misdiagnosis of language impairment. Knowledge about the range of potential dual language skills of typically developing bilingual children across academic contexts can be important for speech-language pathologists working with an increasingly diverse population of school-age children. The purpose of this longitudinal study is to estimate the dual language growth and loss of Spanish–English bilingual children academically instructed primarily in either English or Spanish during early elementary school.

Programs of Academic Language Instruction

Bilingual children enrolled in U.S. public schools can be academically instructed in English and/or their heritage language during the early years of elementary school. Although there is a range of programs of academic language instruction, some of the most common include structured English immersion, dual language, and transitional bilingual programs (Delavan et al., 2023; McCarty, 2012; Roberts, 1995). Structured English immersion programs exclusively focus on English academic instruction, where speaking and listening skills in English are emphasized from the onset. The primary goal of structured English immersion programs is for students to learn to speak, understand, read, write, and demonstrate grade-appropriate academic performance in English as quickly as possible. Although academic instruction is provided in English, and no academic support is offered by default in the heritage language (for instance, Spanish), students in structured English immersion programs are able to request for clarification in their heritage language. Structured English immersion classrooms are exclusively targeted for bilingual children designated as English learners and not for monolingual English-speaking students.

In terms of bilingual education programs, dual language education programs offer the most consistent support of oral language and academic instruction of core academic subjects in the heritage language in addition to English throughout elementary school (McCarty, 2012). Two common variations of dual language education programs include one- and two-way dual language programs (Delavan et al., 2023), where the former includes only English learners and the latter includes approximately 50% students who are monolingual English speakers and 50% who are English learners. The present study includes bilingual children in one-way dual language education programs. Dual language education programs aim to provide balanced academic instruction across both languages (e.g., half day in Spanish and half in English, or one full day in Spanish followed by one full day in English), with the primary goal for bilingual children to be bilingual, to be biliterate, and to demonstrate grade-appropriate academic performance in English and the heritage language.

In addition to including students attending one-way dual language education programs, the present study also includes participants in transitional bilingual education programs. Transitional bilingual education programs provide academic instruction primarily in the heritage language (often, Spanish) during kindergarten and gradually increase the amount of instruction in English every

academic year thereafter. Two variations include early and late transitional bilingual education programs, where Spanish instruction will ultimately be phased out around third grade in the former and around fifth grade in the latter (McCarty, 2012). Although the primary goal of transitional bilingual education programs is for bilingual children to ultimately be able to receive academic instruction entirely in English, existing skills and instruction in the heritage language are supported to varying degrees over time.

Prior studies have examined bilingual children who are instructed in structured English immersion, dual language, or transitional bilingual education programs. Nakamoto et al. (2012) found no significant differences in standardized measures of language and reading development in English and Spanish for 502 Spanish–English bilingual children in dual language and transitional bilingual education programs from kindergarten to third grade. However, differences were found in the performance of bilingual children in structured English immersion relative to that of children in dual language and transitional bilingual education programs. Cárdenas-Hagan et al. (2007) measured English and Spanish phonological awareness and oral language skills in students from structured English immersion, transitional bilingual, and dual language programs. Participants in transitional bilingual and dual language programs were collapsed into one category described as Spanish-instructed within the study. Cárdenas-Hagan et al. provided a breakdown of the proportions of English and Spanish language use in each academic setting in kindergarten. This allowed them to show that dual language and transitional bilingual programs had relatively the same amount of Spanish language use by teachers (68% and 73%, respectively); therefore, the programs were providing academic instruction primarily in Spanish. Similarly, studies have combined the outcome measures for bilingual children in dual language and transitional bilingual education programs (e.g., Francis et al., 2019; Rojas et al., 2019), as children are primarily academically instructed in Spanish during early elementary school across these two "bilingual" programs. Thus, the term *Spanish instruction* is defined as including any type of bilingual instruction as differentiated from English immersion.

Having a functional and educational need to use and alternate between two languages could confer developmental advantages related to advanced inhibitory control that helps bilingual children overcome the potential disadvantage of distributed language practice and knowledge (Bialystok et al., 2008). Research has also shown that sustained use of two languages can provide a developmental advantage to bilinguals, including faster reaction time and fewer errors on vocabulary tasks (Gollan et al., 2008), as well as advantages on cognitive and executive function tasks because of an enhanced ability to control inhibition during these tasks (Bialystok et al., 2008; Carlson & Metzoff, 2008). However, competing findings have shown a disadvantage of bilingualism in completing metacognitive tasks (see deBruin et al., 2015, for a review; Folke et al., 2016). It is still unclear whether there are cognitive advantages of being bilingual, given conflicting findings in the available research. Although there are conflicting findings as to whether bilingual children have cognitive advantages, research has shown that there are other advantages to maintaining heritage language including better self-esteem and mental health, better academic achievement and graduation rates, remaining culturally connected, and being more employable (Verdon, 2023). Continued longitudinal studies of dual language learning with bilingual children who are both typically developing or that have a diagnosed language impairment is important to advance knowledge in the field.

Peña et al. (2011) conducted a study on the relationships between language exposure and performance on measures of semantics and syntax in English and Spanish. Results of the study showed that despite the greater load of organizing and accessing the semantic and syntactic systems of two languages, Spanish–English bilingual children who participated in their study did not fall in the at-risk category at a higher rate than monolingual children, therefore indicating that bilingualism was not related to increased risk for language impairment. The bilingual children from Peña et al. were able to draw from experiences in English and Spanish to respond to semantic and morphosyntactic questions in either or both languages. In other words, bilingual and monolingual children had similar levels of overall language knowledge. Furthermore, children with longer term exposure with both languages were able to advance their language knowledge to near the expected levels of monolingual children and were somewhat less likely to score in the at-risk range.

Outcomes: English Versus Heritage Language Instruction

A number of studies have compared the performance of bilingual children instructed primarily in English versus primarily instructed in the heritage language. MacSwan and Pray (2005) conducted a study with school-age bilingual children that measured accuracy of syntax in both languages and found that those instructed in the heritage language learned English faster than children instructed primarily in English. Being in a bilingual program helped these children with their bilingual syntactic abilities and thus progress academically because they were able to master academic content in two languages. In

addition to the evidence that bilingual children who are instructed in their heritage language may academically outperform their bilingual peers instructed in English, evidence suggests that heritage language instruction may also benefit children in other ways, such as remaining connected to their heritage culture and being able to communicate with a more diverse range and overall larger number of individuals (Golash-Boza, 2005). Three meta-analytic reviews (Bialystok, 2018; Rolstad et al., 2005; Slavin & Cheung, 2005) concluded that bilingual programs generally resulted in higher academic performance outcomes in comparison to all-English or English immersion programs.

A study by Branum-Martin et al. (2010) evaluated the effects of language programs in first grade and showed that although English instruction had a positive impact on outcomes, there was an advantage in the English and Spanish performance of participants instructed primarily in the heritage language. Similarly, Rojas et al. (2019) found that Spanish-instructed bilingual children through second grade performed better on Spanish measures overall, and their performance on English was comparable to that of bilingual children instructed in English. Oppenheim et al. (2020) found that bilingual children showed vocabulary improvements in English and Spanish when they received differing degrees of academic instruction in Spanish during the school day.

Purpose and Research Questions

The purpose of this longitudinal study was to estimate the trajectories of dual language growth and loss of Spanish–English bilingual children with typical development who were academically instructed primarily in English or Spanish from kindergarten to second grade. Two primary research questions were examined: (a) What differences are there in the rates and directions of growth trajectories in English and Spanish language skills (grammaticality and lexical diversity) as a function of being instructed primarily in English or Spanish? (b) What are the ranges of English and Spanish language skills (grammaticality and lexical diversity) of typically developing bilingual children as a function of being instructed primarily in English or Spanish? Although these research questions are observational in nature, it is important to increase the amount of replication studies in the field, especially give the conflicting results of studies on bilingualism.

Consistent with prior findings (e.g., Nakamoto et al., 2012; Rojas et al., 2019), it is hypothesized that Spanish-instructed children will demonstrate higher Spanish skills at the onset of the study (beginning of kindergarten) and faster Spanish growth trajectories than English-instructed children. It is also hypothesized that English-instructed children will demonstrate higher English skills at the onset of the study, but that the Spanish-instructed children will show faster rates of English growth trajectories than the English-instructed children (see Bialystok, 2018, for a review; see Rolstad et al., 2005, for a review). The second prediction was made, because children in Spanish instruction have largely been shown to have an advantage over children in English instruction, even in English (see Bialystok, 2018, for a review; Collier & Thomas, 2017).

Based on the existing evidence on Spanish loss (see Anderson, 2012, for a review; Castilla-Earls et al., 2019; Hiebert & Rojas, 2021), it is hypothesized that all of the study participants will show loss of expressive language skills in Spanish with English-instructed bilingual children demonstrating a faster rate of Spanish loss than Spanish-instructed children. Prior studies of language loss have shown the shift in focus from Spanish to English oral language use when bilinguals attain more proficiency in English (Arinon & Jessner, 2014; de Leeuw et al., 2013; Gürel, 2008; Herdina & Jessner, 2013). It has also been theorized that as children develop language skills, they will shift focus from skills that become less efficient to those that become more efficient, or in other words, children will improve upon the skills to which they are directing most of their cognitive effort (de Bot et al., 2007; Evans, 2002).

Method

This research received institutional review board approval from the University of Kansas. Longitudinal archival data were used in the present study. The study included a total of 90 Spanish–English bilingual participants (46 male, 44 female) with typical development, who produced narrative retell language samples in Spanish and English each semester starting from fall of kindergarten through spring of second grade. A total of 45 participants were English instructed, and 45 were Spanish instructed. The English-instructed participants were drawn from an archival data set that longitudinally tracked narrative retell language samples from children in Texas beginning in preschool. The Spanish-instructed participants were drawn from another archival data set, which used parallel longitudinal, and narrative retell sample data collection methods beginning in kindergarten from children in Texas (Francis et al., 2005).

The semester-based elicitation of narrative retell language samples from kindergarten to second grade (six total waves) was consistent across both archival data sets, and the samples were also elicited using Mercer Mayer's "frog" books (Mayer, 1969, 1974, 1975a, 1975b). Books and languages were counterbalanced across time to ensure

that participants were asked to provide retells in English first one semester and Spanish first the next (or vice versa), and also so that the same book was not repeated during the same school year. Trained bilingual/biliterate research assistants used the wordless picture storybooks and a script to elicit narrative retell samples from the children each semester in both Spanish and English with no less than 2 weeks between collection. Research assistants orthographically transcribed the audio-recorded samples, which were checked for errors by research assistants who had additional training and more than a year of experience. The transcripts were coded and analyzed using Systematic Analysis of Language Transcripts software (Miller & Iglesias, 2018).

Participants were included in the study if they (a) were Spanish–English bilingual, (b) remained in either primarily English or Spanish education settings throughout the duration of the study, and (c) were typically developing. The only difference in the method and inclusionary criteria between English- and Spanish-instructed participants is that the English-instructed participants were administered a bilingual language screening (Bilingual English Spanish Oral Screener; Peña et al., 2008), and the Spanish-instructed participants were not. However, the parents of the Spanish-instructed participants did not report any previous or existing history of special education services upon enrollment, and none of these children were placed in any special education programs throughout the duration of the study.

The English- and Spanish-instructed participants were matched by chronological age, gender, and level of maternal education and qualified for free or reduced lunch, indicative of residing in low-income households. The mean age of the participants was 68.5 months in the fall of kindergarten. They had mothers with a mean level of education that indicated that they had either a GED or vocational training on average (no college education). We were not able to match Spanish and English language skills longitudinally tracked for the present study at the beginning of kindergarten across the two groups of participants. However, the participants did have similar outcomes for the measures of mean length of utterances in words (MLUw) and subordination index (SI-count) at the onset of the study or across time for either language (see Supplemental Material S1 in for means and standard deviations). The differences found in the measures for the present study are most likely due to the prior language exposure and educational contexts that the children experienced prior to entering kindergarten. The English-instructed children attended the same English immersion program for 1–2 years of preschool, where English was encouraged and used for most of the academic day. Prior educational experience for the group of participants who were Spanish instructed is unknown as no information was collected prior to the beginning of this study. It is possible that the children who attended the Spanish-instructed programs had more Spanish exposure prior to kindergarten than those in the English-instructed group, thus contributing to the mismatch in Spanish and English language skills at the onset of the study.

The participants came from bilingual households in areas where there were relatively large populations of Spanish speakers. Home language data were collected at the time of study onset, along with the consent process on a 5-point scale (Francis et al., 2005). All of the participants were reported to speak both languages equally on average by parents. The participants and families had origins and used mostly Spanish dialects from Mexico or other Central American countries. The English-instructed participants all attended the same structured English immersion school throughout the course of the study. The majority of the Spanish-instructed participants were in one-way dual language education programs for all three academic years (n = 33). Others were either in a transitional bilingual program (n = 6) or both types of bilingual programs across 3 years (n = 6).

Based on standards set by prior research, language samples were included in the analyses if they (a) had at least 10 complete and intelligible utterances (e.g., Gusewski & Rojas, 2017; Rojas & Iglesias, 2013) and (b) had more than 20% of total words in the target language (e.g., Hiebert & Rojas, 2021; Pearson et al., 1997). Out of a possible maximum of 1,080 samples across both languages, a total of 709 language samples (344 in Spanish, 365 in English) produced by 90 participants across six total consecutive semesters (waves) of data collection were included in the analyses. The majority of narrative retell samples excluded from analyses due to not meeting inclusionary criteria (n = 28) were from English-instructed participants, while the rest (n = 2) were from Spanish-instructed participants. The difference in numbers was mostly due to children in English instruction refusing or unable to provide a narrative sample in Spanish. All additional missing data were missing due to audio file errors (n = 16), samples provided entirely in the nontarget language (n = 32), samples were planned missing by accelerated design for a single semester (n = 88), or the sample was not collected due to scheduling conflicts or unplanned absences (n = 205). Planned missing data were not designated to be collected at a specified wave. The number of retell samples included in the analyses can be found in Table 1.

Two language sample analysis (LSA) measures were used to track the dual language growth and loss of the participants over time. Specifically, proportion of grammatical utterances (PGU) and moving-average type–token

Table 1. Number of narrative retells provided, proportion of grammatical utterances (PGU), and moving-average type–token ratio (MATTR) descriptive statistics in Spanish and English for English-instructed (EI) and Spanish-instructed (SI) children.

	K fall	K spring	1st fall	1st spring	2nd fall	2nd spring
Spanish measures						
Retells EI	40	33	28	27	17	23
Retells SI	34	29	34	26	30	28
PGU EI	0.68 (0.17)	0.67 (0.16)	0.75 (0.16)	0.60 (0.25)	0.65 (0.13)	0.35 (0.22)
PGU SI	0.90 (0.12)	0.90 (0.11)	0.87 (0.19)	0.86 (0.19)	0.85 (0.15)	0.81 (0.12)
MATTR EI	0.66 (0.15)	0.63 (0.15)	0.69 (0.10)	0.68 (0.13)	0.67 (0.14)	0.68 (0.12)
MATTR SI	0.74 (0.08)	0.78 (0.04)	0.77 (0.04)	0.72 (0.05)	0.77 (0.05)	0.78 (0.03)
English measures						
Retells EI	43	44	34	32	31	21
Retells SI	21	29	28	32	28	27
PGU EI	0.74 (0.13)	0.79 (0.13)	0.85 (0.07)	0.89 (0.07)	0.88 (0.05)	0.89 (0.06)
PGU SI	0.42 (0.19)	0.40 (0.19)	0.51 (0.21)	0.61 (0.18)	0.57 (0.20)	0.62 (0.20)
MATTR EI	0.71 (0.05)	0.72 (0.04)	0.72 (0.04)	0.72 (0.05)	0.74 (0.04)	0.76 (0.03)
MATTR SI	0.65 (0.09)	0.68 (0.05)	0.68 (0.06)	0.67 (0.07)	0.69 (0.06)	0.74 (0.04)

Note. K = kindergarten; 1st = first grade; 2nd = second grade.

ratio (MATTR) were used to track grammatical as well as verbal productivity and lexical skills respectively over time in Spanish and English, because they have been shown to be successful in tracking longitudinal change across time in prior studies (Castilla-Earls et al., 2019; Kapantzoglou et al., 2019). These two measures were found to be the most sensitive in tracking differences in growth and loss of Spanish grammaticality, verbal productivity, and lexical diversity in a prior study in this series (Hiebert & Rojas, 2021). PGU was calculated by dividing the proportion of grammatically correct utterances by the total number of utterances. MATTR, which controls for sample length differences, used a moving window of 25 words in this study to index the type–token ratio, or number of different words divided by the number of total words produced in the target language (words produced in the nontarget language were excluded). Descriptive statistics for PGU and MATTR in each language for English- and Spanish-instructed participants can be found in Table 1. As previously mentioned, in addition to PGU and MATTR, the expressive language measures of MLUw and SI-count were also tracked to determine whether changes in grammaticality were influenced by increases in morphosyntactic complexity over time (see Supplemental Material S1). Code switching was tracked at the word level, so lexical diversity could be measured in each language individually.

All words and codes from 25% of the narrative retell transcripts provided by the English-instructed participants were checked for interrater reliability by trained bilingual research assistants. The word-for-word transcription accuracy for this group of participants ranged from 96% to 100% in English and from 92% to 100% in Spanish. The coding accuracy ranged from 90% to 98% in English and from 87% to 99% in Spanish (see Hiebert & Rojas, 2021). The interrater reliability for the Spanish-instructed participants has been reported in prior studies (see Rojas & Iglesias, 2013), which calculated reliability on 20 English and 20 Spanish transcripts from the whole group of participants in the larger scale study. The reported word-for-word transcription accuracy ranged from 90% to 98% in English and from 91% to 99% in Spanish. The protocol (coding) accuracy ranged from 98% to 100% in English and from 94% to 99% in Spanish.

Analytic Approach

Growth curve modeling (GCM) was chosen as the approach to answer the research questions. It is a common method used in longitudinal studies that use repeated observational measures, which allows for prototypical rates of change to be estimated both within and across participants (Singer & Willet, 2003). GCM also uses maximum likelihood estimation to account for missing data points across time; therefore, participants who did not provide a sample at every wave of the data collection were still included in the analyses. Prior longitudinal research similar to the present study has shown no difference in results as a function of eliminating participants with missing data (see Hiebert & Rojas, 2021). IBM SPSS Statistics (Version 26.0) software for Mac (IBM Corporation, 2020) was used to conduct the GCM analyses for the present study. The order of analyses first included estimation of unconditional means models where time is not a variable. Second, unconditional growth curve models (GCMs) measured grammatical and lexical expressive language skills with time as the independent variable. Third, the conditional GCMs were estimated with time and the additional

independent variable of language of academic instruction to determine whether this better fit the prototypical rates of change.

Unconditional GCMs were estimated using linear, quadratic, and cubic polynomial functions and with fixed and randomly varying slopes in order to determine the best fitting unconditional GCMs for each LSA measure in each language. The best fitting GCMs for PGU and MATTR in Spanish and English were determined by using the −2 log-likelihood (−2LL) deviance statistic (smaller is better) as the primary goodness-of-fit index. Statistically significant better fit was confirmed with a χ^2 distribution test on the degrees of freedom across subsequent nested models to assess −2LL differences (Field, 2013).

Conditional GCMs were then estimated based on the best fitting unconditional GCMs for PGU and MATTR in Spanish and English. Conditional GCMs included the effect of Spanish instruction as a time-invariant covariate and its interaction with time to address this study's two research questions. The best fitting conditional GCMs for the LSA measures were determined with the −2LL deviance statistic, confirmed with the χ^2 distribution test on degrees of freedom, and by the highest overall proportional reduction (pseudo R^2) on the variance components for each model.

Results

Table 2 specifies the fixed-effects and variance components for the final (best fitting) GCMs for PGU and MATTR in Spanish and English. The best fitting GCMs for PGU and MATTR in each language were conditional GCMs with randomly varying intercepts and fixed slopes. The fit statistics, proportion of model variance explained, fixed effects, and variance components for the final conditional GCMs are reported, and the prototypical growth trajectories are illustrated for the outcome measures.

Spanish: PGU

The final (best fitting) model for PGU in Spanish (see Table 2) was a conditional quadratic GCM with the effect of Spanish instruction on the intercept and linear and quadratic slopes. This model demonstrated the lowest goodness-of-fit deviance statistic (−2LL = −286.9, $p < .001$, for a χ^2 distribution on 3 *df*), and the highest overall proportional reduction of within-person residual variance (pseudo-R_ε^2, 17% improvement) and of between-persons variance on the intercept (pseudo-R_0^2, 70% improvement).

The fixed effects of the final conditional GCM for PGU in Spanish estimated that the average initial status for English-instructed participants was $\gamma 00 = 0.67$, $p < .001$, with a positive and significant linear rate of change ($\gamma 10 = 0.07$, $p < .01$) and a negative and significant deceleration on the linear slope ($\gamma 20 = -0.03$, $p < .001$) over time. The Spanish-instructed participants had a positive and significant effect on initial status ($\gamma 01 = 0.23$, $p < .001$), a negative and significant effect on linear rate of change ($\gamma 11 = -0.08$, $p < .01$), and a positive and significant acceleration on the linear slope ($\gamma 12 = 0.03$, $p < .001$) over time. The variance components estimated significant

Table 2. Conditional growth curve models for proportion of grammatical utterances (PGU) and moving-average type–token ratio (MATTR) in Spanish and English.

	Parameter	PGU (Spanish)	MATTR (Spanish)	PGU (English)	MATTR (English)
Fixed effects: γ (SE)					
Intercept	γ00	0.67*** (0.02)	0.65*** (0.01)	0.73*** (0.02)	0.72*** (0.01)
Linear slope	γ10	0.07** (0.02)	0.004* (0.002)	0.07*** (0.02)	–0.004 (0.006)
Quadratic slope	γ20	–0.03*** (0.005)		–0.01* (0.003)	0.002 (0.001)
Spanish instructed (SI)	γ01	0.23*** (0.04)	0.10*** (0.02)	–0.39*** (0.03)	–0.07*** (0.01)
SI × Linear slope	γ11	–0.08** (0.03)		0.02 (0.03)	0.003 (0.009)
SI × Quadratic slope	γ12	0.03*** (0.006)		0.001 (0.005)	0.001 (0.002)
Variance components: σ (SE)					
L1: Within-person variance	σ_ε^2	0.02*** (0.002)	0.003*** (0.0002)	0.01*** (0.001)	0.002*** (0.0001)
L2: Between-person intercept	σ_0^2	0.005** (0.002)	0.01*** (0.001)	0.01*** (0.002)	0.001*** (0.0003)
Proportional variance reduction					
L1: Within-person variance	R_ε^2	17%	1%	33%	22%
L2: Between-person intercept	R_0^2	70%	24%	70%	21%
Goodness-of-fit –2LL		–286.9***	–826.5***	–460.4*	–1,201.1*

Note. *SE* = standard error; L1 = Level 1 variance; L2 = Level 2 variance; –2LL = –2 log-likelihood deviance statistic.
*$p < .05$. **$p < .01$. ***$p < .001$.

within-person variance (σ_ε^2) over time and between-persons variance (σ_0^2) at initial status. Figure 1 illustrates the prototypical growth trajectories of PGU in Spanish for participants instructed primarily in English or Spanish. The visual representation of the results shows the higher initial status of the Spanish-instructed participants at the beginning of kindergarten. The effect of being Spanish instructed also lessened the rate of decline of Spanish PGU; therefore, the difference between the two groups of participants was much greater at the end of second grade. Spanish PGU ranged from 0.03 to 0.97 for the English-instructed participants and from 0 to 1.0 for the Spanish-instructed participants, with a significant amount of variance ($p < .001$) explained by grouping by language of instruction.

Spanish: MATTR

The best fitting model for MATTR in Spanish (see Table 2) was a conditional linear GCM with the effect of Spanish instruction on the intercept. This model demonstrated the lowest goodness-of-fit deviance statistic ($-2LL = -826.5$, $p < .001$, for a χ^2 distribution on 1 *df*) and the highest overall proportional reduction of within-person residual variance (pseudo-R_ε^2, 1% improvement) and of between-persons variance on the intercept (pseudo-R_0^2, 24% improvement).

The fixed-effects of the final conditional GCM for MATTR in Spanish estimated that the average initial status for the English-instructed participants was $\gamma 00 = 0.65$, $p < .001$, with a positive and significant linear rate of change ($\gamma 10 = 0.004$, $p < .05$). The Spanish-instructed participants had a positive and significant effect on initial status ($\gamma 01 = 0.10$, $p < .001$). The variance components estimated significant within-person variance (σ_ε^2) over time and between-persons variance (σ_0^2) at initial status. Figure 2 illustrates the prototypical growth trajectories of MATTR in Spanish for participants instructed primarily in English or Spanish, which shows that the Spanish-instructed participants again started higher than those who were English instructed. However, both groups showed identical rates of growth over time, so that difference remained consistent through the end of second grade. Spanish MATTR ranged from 0.17 to 0.85 for the English-instructed participants and 0.54 to 0.87 for the Spanish-instructed participants, with a significant amount of variance ($p < .001$) explained by grouping by language of instruction.

English: PGU

The best fitting model for PGU in English (see Table 2) was a conditional quadratic GCM with the effect of Spanish instruction on the intercept and linear and quadratic slopes. This model demonstrated the lowest goodness-of-fit deviance statistic ($-2LL = -460.4$, $p < .05$, for a χ^2 distribution on 3 *df*), and the highest overall proportional reduction of within-person residual variance (pseudo-R_ε^2, 33% improvement) and of between-persons variance on the intercept (pseudo-R_0^2, 70% improvement).

The fixed effects of the final conditional GCM for PGU in English estimated that the average initial status for English-instructed participants was $\gamma 00 = 0.73$, $p < .001$, with a positive and significant linear rate of change ($\gamma 10 = 0.07$, $p < .001$) and a negative and significant deceleration on the linear slope ($\gamma 20 = -0.01$, $p < .05$) over time. The Spanish-instructed participants had a

Figure 1. Prototypical quadratic growth trajectories for proportion of grammatical utterances (PGU) in Spanish for English-instructed (EI) and Spanish-instructed (SI) participants.

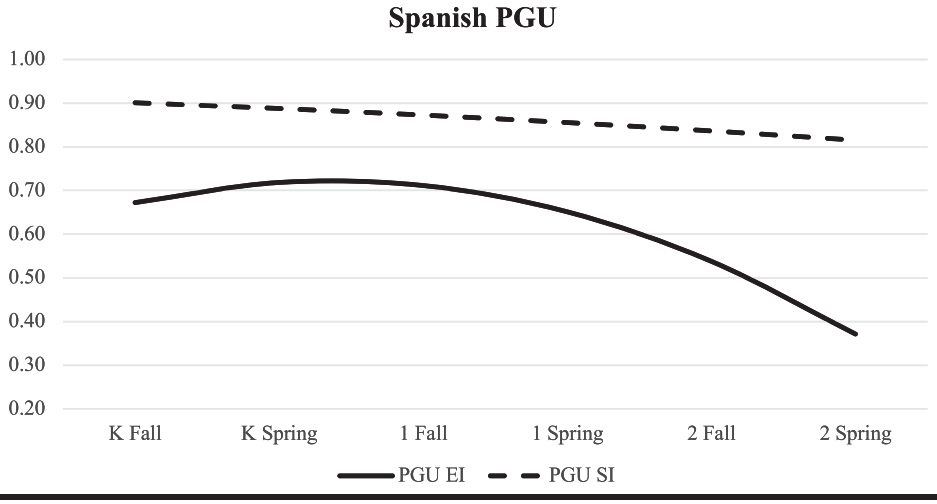
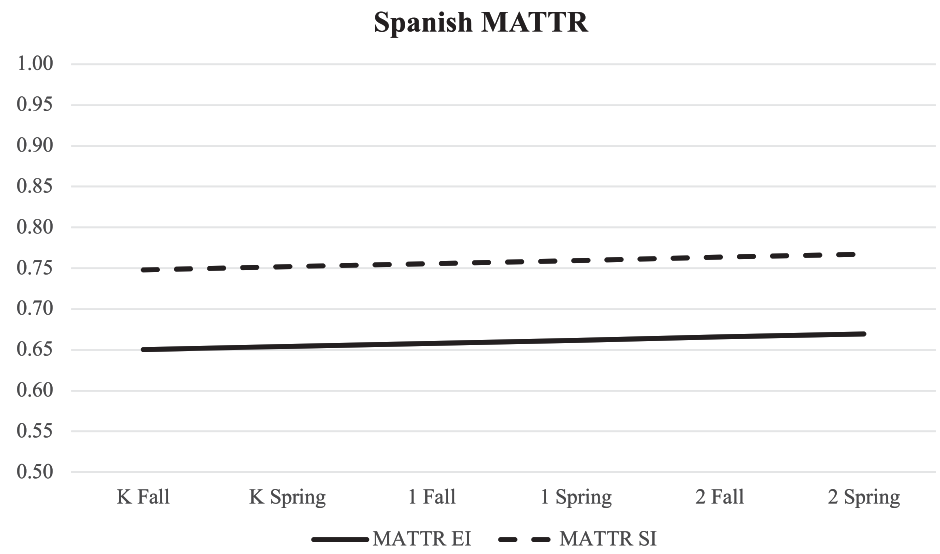


Figure 2. Prototypical quadratic growth trajectories for moving-average type–token ratio (MATTR) in Spanish for English-instructed (EI) and Spanish-instructed (SI) participants.

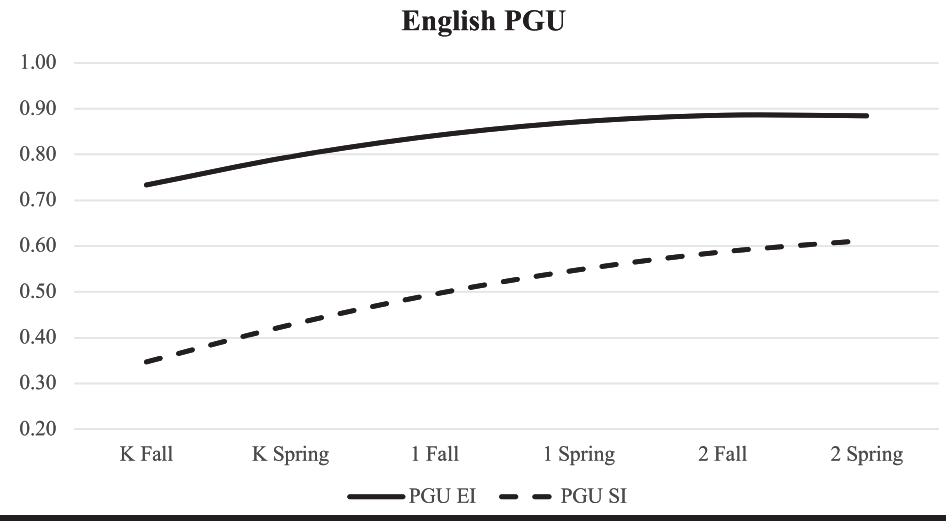


negative and significant effect on initial status ($\gamma 01 = -0.39$, $p < .001$), a positive and nonsignificant effect on linear rate of change ($\gamma 11 = 0.02$, $p = .46$), and a positive and nonsignificant acceleration on the linear slope ($\gamma 12 = 0.001$, $p = .86$) over time. The variance components estimated significant within-person variance (σ_ε^2) over time and between-persons variance (σ_0^2) at initial status. Figure 3 illustrates the prototypical growth trajectories for PGU in English for participants instructed primarily in English or Spanish. In this figure, the English-instructed participants begin at a higher point at the beginning of kindergarten, but the Spanish-instructed participants show a faster rate of growth; therefore, the gap narrowed at the end of second grade. English PGU ranged from 0.34 to 1.0 for the English-instructed participants and from 0 to 0.97 for the Spanish-instructed participants, with a significant amount of variance ($p < .05$) explained by grouping by language of instruction.

English: MATTR

The best fitting model for MATTR in English (see Table 2) was a conditional quadratic GCM with the effect of Spanish instruction on the intercept and linear and

Figure 3. Prototypical quadratic growth trajectories for proportion of grammatical utterances (PGU) in English for English-instructed (EI) and Spanish-instructed (SI) participants.



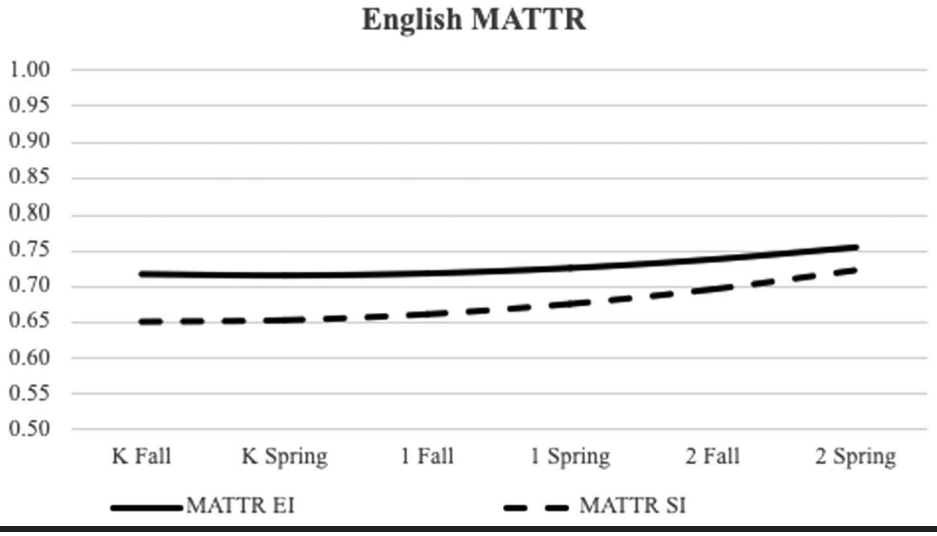
quadratic slopes. This model demonstrated the lowest goodness-of-fit deviance statistic ($-2LL = -1{,}201.1$, $p < .05$, for a χ^2 distribution on 3 *df*) and the highest overall proportional reduction of within-person residual variance (pseudo-R_ε^2, 22% improvement) and of between-persons variance on the intercept (pseudo-R_0^2, 21% improvement).

The fixed effects of the final conditional GCM for MATTR in English estimated that the average initial status for English-instructed participants was $\gamma 00 = 0.72$, $p < .001$, with a negative and nonsignificant linear rate of change ($\gamma 10 = -0.004$, $p = .48$) and a positive and nonsignificant acceleration on the linear slope ($\gamma 20 = 0.002$, $p = .06$) over time. The Spanish-instructed participants had a negative and significant effect on initial status ($\gamma 01 = -0.07$, $p < .001$), a positive and nonsignificant effect on linear rate of change ($\gamma 11 = 0.003$, $p = .73$), and a positive and nonsignificant acceleration on the linear slope ($\gamma 12 = 0.001$, $p = .69$) over time. The variance components estimated significant within-person variance (σ_ε^2) over time and between-persons variance (σ_0^2) at initial status. Figure 4 illustrates the prototypical growth trajectories for MATTR in English for participants instructed primarily in English or Spanish. Again, this figure shows the English-instructed participants beginning at a higher point at the beginning of kindergarten. The effect of being Spanish instructed again meant a faster rate of growth, so this gap narrowed by the end of second grade. English MATTR ranged from 0.57 to 0.82 for the English-instructed participants and from 0.4 to 0.8 for the Spanish-instructed participants, with a significant amount of variance ($p < .05$) explained by grouping by language of instruction.

Discussion

This study aimed to determine to what degree Spanish and English language outcomes differed in direction and rate over three academic years for bilingual participants who were academically instructed primarily in English or Spanish. It also aimed to determine the range of language skills (grammaticality and lexical diversity) that could be found in typically developing bilingual children. It was hypothesized that children instructed primarily in Spanish would begin with higher Spanish oral language skills (PGU and MATTR) and demonstrate faster rates of positive growth in these skills over time relative to English-instructed children. It was also hypothesized that although children instructed primarily in English would begin with higher English oral language skills (PGU and MATTR), they would demonstrate slower rates of positive growth in these skills over time relative to Spanish-instructed children. Additionally, the English-instructed participants were predicted to be those who showed faster rates of negative growth (loss) of Spanish language skills when compared to the Spanish-instructed participants who were predicted to show slower rates of negative growth in Spanish. The hypotheses were supported overall. The growth trajectories differed for children as a function of being academically instructed primarily in English or Spanish. The Spanish-instructed participants demonstrated (a) higher Spanish oral language skills at onset, (b) faster Spanish and English growth over time, (c) higher Spanish oral language outcomes at the end of second grade, and (d) a lesser degree of Spanish loss. The English-instructed participants demonstrated (a) higher English oral language skills at onset, (b) slower English and Spanish growth over

Figure 4. Prototypical quadratic growth trajectories for moving-average type–token ratio (MATTR) in English for English-instructed (EI) and Spanish-instructed (SI) participants.



time, (c) overall higher English oral language outcomes at the end of second grade, and (d) the greatest degree of Spanish loss. A wide range of expressive language skills were found for all the typically developing bilingual participants in the study, which PGU ranging from no grammatical utterances to perfect grammar over time and around 0.5 to 0.9 MATTR. The negative growth patterns and wide ranges of skills seen in the results of this study are not uncommon with a highly variable population. This shows the need for even more studies that longitudinally track dual language development.

English-Instructed Participants

The predicted prevalence of Spanish loss of bilingual participants who received English instruction aligned with prior studies of heritage language loss (see Anderson, 2012, for a review; Hiebert & Rojas, 2021). English-instructed participants predominantly focused their cognitive effort on learning and using English language skills throughout the school day. The amount of exposure to English language supported the growth of English language skills from kindergarten to second grade, but this was at the cost of Spanish loss during the same time frame, a finding consistent with those reported by Anderson's (2012) review. The lack of academic support and systematic exposure to Spanish during the school day may have contributed to Spanish loss over the 3-year duration of this study. The findings from this study are consistent with prior studies that have shown lower levels of Spanish language skills for English-instructed bilingual children (e.g., see Bialystok, 2018, for a review; Rojas et al., 2019).

Loss of the heritage language has been found in prior studies that have focused on morphosyntactic development longitudinally (Anderson, 1999a, 1999b, 2001; Anderson & Márquez, 2009; Arinon & Jessner, 2014; de Leeuw et al., 2013; Castilla-Earls et al., 2019; Gürel, 2008; Herdina & Jessner, 2013; Hiebert & Rojas, 2021). This study similarly found a loss of morphosyntactic skills in Spanish (PGU) for participants regardless of the language of instruction, but to a greater extent for English-instructed participants. The decline in Spanish PGU was not a result of the participants using new and more complex grammar structures and therefore having more opportunities to produce errors (see Supplemental Material S1). The mean SI-count ranged from 1.1 to 1.3 across all six waves of the study for the Spanish retells. This SI-count range indicated that over the 3-year duration of the study, the participants produced primarily simple utterances in Spanish that on average contained one independent clause and, only on occasion, also contained one subordinate clause. Put another way, the grammatical complexity of the retells produced in Spanish by the English-instructed participants remained relatively consistent from kindergarten to second grade. The English-instructed participants shifted their effort over time to continued growth of English language skills, as their skills in Spanish decelerated (see Figures 1 and 3). This may be more indicative of a shift of focus to English grammar from Spanish rather than a shift from grammar to vocabulary (see Figures 1 and 2) as cited in prior studies of child language development (e.g., Dromi, 1987). PGU, however, was more susceptible to loss over time than MATTR in Spanish. Although measures of lexical diversity in Spanish have shown loss in prior studies with young bilingual children during the preschool years (see Anderson, 2012, for a review; Hiebert & Rojas, 2021), this study found growth in verbal productivity and lexical diversity in Spanish when tracked during early elementary school in programs that provided academic instruction primarily in English or Spanish. This may again indicate that MATTR is a more accurate measure of lexical diversity as opposed to a measure of utterance length, such as MLUw (see Supplemental Material S1).

Spanish verbal productivity and lexical diversity (MATTR) demonstrated growth over time for the English-instructed participants, which was not expected. Prior longitudinal studies of language loss have indicated decline of lexical skills in the heritage language along with an increase of code switching to English (see Anderson, 2012, for a review). There are possible explanations as to why the English-instructed participants demonstrated growth in verbal productivity and lexical diversity in Spanish. First, the majority (93.3%) of narrative retell language samples excluded from analyses were from English-instructed participants. This was due to code switching more than 80% of the words to English when the target language was Spanish or not producing at least 10 complete and intelligible utterances in Spanish (see Table 1). The excluded samples in Spanish from English-instructed participants would have likely represented samples with negligible verbal productivity and lexical diversity. The lack of Spanish retells is telling and may indicate that Spanish loss is far greater than what is depicted by the prototypical GCMs estimated with the included samples. Second, the unexpected growth of MATTR for the English-instructed participants was characterized by a declining use of verbs in Spanish and an increase in use of nouns within their narratives. Labeling of pictures in the storybooks may have been a relative strength in Spanish, as a recent study that used a measure of picture vocabulary to assess Spanish lexical diversity found an increase in lexical diversity in bilingual children receiving academic instruction in English with varying degrees of support in Spanish (Oppenheim et al., 2020).

As predicted, the English-instructed participants demonstrated overall higher grammaticality (PGU), as well as verbal productivity and lexical diversity (MATTR)

in English at the end of second grade. This is likely linked to the amount of exposure and focus on English language learning within the English immersion setting. This finding was consistent with prior work demonstrating that the amount of exposure in a specific language is predictive of outcomes in that same language (Peña et al., 2011). Discussed in further detail below, it bears to note that this study also found that Spanish-instructed participants demonstrated faster English growth over time. Thus, concluding that English instruction conveys a unique advantage for the English development of bilingual children based on this study's findings would be premature. Overall, findings from the present study show that typically developing bilingual children who attend structured English immersion programs will learn English language skills without the support of the heritage language. However, policies that prescribe language of instruction for bilingual children should take into consideration studies that employ longitudinal data across a wide variety of participants instructed in a range of academic programs of language instruction, which can help reveal dynamic patterns of dual language growth.

Spanish-Instructed Participants

Spanish-instructed participants were hypothesized to show higher levels of Spanish language skills, with faster rates of Spanish language growth, as well as faster rates of English growth. They were not expected to experience loss of their Spanish language skills. These hypotheses were mostly supported. The Spanish-instructed participants demonstrated higher skill levels in Spanish at onset as well as faster Spanish and English growth relative to English-instructed participants. However, the Spanish-instructed participants showed loss of their grammatical skills as measured by PGU in Spanish, which was not expected given that Spanish was their primarily language of instruction from kindergarten to second grade. However, their degree of loss of PGU in Spanish was minimal, and their grammaticality in Spanish remained above mastery level (when defined as $\geq$ 80% grammaticality) over time. They may have experienced this decline in Spanish grammatical skills to a lesser degree as they began to produce more grammatically complex utterances. However, their SI range from 1.1 to 1.4 was similar to those who were instructed in English (1.1–1.3). This is something commonly observed in monolingual and bilingual children as they continue to learn grammatical rules of the language(s) they speak (Marchman et al., 2004; Simon-Cereijido & Gutiérrez-Clellen, 2007). Finally, it is possible that the minor loss of PGU in Spanish demonstrated by Spanish-instructed participants may be associated with their dynamic co-development and accelerating growth of grammatical skills in English during the time period.

The Spanish-instructed participants had a higher Spanish MATTR at the onset of the study compared to the participants in English instruction. The higher level of MATTR in Spanish was maintained across time through second grade. This was expected as the Spanish-instructed participants were exposed to more Spanish throughout their day, particularly within their school day. Therefore, they had more opportunities to hear and use Spanish vocabulary than the participants who were English instructed. The rate of linear MATTR growth in Spanish was the same for Spanish- and English-instructed participants. This may be explained by a focus on grammatical skills in early elementary years rather than vocabulary (Dromi, 1987). It may also be due to the more balanced bilingual nature of the Spanish-instructed children, suggesting that they were learning some words in English and others in Spanish, but not all words in both languages at this stage of development.

The Spanish-instructed participants were also expected to show faster rates of growth of English language skills. This hypothesis was supported for both measures, grammaticality (PGU), as well as verbal productivity/lexical diversity (MATTR). They did not, however, demonstrate higher levels of English oral language skills by the end of second grade, relative to the English-instructed participants. This finding was less marked in English PGU; however, because the Spanish-instructed children had less exposure to English throughout their school day, as well as fewer opportunities to use English expressive language skills, they were likely still in the process of learning a second language (English), albeit at a faster rate than their English-instructed peers. Studies that focus only on the preschool or kindergarten years, may inaccurately suggest that Spanish-instructed children have difficulties learning English or are at a disadvantage in their projected success in English language skills. Such studies do not take into account the proficiency shift to English that has been documented in work that has focused on the dual language development of school-age bilingual children. Such work has overall shown that children instructed in the heritage language can eventually demonstrate comparable or even superior performance in English to that of English-instructed children (see Bialystok, 2018, for a review; Branum-Martin et al., 2010; Collier & Thomas, 2017; Rojas et al., 2019; see Rolstad et al., 2005, for a review). The findings from the present study show prototypical growth curves continuing at similar rates into later grades. Given these results, Spanish-instructed children could potentially "catch up" or even eclipse the English oral language skills of children instructed in English. Collier and Thomas (2017) determined in a large-scale study that children require academic support in the heritage language until at least the age of 11 or 12 years in order to fully develop English language skills, particularly the highly decontextualized language necessary for

academic purposes. The Spanish-instructed children in this study may have been actively transferring language skills from Spanish to English, as well as using their higher proficiency in Spanish to support their English development. Furthermore, a shift in focus from Spanish to English will occur in later school years for many children as the focus of academic language shifts from Spanish to English, or the participants are proficient enough in English to no longer depend on the support of Spanish language skills (de Bot et al., 2007). Overall, the findings from the study suggest that children in bilingual education will still acquire English language skills, even when Spanish is the primary language of academic instruction.

Limitations and Future Directions

The number of participants in the current study is relatively large but is only representative of other Spanish–English bilingual children from the same geographic area of the United States who speak Mexican or Central American Spanish dialects. Spanish–English bilinguals are a heterogenous group, so larger scale longitudinal studies that include participants from other areas of the United States and that speak other variations of Spanish would lead to more generalizable results. Another limitation of this study is the differences in the initial status of each of the language measures for the two groups being so disparate. The English-instructed participants had already attended preschool in English for 2 years, and their English language skills had already grown considerably over that timeframe (see Gusewski & Rojas, 2017). Data collection began in kindergarten for the Spanish-instructed participants, so the changes in their language skills prior to that time are largely unknown. Given the differences in the starting points of PGU and MATTR for the two groups of participants, it is likely that the Spanish-instructed participants had more exposure to Spanish prior to the start of data collection. The differences in the fall semester of kindergarten could be representative of typically developing Spanish–English bilingual children. Interestingly, there were no significant differences found between the two groups at the onset of the study or over time for MLUw and SI-count, which have been used in prior longitudinal studies of dual language development (e.g., Castilla-Earls et al., 2019; Rojas & Iglesias, 2013). This study represents a loose replication of prior observational work measuring dual language development over time. Future studies that begin at younger ages would be needed to make a determination on the differences found in expressive dual language skills at the beginning of kindergarten.

Future planned research with these participants will aim to add to the current findings in this study by conducting a qualitative analysis of differences in language samples, with specific attention toward those who are experiencing Spanish loss. Specifically, by finding the types of errors that bilingual children are making in individual Spanish retells. A detailed look into the types and proportions of morphosyntactic errors may help to differentiate language loss in typically developing dual language learners from errors made by bilingual children with a diagnosed language impairment. In order to further explain the variability in dual language learners, targeted analyses of the participants' prototypical language trajectories that link to language learning profiles similar to those in Su et al. (2022) would serve to provide better guidelines for clinical comparisons.

Beyond the planned future research with the same participant data, additional investigations along this line should continue to add narrative language samples from bilingual children in different areas across the United States. With the range of variation found in typically developing bilingual children, it is also important to collect longitudinal data from dual language learners with language impairment. Information such as home language use at each point of retell sample collection would help to answer further questions about variance of language skills.

Clinical Implications

Bilingual children demonstrate a wide range of expressive language skills. Without a gold standard assessment or generalizable data on bilingual school-age children, speech-language pathologists may be more at risk of misdiagnosis of a child. The findings from this study show that typically developing bilingual children may have language skills that are below mastery level when looking at one point in time. Remembering to consider more than one point in time with early language learners is important. The results also inform clinicians about differences in dual language development based on language of academic instruction as a consideration for expectations. Finally, clinicians can have awareness of the changes we may see in development, lack of development, or regression in the heritage language and the ages and grades that bilingual children may experience these changes. Specifically, there seems to be a pattern of shifting from the heritage language to English around first grade. During these critical early years when dual language learners may be more likely to be referred for language assessment, the potential for language loss should be considered. It may also be important for clinicians to remember that there may be other points in time that critical changes to language skills could occur. It can be time consuming and even difficult to accurately diagnose language impairment in bilingual children, but information such as the present

findings can serve to alleviate some of the unknowns in bilingual language assessment.

Summary

In this study, there were periods of deceleration of one measure of grammaticality (PGU) in Spanish, growth of grammaticality in English, and growth of verbal productivity and lexical diversity (MATTR) in Spanish and English. The longitudinal findings appeared to usher a complex shift in dual language learning that has been shown in grammaticality (Castilla-Earls et al., 2019) and lexical diversity (Oppenheim et al., 2020) in previous studies with bilingual children. The trajectories of the Spanish and English co-development of participants academically instructed in English or Spanish displayed nearly mirror functional forms of one another over three academic years (see Figures 1–4). The growth trajectories reflect an overall proficiency shift from Spanish to English as focus of academic, decontextualized language is emphasized in school. The English-instructed participants began with Spanish and English grammatical and lexical skills around the same level but grew dramatically in English PGU, which simultaneously decelerated dramatically in Spanish. The complex dynamics of dual language growth were more evident in the growth trajectories for grammaticality (PGU) from kindergarten to second grade, as MATTR grew at similar rates in English and Spanish for the participants, whether they were English or Spanish instructed. The findings from this study overall support the hypothesis that there would be differences in the dual language growth of participants as a function of being academically instructed primarily in English or Spanish. In summary, the language of academic instruction during the early and later elementary school years should be considered in future research with bilingual children, as well as in bilingual clinical assessment.

Data Availability Statement

All data generated or analyzed in this study are available upon reasonable request from the corresponding author.

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