Research Article

Changes in English Past Tense Use by Bilingual School-Age Children With and Without Developmental Language Disorder

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Purpose: The purpose of this study is to examine changes in English past tense accuracy and errors among Spanish–English bilingual children with typical development (TD) and developmental language disorder (DLD).

Method: Thirty-three children were tested before and after 1 year to examine changes in clinically relevant English past tense errors using an elicited production task. A mixed-model linear regression using age as a continuous variable revealed a robust effect for age. A 4-way repeated-measures analysis of variance was conducted with age (young, old) and language ability group (TD, DLD) as between-subjects variables, time (Time 1, Time 2) and verb type (regular, irregular, and novel verbs) as within-subject variables, and percent accuracy as the dependent variable. Subsequently, a 4-way repeated-measures analysis of variance was conducted to measure the overall distribution of verb errors across 2 time points.

Results: Overall, children produced regular and novel verb past tense forms with higher accuracy than irregular past

tense verbs in an elicitation task. Children with TD were more accurate than children with DLD. Younger children made more improvement than older children from Time 1 to Time 2, especially in the regular and novel verb conditions. Bare stem and overregularization were the most common errors across all groups. Errors consisting of stem + ing were more common in children with DLD than those with TD in the novel verb condition.

Discussion: Contrary to an earlier report (Jacobson & Schwartz, 2005), the relative greater difficulty with regular and novel verbs was replaced by greater difficulty for irregular past tense, a pattern consistent with monolingual impairment. Age was a contributing factor, particularly for younger children with DLD who produced more stem + ing errors in the novel verb condition. For all children, and particularly for those with DLD, an extended period for irregular past tense learning was evident. The results support a usage-based theory of language acquisition and impairment.

Developmental language data for children who learn English as a second language (L2) while maintaining Spanish are scarce. Compared with other languages spoken in the United States, Spanish is ranked as the language that is used most often (57 million speakers) and most likely to be maintained (U.S. Census Bureau, 2012). Active use of more than one language may result in a profile for each language distinct from that of monolinguals. Fluctuations in the amount and quality of English input received at different stages of learning may result in qualitative differences that include features influenced by the first language (L1) or usage patterns

characteristic of other children and adults in the community who may be in the intermediate stages of learning English (Hoff et al., 2012; Morgan, Restrepo, & Auza, 2013; Paradis, 2010).

Developmental language disorder (DLD) is a term recommended to replace previous terminology (e.g., *specific language impairment* [SLI]; *primary language impairment* [PLI]; or simply, *language impairment* [LI]). All describe a heterogeneous grouping of children who, for no apparent clinical reason (e.g., hearing loss, intellectual disability, neurological impairment, behavioral disorder, or structural deficit), exhibit unusual difficulty in acquiring language (Leonard, 2014). Although *SLI* has been the preferred term in research practices (Leonard, 2014; Schwartz, 2017), use of the term *DLD* coincides with international efforts to reduce the confusion involving separate terms for research and clinical practice. Consequently, *DLD* is employed throughout our article even for previous research that used other terms.

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The estimated prevalence of DLD is 7% in monolingual English speakers (Tomblin et al., 1997); a similar prevalence is assumed for bilingual children. Importantly, pieces of evidence of deficits in both languages are essential for the diagnosis of DLD in bilingual children. Grammatical deficits are most common, although the problems often extend to other cognitive functions, such as memory, visual rotation, perception, attention, speed of processing, and executive functions (Schwartz, 2017).

The diagnosis of DLD in bilingual children is complex. Changes to each language, known as *bilingual effects*, can result in error patterns that simulate impairment or delay in both languages (Castilla-Earls, Restrepo, Perez-Leroux, & Gray, 2015; Kohnert, 2010). Variation in bilingual versus monolingual learning context may also alter the pattern of deficit in the respective languages (Morgan et al., 2013). Age at time of assessment may also influence performance on language tasks, as younger children are generally perceived to be more vulnerable to the effects of L1 suppression in an immersion context. Of general concern are the reported higher rates of learning difficulties among children from minority language backgrounds beyond third grade (Artiles, Rueda, Salazar, & Higareda, 2005) and problems with underidentification of impairment during the early school years (Bohman, Bedore, Peña, Mendez-Perez, & Gillam, 2010; Collins, O'Connor, Suárez-Orozco, Nieto-Castanon, & Toppelberg, 2014).

Separating low proficiency from low ability is complicated, although necessary for the determination of DLD in bilingual children. *Proficiency* refers to the relative attainment in a first or L2 and can be predicted by the amount and quality of exposure over time. Conversely, *language ability* refers to the child's individual capability for learning language. Proficiency in a given language may shift over time. In the United States, bilingual children generally start out with greater proficiency in L1 and gradually shift toward dominance in the majority language through increased English exposure at school. Yet, children with DLD take longer to reach similar proficiency levels as their bilingual peers with typical development (TD) despite similar amounts of input. The results of Bohman, Bedore, Peña, Mendez-Perez, and Gillam (2010) showed that simply hearing another language did not necessarily yield improvement across all language domains. For bilingual kindergarten children, growth in semantic development was driven by input; alternatively, morphosyntactic development was motivated by a combination of input (exposure) and output (language use).

The dynamic aspect of bilingual acquisition is best captured by longitudinal data. Most existing studies focus on young bilingual children with TD (Bohman et al., 2010; Collins et al., 2014; Hoff et al., 2012; Rojas & Iglesias, 2013). Fewer address changes in bilingual children who also have DLD (Gillam, Peña, Bedore, Bohman, & Mendez-Perez, 2013; Gutiérrez-Clellen, Simon-Cereijido, & Sweet, 2012; Paradis, Jia, & Arppe, 2017; Salameh, Håkansson, & Nettelbladt, 2004). Moreover, the chief focus has been on bilingual children attending majority language immersion

programs to the near exclusion of those receiving bilingual instruction.

Longitudinal studies are essential for understanding changes in proficiency levels. Although substantial reductions in the amount of L1 input can lead to language loss, or attrition (Anderson, 1999), positive, although uneven, rates of growth in proficiency for both languages (Collins et al., 2014; Rojas & Iglesias, 2013) have been reported when both languages are used, particularly in areas having high concentrations of Spanish speakers. In one study, 96% of children between kindergarten and second grade showed no loss of proficiency in either English or Spanish (Collins et al., 2014). Moreover, most (63%) improved their proficiency ratings in one or both languages; others (37%) maintained their proficiency ratings. Of concern in this study were the 10% of children who showed low proficiency in kindergarten and who remained in the low proficiency group at second grade, presumably due to lack of timely screening or referrals and lack of intervention (Collins et al., 2014). Then again, others found that continued growth in English was hampered by the temporary declines in English when retested following summer vacation (Rojas & Iglesias, 2013).

Theoretical Framework

Proceeding from general acquisition theories, theories of DLD have been split between those positing either linguistic (generative) or processing (input/usage based) explanations of difficulty (Leonard, 2014; Leonard, Eyer, Bedore, & Grela, 1997; Schwartz, 2017). In linguistic accounts, children with DLD are seen as having deficits in the linguistic representations that support grammatical use. Among the most widely cited is the extended optional infinitive account. The extended optional infinitive account stipulates that children with DLD remain in a stage when tense marking on main verbs is "optional," a stage that also occurs in typical acquisition but resolves by the end of the preschool period in monolingual English speakers as a result of biological maturation (Rice & Wexler, 1996). Subsequently proposed linguistic accounts include Wexler's Extended Unique Checking Constraint (EUCC) hypothesis (as reviewed in Schwartz, 2017), linking children's difficulties to an inability to simultaneously check tense and agreement morphology within the same phrase. The EUCC offered an explanation for grammatical deficits in other languages for which tense marking is not the primary deficit. Van der Lely's computational grammatical complexity hypothesis further extended both earlier linguistic accounts by placing the deficit more generally in the hierarchical computations that support morphology, syntax, and phonology (Schwartz, 2017). These accounts are useful for predicting the sequence of acquisition and detailing the linguistic errors of children with DLD yet do not account for the results of fluctuation and variability of bilingual input. Further, they do not explain the non-linguistic areas of deficit for children with DLD (Schwartz, 2017).

An alternative to linguistic-based accounts are those that involve processing deficits or problems associated with

the ability to adequately utilize the cognitive resources necessary for developing language (Weismer, Evans, & Hesketh, 1999). Central to processing accounts is the role of input frequency. Despite generative claims that children would move out of the nonfinite stage once they reached a point of biological maturation (Rice & Wexler, 1996), input-based explanations have shown that the number and distribution of finite verbs in the input drive the rate of error resolution in different languages (Legate & Yang, 2007). Given that input frequency varies in bilingual situations, input-based explanations are best suited to explaining the changes associated with bilingual acquisition.

Input-based explanations of language acquisition have also been extended to situations of impairment. The competing sources of input (CSI) account (Leonard, 2014) stipulates that tense omission errors by children with DLD reflect inappropriate extraction of the nonfinite subject–verb sequence commonly occurring in utterance final position (Leonard & Deevy, 2011; Leonard, Fey, Deevy, & Bredin-Oja, 2015). Given that children are likely to have heard both “*the dog played*” and “*we watched the dog play*,” it has been proposed that children with DLD fail to recognize that tense marking is present in the earlier appearing verb form (“*we watched*”) and, as a result, inappropriately extract the nonfinite syntactic frame (“*the dog play*”) at the end of the utterance, using it in contexts where a tensed verb is required. Although linguistic explanations would see this as a failure to acquire a rule, processing explanations see this as a breakdown in accessing something that was rote memorized. Separate predictions for the resolution of errors follow.

Past Tense Errors

Past tense errors occur in both typical and atypical development (Ambridge & Lieven, 2011). Bare stem verb substitutions predominate early on (e.g., *throw* for *threw* or *play* for *played*) and are later followed by the overregularization of irregular verbs. Occasional, although less frequent, are double marking on regular (e.g., *droppeded* for *dropped*) or irregular verbs (e.g., *helded* for *held*). Most studies report higher rates of bare stem errors accompanied by lower rates of overregularization for children with DLD (Rice, Wexler, Marquis, & Hershberger, 2000; van der Lely & Ullman, 2001). Similar patterns exist for children with DLD who are nonmainstream dialect speakers (Oetting & Horohov, 1997; Pruitt & Oetting, 2009) or who speak L2 English (Blom & Paradis, 2013; Jacobson & Schwartz, 2005; Paradis, Schneider, & Duncan, 2013). However, when older children (6–10 years) with DLD were compared with age-matched controls, no difference in overregularization rates was found (Marchman, Wulfeck, & Ellis Weismer, 1999).

Linguistic and processing accounts offer distinct explanations for errors on novel past tense verbs. Generative accounts maintain that children produce novel past tense verbs as soon as the “add *-ed*” rule is mastered (90% accuracy), so that omission errors on novel verbs occur as a result of failing to acquire the rule (Berko, 1958). In contrast, processing accounts maintain that use of past tense novel

verbs depends on input frequency and, the analogy, to stored exemplars. Errors occur because children are unable to access the rote-learned form as a result of reduced input frequency and lack of analogy to stored exemplars (Ambridge & Lieven, 2011). In linguistic accounts, errors are resolved once the rule is mastered; processing accounts predict a gradual resolution of errors that are linked to increased input.

The incorporation of novel verb stimuli is well established in child language research (Berko, 1958). Novel words have been used to examine and control for the influence of word familiarity. Two-year-old children may show difficulty manipulating novel word stimuli due to restrictions on memory, attention, and recall using an unfamiliar form. The *stem + ing* error consists of the child simply repeating the last word heard in the prompt. Thus, instead of the usual bare stem error (e.g., *nop* it), some children respond with *nopping* it, indicating a failure to separate the verb stem from the *-ing* inflection, store it, retain it, and recall it for production.

The English Past Tense

The English past tense is unique in its regularity distinction. According to Bybee (1995), regular verbs are learned sooner because of the relatively high number of verbs with *-ed* endings in the input (type frequency) in combination with the verb’s frequency of use (token frequency). The combined effects of Bybee’s type and token frequency account are particularly relevant for the acquisition of children whose input is split between two languages (Blom & Paradis, 2013). For children learning L2 English, the regular–irregular sequence is similar but proceeds at a slower pace (Blom & Paradis, 2013; Nicoladis, Song, & Marentette, 2012), driven by the age of acquisition and amount of English input (Blom & Paradis, 2014) and whether or not the L1 marks tense (Blom & Paradis, 2013). Most studies report an advantage for regular past tense among developing bilinguals (Marinis & Chondrogianni, 2010; Nicoladis, Palmer, & Marentette, 2007; Nicoladis et al., 2012; Paradis, Nicoladis, Crago, & Genesee, 2010). In a comparison of monolingual and L2 learners of English, Marinis and Chondrogianni (2010) found that after approximately 4 years of English exposure at school, the L2 English speakers, aged 8–9 years, did not differ from the monolinguals on the use of regular past tense and the number of uninflected bare stem verbs. However, they achieved lower accuracy on irregular verbs and significantly more overregularization errors. The special status of irregular morphology extends also to the dominant language. In Dutch, a language related to English, typically developing Dutch–Hebrew bilinguals who were dominant in Dutch showed greater difficulty in using the Dutch irregular past tense (Rispen & DeBree, 2015).

Longitudinal Data for Monolingual and Bilingual Children With DLD

Longitudinal studies have the unique capacity to show how language and language-related skills change

over time. For monolingual English speakers with DLD, grammatical skills improve steadily to the extent that tense omission errors no longer serve as clinical markers of the disorder by ages 8–10 years (Conti-Ramsden, St Clair, Pickles, & Durkin, 2012; Rice et al., 2000). Past tense accuracy increased from 32% to 88% for regular verbs (Rice et al., 1998) and from 13% to 48% for irregular verbs by 8–10 years (Rice et al., 2000). Over time, a decrease in bare stem errors was accompanied by an increase in overregularization for children with DLD, thus reversing the profile of errors and relative verb regularity difficulty exhibited in earlier years. Over time, decreases in IQ scores have also been documented so that children who met the DLD criteria at age 6 years no longer did so at 10–11 years of age (Conti-Ramsden et al., 2012).

Reported outcomes for preschool and early school-age bilingual children with DLD showed the same sequence of grammatical development as monolingual English children with DLD (Rice et al., 2000), albeit at a slower pace (Salameh et al., 2004). A similar regular–irregular past tense profile was also reported for seven children with DLD from varied L1 backgrounds (Paradis et al., 2017). In this study, L2 English speakers with DLD were matched to monolingual English speakers with DLD having the same number of years of English exposure. Over a period of 3 years, children with DLD (aged 8–10 years) showed consistent improvement on regular past tense, but the development of irregular past tense was protracted (Paradis et al., 2017). At the study's conclusion, bilingual children with DLD differed from their peers only with respect to irregular verbs. Notably, the bilingual children with DLD performed better than the younger monolingual children with DLD on regular past tense verbs. Reported negative outcomes for bilingual children's grammatical development have been attributed to the inclusion of children having fewer than 3 years of exposure to English (Paradis et al., 2017).

This study contributes to our understanding of typical and atypical language development in bilingual children by examining changes in clinically relevant English past tense errors for children in a Spanish maintenance context at two time points. A unique aspect of this study is that it was preceded by earlier research conducted in the same bilingual community using a similar procedure and verb stimuli. The first examined past tense use in second-grade children using elicited production (Jacobson & Schwartz, 2005). Although children with DLD performed proportionally and absolutely lower than their TD peers on all verb categories, a significant interaction indicated that they did better on irregular verbs. Moreover, children with TD produced more overregularization errors, whereas children with DLD produced higher rates of tense omission errors (bare stems and stem + ing). Noteworthy, the existence of stem + ing errors on novel verbs was higher among children with DLD. In fact, children with DLD produced double the number of stem + ing errors for the novel verb forms, 35.3% (52 of 147 errors), compared with 15.8% (16 of 101 errors) by the TD group. Subsequently, Jacobson and Livert (2010) compared older bilingual children with DLD with the younger bilingual

children with DLD from the previous 2005 study. That comparison revealed that the older bilingual children with DLD still lagged in the production of regular and novel past tense verbs and failed to achieve rates of overregularization comparable with those of the younger TD bilingual children, despite having had an additional 2.5 years of English exposure at school. A drawback to this comparison was the reliance on cross-sectional samples, which precluded the ability to examine individual change. Presently, we corrected for this limitation by examining change for individual children over the course of approximately 1 year. In doing so, we illustrated a reversal of the regularity profile displayed earlier for children with DLD and provided further evidence regarding the English error patterns of children with typical and atypical bilingual acquisition.

Our study posed the following questions: Do bilingual children having TD or DLD differ on accuracy rates for regular, irregular, and novel past tense verbs at Time 1 and Time 2? Do differences exist in the amount/rate of change from Time 1 to Time 2? Do differences exist with respect to error patterns? Specifically, how do the groups differ with respect to tense omission or overregularization errors over time?

Method

Prior approval from the university institutional review board for the protection of human subjects was obtained. Children were tested in their homes on weekends and after school so as not to take them away from important school activities. The parent interviews were conducted almost exclusively in Spanish by the principal investigator (first author). All but one parent opted to sign the Spanish version of the letter of informed consent.

Participants

There were 16 TD children and 17 children with DLD who were part of a larger cohort (64). Children were excluded for the following reasons: failing the hearing screening (two), diagnosis of cerebral palsy (one), unable to be tested at two time points in English (14), not receiving bilingual instruction (two), and fewer than 3 years in the United States (12). The remaining 33 participants attended the same late exit transitional bilingual program in a northeast metropolitan area. All children received initial literacy instruction in Spanish with a transition to English instruction by the third or fourth grade. Spanish maintenance was facilitated by high levels of Spanish used at home and in the community (Anderson, 1999; Collins et al., 2014) and the fact that most parents were not bilingual and spoke primarily Spanish at home (Anderson, 1999). According to the information provided by the State Education Department, approximately 54% of children in this school community were Latino, and 43% were classified as limited English proficient; 57% qualified for free or reduced-priced lunch.

For nearly all children (31 of 33, or 94%), both parents were immigrants. Places of parental origin included El

Salvador (24 of 33, or 73%), the Dominican Republic (4 of 33, or 12%), Guatemala (2 of 33, or 6%), Mexico (2 of 33, or 6%), and Puerto Rico (1 of 33, or 3%). All but two parents received formal schooling outside of the United States, and most had attended only elementary school. Only two parents had postsecondary education, which had been completed in the United States. In both cases, the grandparents also resided in the home and assumed a large portion of the child care responsibilities.

Classification of DLD

Given the lack of a gold standard for identifying LI in bilingual children (Dollaghan & Horner, 2011), a functional classification of LI was established based on failure to meet age-expected performance levels relative to their bilingual peers. Children classified as DLD exhibited at least two of the following: (a) current or previous enrollment in a speech-language therapy program—13 of 17 (76%) met this criterion, (b) grade retention and/or enrollment in a remedial reading program—12 of 17 (73%) met this criterion, and (c) performance below 1.5 *SD* on the Sentence Recall subtest of the Clinical Evaluation of Language Fundamentals—Fourth Edition (CELF-4; Semel, Wiig, & Secord, 2006) or below the second stanine on the CELF-4 (Spanish version)—15 of 17 (88%) met this criterion. The children who received speech-language therapy or remedial reading instruction (15 of 17, or 88%) qualified following a multidisciplinary comprehensive evaluation, including social history, psychological, and speech-language evaluations administered in accordance with the New York State guidelines for assessment practices. All exclusionary criteria for DLD were met. In addition, the clinical judgment of two American Speech-Language-Hearing Association–certified bilingual speech-language pathologists with more than 10 years of experience assessing and treating bilingual children concurred with the classifications, a grouping practice used by others (Gillam, et al., 2013; Lugo-Neris, Peña, Bedore, & Gillam, 2015).

All children passed a pure-tone hearing screening bilaterally. Additional tests included the Test of Nonverbal Intelligence—Third Edition (Brown, Sherbenou, & Johnsen, 1997), the Spanish and English versions of the Woodcock–Muñoz Language Survey III (Woodcock & Muñoz-Sandoval, 2001), and the Spanish or English version of the Sentence Recall subtest from the CELF-4. The Woodcock–Muñoz Language Survey III provides a proficiency rating on a 5-point scale for each language using monolingual norms for the respective languages. Sentence recall tasks have strong sensitivity for the determination of DLD for monolingual children (Conti-Ramsden, Botting, & Faragher, 2001; Redmond, 2005). The same holds true for bilingual children in their L1 and L2 provided that adequate exposure to the languages has been provided (Gillam et al., 2013; Marinis & Armon-Lotem, 2015). The CELF-4 Sentence Recall subtest was administered in either English or Spanish depending on the higher language proficiency score. As per test manual instructions, the responses were recorded manually by the examiner and audiotaped. A trained graduate

research assistant listened to the recorded responses and scored the subtest independently. Reliability measures were based on approximately 23% of randomly selected samples. Percent agreement on raw scores ranged from 87% to 100% and averaged 95%.

Children classified as TD did not meet the above criteria. Admittedly, this classification represents a wider grouping of children compared with the more rigorous exclusionary criteria generally applied for the classification of monolingual children with DLD. However, the overlapping general learning deficits in children with DLD and children labeled as *poor reading comprehenders* cannot be ignored (Catts, Adolf, & Ellis Weismer, 2006). The overwhelming majority of children classified as DLD had documented language learning difficulties that required either speech-language therapy or remedial reading and often both at different stages. Poor sentence recall on the CELF-4 subtest was evident in almost all children classified as DLD.

Grammatical measures taken from language samples collected in both languages further supported the classification of DLD in bilingual children (Gutiérrez-Clellen et al., 2012; Kapantzolou, Fergatodis, & Restrepo, 2017). Our participants constituted a subset of children from a related report (Jacobson & Walden, 2013). In reexamining the number of words and word and morpheme omissions in this subtest, we found a similarly significant difference between the TD and DLD group ($p = .02$) and no difference in number of words. On average, children classified as DLD produced twice as many omission errors on oral language samples produced in English and Spanish. This information is provided as an Appendix to support the grouping of children with TD and DLD.

Group Characteristics

As indicated by the results of independent *t* test comparisons appearing in Table 1, the groups did not differ on age at first exposure to English (in months), years of schooling, and nonverbal IQ scores. The Test of Nonverbal Intelligence—Third Edition score was missing for one participant. Gender distribution was comparable across groups according to the results from the Fisher's exact test ($p = .73$). There were 10 females and six males for the group with TD and nine females and eight males for the group with DLD. We first examined the overall maturational effect using age as a continuous variable. We further divided the children by age and grade level (i.e., younger/lower grades and older/higher grades) to examine lower versus higher grade difference in past tense acquisition. The lower grade groups consisted of 17 children (eight TD, nine DLD) in first and second grades, and the later grade groups consisted of 16 children (eight TD, eight DLD) in third grade and up (see Table 2 for details). Dividing children at third grade and above was based on the rationale that, by third grade, all children were receiving mostly English instruction and input at school.

Information regarding home language use was obtained using the Woodcock–Muñoz Language Survey Language

Table 1. Group characteristics for children with typical development (TD) and developmental language disorder (DLD).

Characteristics	TD (<i>n</i> = 16)	DLD (<i>n</i> = 17)	<i>t</i> value	<i>df</i>	<i>p</i> value
Age in years	8.68 (2.52)	9.09 (2.09)			
Onset of formal English exposure in years	4.5 (.87)	4.5 (.97)	.092	31	.927
Years of formal English exposure	4.31 (1.8)	3.94 (1.99)	-.585	31	.576
WMLS proficiency score: English	3.82 (.64)	2.78 (.68)	4.454	31	.000**
WMLS proficiency score: Spanish	3.73 (1.13)	2.97 (.94)	2.108	31	.043*
TONI-3 standard scores	96.19 (8.79)	91.56 (11.77)	1.259	30	.218
Demographic information	TD	DLD			
Home language use by child					
more or mostly Spanish	8/16 (50%)		13/17 (76%)		
equal amounts Spanish/English	7/16 (44%)		4/17 (24%)		
more or mostly English	1/16 (6%)		0		
Home language use by others					
more or mostly Spanish	11/16 (69%)		17/17 (100%)		
equal amounts Spanish/English	5/16 (31%)		0/17		
more or mostly English	0/16		0/17		
Parents with postsecondary education	2/16 (13%)		0/17		

Note. WMLS = Woodcock–Muñoz Language Survey; TONI-3 = Test of Nonverbal Intelligence–Third Edition.

Questionnaire (2001). For each language, parents estimated the approximate percentage of Spanish and English language use at home. The percentages were converted to verbal descriptions (e.g., 100% = *all Spanish*, 75% = *more Spanish*, 50% = *equal amounts of Spanish and English*, 25% = *more English*, and < 25% = *all English*). Thus, if a parent stated that the child spoke mostly (but not all) Spanish, this would be equivalent to an estimation of 75%. The reported higher rates of English usage at home by typically developing children reflect the quicker pace of English learning by this group.

Stimuli

The past tense task included regular, irregular, and novel verbs elicited in transitive sentences using a cloze procedure. The regular and irregular verbs were selected on the basis of their familiarity and transitivity. The vast majority were documented to occur in the speech of pre-school children attending Head Start Centers in New York City (Hall, Nagy, & Linn, 1984). In its entirety, the elicited production task consisted of 66 items broken down as

follows: 16 regular past tense verbs; 16 irregular past tense verbs, including irregular foils (*hit*, *cut*, and *shut*); 13 complex verb phrases (e.g., *took it off*); and 16 novel verbs. However, the present analysis was restricted to 16 regular, 14 irregular, and 16 novel verbs. The practice trials included *crack*, *fly*, *hug*, *brush*, and *kiss*. The regular verbs were *tie*, *lock*, *push*, *wipe*, *close*, *burn*, *kill*, *move*, *turn*, *wash*, *drop*, *roll*, *pull*, *tape*, *open*, and *clean*. The irregular verbs were *throw*, *take*, *eat*, *win*, *drink*, *read*, *stick*, *catch*, *buy*, *blow*, *find*, *bite*, *break*, and *write*; *hit*, *cut*, and *shut* appeared as foils. The novel verbs were *blean*, *dill*, *din*, *doll*, *mull*, *gull*, *gurn*, *flimb*, *gock*, *kie*, *dush*, *mosh*, *lape*, *naip*, *nop*, and *wug*. Frequency and phonotactic probability measures were obtained using an online counter for English words and nonwords (Vitevich & Luce, 1999, 2004). Although verb frequency and phonotactic probability are known to influence past tense production, these aspects of the stimuli were not directly manipulated. A one-way analysis of variance (ANOVA) showed that frequency and phonotactic probability did not differ by verb type. For all intents and purposes, any latent effects of verb type frequency and phonotactic probability were, in effect, suppressed. The novel verbs consisted of monosyllables that

Table 2. Average ages in months with standard deviations (in parenthesis) and average grades for the lower and higher grade groups for bilingual children with typical development (TD) or developmental language disorder (DLD).

Variable	Lower < 3rd grade		Higher > 2nd grade	
	TD	DLD	TD	DLD
<i>N</i>	8	9	8	8
Age	80.3 (8.6)	91.4(12.2)	129.3 (22)	134.9 (16.7)
Grade	1.13(0.35)	1.33(0.50)	5.0 (2.0)	4.1(1.0)
Word/morpheme omissions: English	4.5(4.2)	8.8(8.2)	2.0(2.8)	6.6(3.4)
Word/morpheme omissions: Spanish	2.4(2.1)	4.6(3.6)	1.6(1.2)	4.9(2.9)

Note. Language sample data from participants in the lower and higher grades are summarized. Means and standard deviations for the number of different words and word and morpheme omissions in English and Spanish were based on oral narrative retells in English and Spanish (Jacobson & Walden, 2013).

rhymed with the regular and irregular verbs and did not differ on phonological complexity yet differed with respect to familiarity—an important distinction.

The stimuli were developed by the first author and consisted of videotaped actions. Children listened and watched as a prerecorded female voice described each action using the present progressive tense (e.g., “*Look, the man is throwing the ball.*” Upon completion, the examiner prompted, “*What did the man do with the ball? He....*” The anticipated response was “*threw it*” or “*he threw it.*” All verbs were elicited in transitive position. Five practice trials were provided. Children were discouraged from using the past progressive “*was throwing*” by explaining that this was not the best response because the action had already been completed. The correct response was modeled by the examiner, and the child was encouraged to repeat it. All children demonstrated the ability to repeat the phonological clusters that constituted the past tense inflections. The regular and irregular verbs were presented in pseudorandom order to avoid priming effects. The novel verbs were elicited immediately afterward. For novel words, children were told that they would perform a similar task using silly made-up words that they had probably never heard before. Two practice trials were provided. Two American Speech-Language-Hearing Association–certified speech-language pathologists who were blind to the child’s language ability grouping administered the tasks.

Scoring

Accuracy for regular, irregular, and novel verbs was measured using a binary scoring procedure. Items were scored as “correct” if the child’s production matched the targeted response (i.e., *-ed* for regular and novel verbs or use of the correct irregular verb). The error responses were further classified as follows: (a) overregularization (e.g., *eated*), (b) double marking (e.g., *dranked*), (c) bare stem (e.g., *eat*), (d) stem + *ing* (e.g., *eating*), (e) other verbs including past progressive (e.g., *was eating*), or (f) other (e.g., *unintelligible or unrelated responses*). These last two types of responses were excluded from the error analysis. The error analysis focused on errors that included tense (e.g., *overregularization and double marking errors*) and those that did not include tense (e.g., *stem or stem + ing*). Verbs that did not change from the stem to the past (e.g., *hit*, *shut*, and *cut*) were also removed from the analysis.

Data Analysis

Mixed-Effects Linear Regression Analyses on Response Accuracy Using Age as a Continuous Variable to Examine Maturational Effect

To examine whether age (in months), language ability status (TD vs. DLD), time (Time 1, Time 2), and verb type (regular, irregular, and novel) were predictive of the response accuracy, linear mixed-effects models were developed using R (R Core Team, 2014) and the nlme package (Version 3.1-128; Pinheiro, Bates, DebRoy, Sarkar, & R Core Team, 2017). To account for within-subject variability, a

random intercept and a random slope of time and verb type for each participant were included in the model. The effects of age (in months), language ability status, time, and verb type were then tested following a bottom-up theory-guided approach, starting with Level 1 predictors, then progressively adding to the models’ subject level independent variables and interaction terms. The likelihood ratio test and the Akaike information criterion were used to compare the fit of the competing models. Only variables and interactions that significantly improved the model fit (as indicated by a significant decrease of Akaike information criterion value) were retained.

Analyses on Response Accuracy Dividing Children Into Lower Grade/Younger and Later Grade/Older Groups

To address the question of whether all children improved similarly across all three verb types, a four-way repeated-measures ANOVA was conducted with age (early grade/young and later grade/old) and language ability status (TD, DLD) as between-subjects variables, time (Time 1, Time 2) and verb type (regular, irregular, and novel) as within-subject variables, and percent accuracy as the dependent variable.

Overall Verb Error Distribution

A four-way repeated-measures ANOVA was conducted to measure the overall verb error distribution across the two time points. Language ability status (TD, DLD), age (early grade and later grade), error type (overregularization, stem, stem + *ing*, etc.), and time (Time 1, Time 2) were used as independent variables. The dependent variable was percent of errors.

Error Distribution for Regular, Irregular, and Novel Verbs

Given error distribution across verb types (six errors types for irregular verbs, but for regular and novel verbs, the errors are concentrated stem and stem-*ing*), two sets of repeated-measures ANOVAs were conducted to examine how errors were distributed—one set for irregular verbs and another set for regular and novel verbs together. Language ability status and age were between-subjects variables, and time of measurement and error type were the within-subject independent variables. Verb type is the within-subject variable for the regular versus novel verb comparison. The dependent variables are the proportion of errors made.

For all repeated-measures ANOVAs, significant effects were followed up by Tukey’s honestly significant difference (HSD) post hoc tests, and degrees of freedom were adjusted using Greenhouse–Geisser correction for comparisons with more than one degree of freedom in the numerator and were reported as corrected *p* values. The uncorrected degrees of freedom, *F* values, and the partial eta squared values, when applicable, were included.

Results

Change in Accuracy Using Age as a Continuous Variable

Table 3 summarizes the results from best-fitting mixed-effects model. Linear mixed-effects regression analysis revealed that all four fixed effects are significant predictors of accuracy. Language was a significant predictor of accuracy, $t(44) = -4.328, p < .001$, semipartial $R^2 = .30$, age is also a significant predictor of accuracy with a large effect size, $t(44) = 10.6, p < .001$, semipartial $R^2 = .72$. The other two significant predictors are time, $t(33) = 4.997, p < .001$, semipartial $R^2 = .43$, verb condition (regular-irregular: $t(33.8) = -4.299, p < .001$, semipartial $R^2 = .35$; regular novel: $t(79.1) = -2.308, p = .02$, semipartial $R^2 = .35$).

Change in Accuracy (Lower vs. Higher Grades)

Changes in the proportion of correct verbs according to verb type and language ability status group at Times 1 and 2 are illustrated in Figure 1. The results of repeated-measures ANOVAs showed four main effects, including a main effect of age, $F(1, 29) = 36.1, p < .001, \eta_p^2 = .55$, in which the children in the higher grades have higher accuracy than the children in the lower grades; a main effect of language ability group, $F(1, 29) = 7.654, p = .01, \eta_p^2 = .21$, with higher accuracy in the TD group; a main effect of time, $F(1, 29) = 29.3, p < .001, \eta_p^2 = .50$, with higher accuracy in Time 2 than in Time 1; and a main effect of verb type, $F(2, 58) = 10.03, p < .001, \eta_p^2 = .26$, in which the accuracy for the irregular verb type is lower than that of the regular and novel verbs, with no difference between regular and novel verbs. Significant interactions included time by age (younger/lower grades and older/higher grades, $F(1, 29) = 5.623, p = .02, \eta_p^2 = .16$, time by verb type, $F(2, 58) = 9.39, p < .001, \eta_p^2 = .24$, and time by age by verb type, $F(2, 58) = 3.25, p = .05, \eta_p^2 = .10$). Post hoc testing using Tukey's HSD following the Time $\times$ Age interaction showed no difference in accuracy for the older children in higher grades between Time 1 and Time 2, although accuracy was higher at Time 2 than at Time 1 for the younger children in the lower grades. Post hoc analysis following the Age $\times$ Time $\times$ Verb Type three-way interaction indicated that the only significant increase in accuracy for the older children was in the regular verb condition, whereas for the younger

group, accuracy was increased in both the regular and novel verb conditions. Time $\times$ Verb Type $\times$ Language Ability Status group interaction was not significant, $F(2, 58) = 0.562, p = .57$. Figure 2 suggests similar patterns of progress for both TD and DLD groups across the two time points.

In summary, higher response accuracy for the regular verbs and novel verbs than for the irregular verbs was evident. Children in the TD group were more accurate than children in the DLD group. Older children had higher accuracy than the younger children regardless of language status, but the younger children improved more from Time 1 to Time 2. Verb type was relevant. Significant improvement from Time 1 to Time 2 was evident for the younger children in the lower grades under the regular and novel verb conditions. However, older children in the higher grades improved only in the regular verb condition.

Overall Verb Error Distribution

The proportion of error types by age and group appears in Table 4. Four-way repeated-measures ANOVA found a main effect of language ability, $F(1, 29) = 7.18, p < .001, \eta_p^2 = .20$, age, $F(1, 29) = 36.6, p < .001, \eta_p^2 = .56$, and time, $F(1, 29) = 21.2, p < .001, \eta_p^2 = .42$, with lower error rate seen in the TD group, older children in higher grades, and Time 2, respectively. A main effect of error type, $F(5, 145) = 18.4, p < .001, \eta_p^2 = .39$, was also found and post hoc test suggesting that stem + ing and was + verb-ing are the most frequent nontarget responses. Significant interactions include Time $\times$ Age, $F(1, 29) = 5.22, p = .03, \eta_p^2 = .15$, Error Type $\times$ Language Ability Status, $F(5, 145) = 3.18, p = .01, \eta_p^2 = .10$, Error Type $\times$ Age/Grade, $F(5, 145) = 5.92, p < .001, \eta_p^2 = .17$, and Error Type $\times$ Time, $F(5, 145) = 5.76, p < .001, \eta_p^2 = .17$. Post hoc tests revealed that the younger children in lower grades made more errors than the older children in higher grades at both Time 1 and Time 2, the DLD group made significantly more stem + ing type of errors than the TD group, the younger children made more stem and stem + ing types of errors than did the older children, and the Error Type $\times$ Time interaction was driven by the stem error type with more bare stem errors in Time 1 than in Time 2. The three-way Language $\times$ Age $\times$ Error Type interaction was marginally significant, $F(5, 145) = 2.20, p = .058$. No other interactions were significant. That is, in general, stem + ing and overgeneralization were common, but more bare stem and

Table 3. The response accuracy results from mixed-effects linear models using age as a continuous variable.

Fixed effects	Estimate	SE	df	t	Pr	Semipartial R^2
(Intercept)	-0.40	0.11	53.6	-3.752	< .001	
Language (SLI)	-0.21	0.05	44.0	-4.328	< .001	.30
Age in month	0.01	0.001	44.0	10.663	< .001	.72
Time (Time 2)	0.21	0.04	33	4.977	< .001	.43
Condition (irregular)	-0.15	0.03	33.8	-4.299	< .001	.35
Condition (novel)	-0.07	0.03	79.1	-2.308	.02	.35

Note. SLI = specific language impairment.

Figure 1. Accuracy for regular, irregular, and novel past tense at two time points according to lower and higher grades.

Figure 2. Accuracy for regular, irregular, and novel words at two time points according to TD and DLD. TD = typical development; DLD = developmental language disorder.

Table 4. Proportion of errors by language ability group, grade level, and error type, including double marking (DM), overregularization (OR), stem, stem + ing, was + verbing (wasVB), other, and time of testing.

Group	Grade	Verb type	DM		OR		Stem		Stem + ing		wasVB		Other	
			T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
TD	Lower grades, N = 8	(total)	0.00	0.01	0.06	0.07	0.33	0.12	0.02	0.00	0.06	0.02	0.00	0.02
			0.00	0.01	0.05	0.10	0.54	0.20	0.03	0.01	0.11	0.03	0.00	0.01
		Regular				0.00	0.53	0.16	0.03	0.01	0.13	0.02	0.00	0.00
	Higher grades, N = 8	Irregular	0.00	0.01	0.10	0.30	0.49	0.21	0.01	0.00	0.11	0.04	0.00	0.01
		Novel			0.00	0.00	0.61	0.24	0.03	0.01	0.11	0.00	0.00	0.00
		Regular	0.01	0.01	0.07	0.03	0.12	0.03	0.01	0.00	0.01	0.02	0.00	0.02
		Irregular				0.00	0.12	0.02	0.00	0.00	0.02	0.01	0.00	0.00
		Novel	0.01	0.01	0.15	0.10	0.13	0.04	0.02	0.00	0.00	0.02	0.00	0.02
					0.00	0.01	0.12	0.02	0.02	0.00	0.00	0.00	0.00	0.00
		(total)	0.02	0.02	0.04	0.05	0.34	0.23	0.23	0.17	0.00	0.01	0.01	0.02
DLD	Lower grades, N = 9		0.00	0.01	0.03	0.06	0.44	0.35	0.41	0.27	0.00	0.01	0.01	0.03
		Regular				0.00	0.55	0.39	0.34	0.20	0.00	0.00	0.00	0.00
		Irregular	0.00	0.01	0.07	0.18	0.44	0.35	0.33	0.23	0.00	0.01	0.01	0.03
	Higher grades, N = 8	Novel			0.00	0.00	0.35	0.31	0.55	0.38	0.00	0.00	0.02	0.00
		(total)	0.04	0.04	0.05	0.05	0.23	0.11	0.04	0.06	0.01	0.01	0.00	0.01
		Regular				0.01	0.30	0.05	0.00	0.03	0.01	0.01	0.0	0.00
		Irregular	0.04	0.04	0.09	0.13	0.19	0.14	0.00	0.01	0.00	0.01	0.01	0.01
		Novel			0.01	0.00	0.19	0.14	0.12	0.15	0.02	0.00	0.00	0.00

Note. TD = typical development; DLD = developmental language disorder.

stem + ing errors were made in the younger children in lower grades, especially at Time 1, and the stem + ing error was particularly more common in children with DLD than those with TD.

Error Distribution Among Irregular, Regular, and Novel Verbs

The results from the four-way repeated-measures ANOVAs on error patterns under irregular verb conditions mirror the overall error patterns described above. Main effects include age, $F(1, 29) = 38.2, p < .001, \eta_p^2 = .57$, time, $F(1, 29) = 5.88, p = .02, \eta_p^2 = .17$, and verb error type, $F(5, 145) = 14.8, p < .001, \eta_p^2 = .34$, with a higher proportion of errors in the younger children and during Time 1, respectively, and the highest proportion of errors was under the bare stem condition followed by overgeneralization and stem + ing. Significant two-way interactions include Error Type $\times$ Language Ability Status, $F(1, 29) = 4.41, p = .04, \eta_p^2 = .13$, Type $\times$ Age, $F(1, 29) = 4.075, p < .01, \eta_p^2 = .12$, and Error Type $\times$ Time, $F(4, 145) = 5.9, p < .001, \eta_p^2 = .17$. Post hoc tests did not find any specific driving factor for the Error Type $\times$ Language Ability interaction but did show that the Error Type $\times$ Age interaction was driven by the younger children in lower grades having produced more stem errors than the older children in the higher grades. The Error Pattern $\times$ Time interaction was also driven by more stem errors produced during Time 1 than during Time 2, suggesting that stem errors reduced significantly. The three-way Type $\times$ Age $\times$ Time interaction was driven by the younger children producing fewer bare stem but more overgeneralization errors in Time 2 than in Time 1, $F(5, 145) = 2.88, p = .02, \eta_p^2 = .09$.

Five-way repeated-measures ANOVA comparing novel with regular verbs revealed that all main factors were significant, age: $F(1, 29) = 22.9, p < .001, \eta_p^2 = .44$; language: $F(1, 29) = 8.85, p = .01, \eta_p^2 = .23$; time: $F(1, 29) = 15.2, p < .001, \eta_p^2 = .34$; verb type: $F(1, 29) = 7.98, p < .01, \eta_p^2 = .22$; error pattern: $F(2, 58) = 6.17, p < .05, \eta_p^2 = .18$. More errors were noted in the younger/lower grade, DLD group, novel verb type, and T1 conditions, respectively, and there were more errors in the bare stem condition than in the stem + ing condition. A two-way Error Type $\times$ Verb Type interaction, $F(1, 29) = 6.60, p = .02, \eta_p^2 = .19$, showed that significantly more stem + ing errors occurred in the novel verb than in the regular verb condition. A three-way Verb Type $\times$ Error Type $\times$ Language Ability Status interaction, $F(1, 29) = 13.23, p < .001, \eta_p^2 = .31$, was significant. Post hoc analyses revealed more stem + ing errors in the novel verb condition for children with DLD compared with children with TD. A three-way Verb Type $\times$ Language Ability $\times$ Time interaction, $F(1, 29) = 4.21, p = .05, \eta_p^2 = .13$, was also significant, but post hoc testing did not find any specific driving factor. Notwithstanding the types of errors for irregular verbs, children made largely similar types of errors for regular and novel verbs, with the exception that children with DLD tended to make more stem + ing errors in the novel verb condition than their TD peers. See Figure 3.

Discussion

The current study provides evidence of a shifting profile of past tense errors with respect to verb regularity in bilingual children with DLD over time. Not only was the previously reported advantage for irregular verbs (Jacobson

Figure 3. Error rates, including DM, OR, stem, stem + ing, wasVB, and other, for lower and higher grades according to TD and developmental language disorder. TD = typical development; DLD = developmental language disorder; DM = double marking; OR = overregularization; wasVB = was + verbing.

& Schwartz, 2005) not supported in this analysis but also children with DLD reversed the profile and performed relatively better on regular verbs, an outcome consistent with that of older monolingual English speakers with DLD (Rice et al., 2000) and L2 English speakers with DLD from varied L1 backgrounds (Marinis & Chondrogianni, 2010; Paradis et al., 2017). The pattern of error resolution favors processing over linguistic accounts of impairment. In particular, the CSI account (Leonard & Deevy, 2011; Leonard et al., 2015) is tenable given the gradual resolution of errors that could be influenced by variability in the input.

Our initial question addressed changes in the accuracy rates for regular, irregular, and novel past tense verbs for bilingual children with TD and DLD and the maturational changes relating to verb morphology acquisition. We observed a robust maturational effect using age as a continuous variable (semipartial $R^2 = .72$). To further examine potential grade level effects, the groups were split into early (one to second grade, i.e., < 8 years) and later grades (third to seventh grades, or > 8 years). The results showed that older children in higher grades performed better than younger children in lower grades at both time points irrespective of language ability group and that both groups made significant progress from Time 1 to Time 2. These outcomes support the role of input for driving acquisition. Not only had the older children been exposed to English for a longer period but they were also exposed to greater amounts of English at school. Likewise, positive changes for both groups of children demonstrate that increased input also plays role for children with DLD. However, the three-way interaction involving verb type showed that the older children improved only in the regular verb condition, whereas younger children improved on both regular and novel verbs. In addition,

younger children made more progress overall. The pattern for irregular past tense verbs differed in that accuracy did not change significantly for either age or language ability groups, suggesting that irregular verb learning relies more heavily on input and, potentially, experience.

Our next question addressed error patterns and whether there were differences driven by age (younger/lower grades, older/higher grades), language ability group (TD, DLD), or time of testing. Our results revealed a higher rate of errors in younger children, children with DLD, and fewer overall errors at Time 2. Of greater importance, we wanted to know the overall distribution of errors across groups and age levels. As expected, bare stem verbs were the most common error. Our results revealed that younger children in both groups (TD and DLD) produced more bare stem errors overall and more of these errors at Time 1, compared with Time 2. While the number of bare stem errors decreased for younger children at Time 2, the number of overregularization errors increased for both groups. For older children, the patterns did not match because the number of overregularization errors among older TD children appeared to be trending toward a decrease, although this was not captured by the analysis.

Notably, children with DLD produced higher rates of stem + ing errors in the novel verb condition, and this error was most apparent in the younger children. Not only does this pattern substantiate the unusual difficulty of novel verbs documented for children with impairment but it also suggests a lower level of processing ability. The stem + ing error consists of the child simply repeating the last word heard in the prompt. Thus, instead of the usual bare stem error (e.g., *nop* it), younger children with DLD were more likely to respond *nopping it* than their TD peers—indicating

a failure to separate the verb stem from the *-ing* inflection, store it, retain it, and recall it for production. Consistent with other reports, children with DLD were negatively affected by the lack of familiarity with the novel verb stimuli, even though the phonotactic frequency ratings for the regular and novel verbs did not differ. Deficits relating to processing speed, memory, and recall are all plausible but cannot be addressed by the current design.

We then compared our results with what we found earlier for children tested in the same ethnogeographic community. As indicated by the analysis, children with DLD were less accurate than children with TD on the production of regular and novel past tense verbs, yet no difference was observed for the production of irregular past tense. The profile at Time 1 demonstrating greater challenges with regular and novel verb acquisition for children with DLD conformed to the profile reported in the earlier study involving children in second grade (Jacobson & Schwartz, 2005). Despite a protracted course of acquisition for both groups, children with DLD showed an even more pronounced difficulty in using irregular verbs. For this group, contributing deficits may include difficulties in abstracting morphophonological patterns for irregular past tense (Rice et al., 2000) and the general word learning deficits associated with DLD (Kan & Windsor, 2010).

With respect to overregularization errors, our results matched those of Marchman, Wulfeck, and Ellis Weismer (1999) who reported similar rates of overregularization in a cross-sectional comparison that included older school-aged children. Moreover, the anticipated direction of change was not entirely linear, that is to say, moving from overregularization to what is considered the correct irregular. In general, overregularizations at Time 2 were preceded by tense omission errors at Time 1, but this was not the only pattern. In a few cases, overregularizations at Time 2 were preceded by overregularizations at Time 1, and less often, but still noteworthy, some correct forms at Time 1 became overregularizations at Time 2. Although we did not design the stimuli to examine this particular pattern, we noted that the verbs appearing most vulnerable to error were those forms having dual functions (e.g., *stuck*, which also exists as an adverb or past participle).

Linguistic and processing accounts share many overlapping predictions regarding the types of errors that children produce. Both predict bare stems and overregularization. However, linguistic accounts do not address the use of “stem + ing” errors in children’s responses, nor do they adequately address error resolution that can be linked to input factors. Biological maturation is an unlikely explanation due to the advanced ages of children studied. By focusing exclusively on linguistic aspects, such as tense marking, phonological influences, and long-distance dependency relations, the importance of individual differences in experience and the result of input variation and/or reduction may be overlooked in situations of typical bilingual acquisition and LI. The Computational Grammatical Complexity account predicts that overregularization errors would be on words with complex codas, but this was not the case

because *sticked*, *catched*, and *drinked* were common among all children. Fluctuating input is common in bilingual acquisition and may lead to attrition if sufficiently reduced. Linguistic accounts fail to explain how grammatical knowledge once gained becomes inaccessible or lost. Moreover, there is no explanation for the effects of potential variability in the input by speakers at different stages of learning English.

The results for children with TD and DLD were compatible with usage-based accounts of language acquisition (Tomasello, 2003) and impairment (Leonard, 2014). As such, children’s individual capacity for acquiring language is driven by the input that includes all meaningful social experiences. Processing accounts and input-based theories predict that learning proceeds gradually in a piecemeal fashion, and this is supported by our data. Given no differences in the time of initial exposure to English, or in the length of school exposure, it is feasible that reduced abilities to abstract patterns from the available input extend the learning period for bilingual children with DLD. Error resolution is believed to occur as a result of increased input and language experience.

The Competing Sources of Input account predicts the observed sequence of development for regular, irregular, and novel verbs and accompanying error patterns. Accordingly, children’s errors consist primarily of bare stem verbs, which appear as competing forms. For typically developing children, the continuance of overregularization, or switching between forms (e.g., *caught-catched*), coincides with input-based explanations, a phenomenon observed in typical monolingual acquisition at earlier ages (Maratsos, 2000). Conceivably, children who have their input and production split between two or more languages and/or who hear instances of alternate forms (e.g., *catched* and *caught*) in their learning environment (McWhorter, 2001) may take longer to resolve the regular/irregular ambiguity (Jacobson & Cairns, 2008).

Limitations

Access to the children’s educational records would have benefited our analyses. Particularly, outcomes for children receiving different types of interventions would have enhanced the interpretation of our results. Issues related to the confidentiality agreement maintained between the investigator and the school restricted access to this information. Another limitation was the static nature of the assessments used.

Conclusions

Qualitative differences in the type of English input, together with input quantity, and timing of English exposure play key roles in the use of English past tense morphology (Goldberg, Paradis, & Crago, 2008). Acknowledging that different language forms may be vulnerable at differing ages and stages of bilingual acquisition is essential for informing assessment and treatment protocols. Support for processing accounts of impairment confirms that performance may be improved by increasing the input—an important principle

guiding therapy practice. The continuation of overregularization in bilingual situations (McWhorter, 2001) combined with the challenges for learning irregular morphology in typical bilingual acquisition (Schwartz, Kozminsky, & Leikin, 2009) highlights the importance of input and the need for explicit instruction for children with and without impairment. Children schooled in subtractive bilingual environments whereby L2 English is learned at the expense of losing the L1 will probably resemble English monolinguals sooner. Yet, children learning L2 English in a supported maintenance context gain functional use of two languages, thus enhancing their communication options at home, school, within the local communities, and beyond.

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References

- Ambridge, B., & Lieven, E. V. (2011). *Child language acquisition: Contrasting theoretical approaches*. New York, NY: Cambridge University Press.
- Anderson, R. (1999). Impact of first language loss on grammar in a bilingual child. *Communication Disorders Quarterly*, 21, 4–16.
- Artiles, A. J., Rueda, R., Salazar, J. J., & Higuera, I. (2005). Within-group diversity in minority disproportionate representation: English language learners in urban school districts. *Exceptional Children*, 71(3), 283–300.
- Berko, J. (1958). The child's learning of English morphology. *Word*, 14, 150–177.
- Blom, E., & Paradis, J. (2013). Past tense production by English second language learners with and without language impairment. *Journal of Speech, Language, and Hearing Research*, 56, 281–294.
- Blom, E., & Paradis, J. (2014). Sources of individual differences in the acquisition of tense inflection by English second language learners with and without specific language impairment. *Applied Psycholinguistics*, 36, 953–976.
- Bohman, T. M., Bedore, L. M., Peña, E. D., Mendez-Perez, A., & Gillam, R. (2010). What you hear and what you say: Language performance in Spanish–English bilinguals. *International Journal of Bilingual Education and Bilingualism*, 13(3), 325–344.
- Brown, L., Sherbenou, R. J., & Johnsen, S. K. (1997). *Test of Nonverbal Intelligence* (3rd ed.). Austin, TX: Pro-Ed.
- Bybee, J. (1995). Regular morphology and the lexicon. *Language and Cognitive Processes*, 10(5), 425–455.
- Castilla-Earls, A., Restrepo, M. A., Perez-Leroux, A. T., & Gray, S. (2015). Interactions between bilingual effects and language impairment: Exploring grammatical markers in Spanish-speaking bilingual children. *Applied Psycholinguistics*, 37(5), 1147–1173.
- Catts, H. W., Adolf, S. M., & Ellis Weismer, S. (2006). Language deficits in poor comprehenders: A case for the simple view of reading. *Journal of Speech, Language, and Hearing Research*, 49, 278–293.
- Collins, B. A., O'Connor, E., Suárez-Orozco, C., Nieto-Castanon, A., & Toppelberg, C. O. (2014). Dual language profiles of Latino children of immigrants: Stability and change over the early school years. *Applied Psycholinguistics*, 35, 581–620.
- Conti-Ramsden, G., Botting, N., & Faragher, B. (2001). Psycholinguistic markers for specific language impairment (SLI). *The Journal of Child Psychology and Psychiatry*, 42, 741–748.
- Conti-Ramsden, G., St Clair, M. C., Pickles, A., & Durkin, K. (2012). Developmental trajectories of verbal and nonverbal skills in individuals with a history of specific language impairment: From childhood to adolescence. *Journal of Speech, Language, and Hearing Research*, 55(6), 1716–1735.
- Dollaghan, C. A., & Horner, E. A. (2011). Bilingual language assessment: A meta-analysis of diagnostic accuracy. *Journal of Speech, Language, and Hearing Research*, 54, 1077–1088.
- Gillam, R. B., Peña, E. D., Bedore, L. M., Bohman, T. M., & Mendez-Perez, A. (2013). Identification of specific language impairment in bilingual children: I. Assessment in English. *Journal of Speech, Language, and Hearing Research*, 56(6), 1813–1823.
- Goldberg, H., Paradis, J., & Crago, M. (2008). Lexical acquisition over time in minority first language children learning English as a second language. *Applied Psycholinguistics*, 29(1), 41–65.
- Gutiérrez-Clellen, V. F., Simon-Cerejido, G., & Sweet, M. (2012). Predictors of second language acquisition in Latino children with specific language impairment. *American Journal of Speech-Language Pathology*, 21, 64–77.
- Hall, W. S., Nagy, W. E., & Linn, R. (1984). *Spoken words, effect of situation and social group on oral word usage and frequency*. Hillsdale, NJ: Erlbaum.
- Hoff, E., Core, C., Place, S., Rumiche, R., Señor, M., & Parra, M. (2012). Dual language exposure and early bilingual development. *Journal of Child Language*, 39, 1–27.
- Jacobson, P. F., & Cairns, H. S. (2008). Considering linguistic input in a bilingual situation: Implications for acquisition. *Language, Speech, and Hearing Services in the Schools*, 39, 352–364.
- Jacobson, P. F., & Livert, D. (2010). Past tense production in older bilingual children with language impairment. *Clinical Linguistics & Phonetics*, 24(2), 101–121.
- Jacobson, P. F., & Schwartz, R. G. (2005). Elicited production of English past tense by bilingual children with language impairment. *American Journal of Speech-Language Pathology*, 4, 313–323.
- Jacobson, P. F., & Walden, P. R. (2013). Lexical diversity and omission errors as predictors of language ability in the narratives of sequential Spanish–English bilinguals: A cross-language comparison. *American Journal of Speech-Language Pathology*, 22, 554–565.
- Kan, P., & Windsor, J. (2010). Word learning in children with language impairment: A meta-analysis. *Journal of Speech, Language, and Hearing Research*, 53(3), 739–756.
- Kapantzolou, M., Fergatodis, G., & Restrepo, M. A. (2017). Language sample analysis and elicitation technique effects in bilingual children with and without language impairment. *Journal of Speech, Language, and Hearing Research*, 60, 2552–2864.
- Kohnert, K. J. (2010). Bilingual children with primary language impairment: Issues, evidence and implications for clinical actions. *Journal of Communication Disorders*, 43(6), 456–473.
- Legate, J., & Yang, C. (2007). Morphosyntactic learning and the development of tense. *Language Acquisition*, 14, 315–344.
- Leonard, L. B. (2014). *Children with specific language impairment*. Cambridge, MA: MIT Press.
- Leonard, L. B., & Deevy, P. (2011). Input distribution influences degree of auxiliary use by children with specific language impairment. *Cognitive Linguistics*, 22, 247–273.

- Leonard, L. B., Eyer, J. A., Bedore, L. M., & Grela, B. G. (1997). Three accounts of the grammatical morpheme difficulties of English-speaking children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, 40(4), 741–753.
- Leonard, L. B., Fey, M. E., Deevy, P., & Bredin-Oja, S. L. (2015). Input sources of third person singular-s inconsistency in children with and without specific language impairment. *Journal of Child Language*, 42, 786–820.
- Lugo-Neris, M. J., Peña, E. D., Bedore, L. M., & Gillam, R. B. (2015). Utility of a language screening measure for predicting risk for language impairment in bilinguals. *American Journal of Speech-Language Pathology*, 24, 426–437.
- Maratsos, M. (2000). More overregularizations after all: New data and discussion on Marcus, Pinker, Ullman, Hollander, Rosen, & Xu. *Journal of Child Language*, 27, 183–212.
- Marchman, V. A., Wulfeck, B., & Ellis Weismer, S. (1999). Morphological productivity in children with normal language and SLI: A study of the English past tense. *Journal of Speech, Language, and Hearing Research*, 42, 206–219.
- Marinis, T., & Armon-Lotem, S. (2015). Sentence repetition. In S. Armon-Lotem, J. de Jong, & N. Meir (Eds.), *Assessing multilingual children: Disentangling bilingualism from language impairment* (pp. 95–124). Bristol, United Kingdom: Multilingual Matters.
- Marinis, T., & Chondrogianni, V. (2010). Production of tense marking in successive bilingual children: When do they converge with their monolingual peers? *International Journal of Speech-Language Pathology*, 12(1), 19–28.
- McWhorter, J. H. (2001). *The power of Babel: A natural history of language*. New York, NY: Times Books.
- Morgan, G., Restrepo, M. A., & Auza, A. (2013). Comparison of Spanish morphology in monolingual and Spanish-English bilingual children with and without language impairment. *Bilingualism, Language, and Cognition*, 16(3), 578–596.
- Nicoladis, E., Palmer, A., & Marentette, P. (2007). The role of type and token frequency in using past tense morphemes correctly. *Developmental Science*, 10, 237–254.
- Nicoladis, E., Song, J., & Marentette, P. (2012). Do young bilinguals acquire past tense morphology like monolinguals, only later? *Applied Psycholinguistics*, 33(3), 457–479.
- Oetting, J., & Horohov, J. (1997). Past tense marking by children with and without specific language impairment. *Journal of Speech, and Hearing Research*, 40, 62–74.
- Paradis, J. (2010). Bilingual children's acquisition of English verb morphology: Effects of language exposure, structure complexity, and task type. *Language Learning*, 60(3), 651–680.
- Paradis, J., Jia, R., & Arppe, A. (2017). The acquisition of tense morphology over time by English second language children with specific language impairment: Testing the cumulative effects hypothesis. *Applied Psycholinguistics*, 38(4), 881–908.
- Paradis, J., Nicoladis, E., Crago, M., & Genesee, F. (2010). Bilingual children's acquisition of the past tense: A usage-based approach. *Journal of Child Language*, 37, 1–25.
- Paradis, J., Schneider, P., & Duncan, T. S. (2013). Discriminating children with language impairment among English language learners from diverse first language backgrounds. *Journal of Speech, Language, and Hearing Research*, 56, 971–981.
- Pinheiro, J., Bates, D., DebRoy, S., Sarkar, D., & R Core Team. (2017). *R Core Team. nlme: Linear and nonlinear mixed effects models*. R package version 3.1-132. Retrieved from <http://CRAN.R-project.org/package=nlme>
- Pruitt, S., & Oetting, J. (2009). Past tense marking by African American English-speaking children reared in poverty. *Journal of Speech, Language, and Hearing Research*, 52, 2–15.
- R Core Team. (2014). *R: A language and environment for statistical computation*. R Foundation for Statistical Computing, Vienna, Austria. Retrieved from <http://www.R-project.org/>
- Redmond, S. M. (2005). Differentiating SLI from ADHD using children's sentence recall and production of past tense morphology. *Clinical Linguistics & Phonetics*, 19, 109–127.
- Rice, M. L., & Wexler, K. (1996). Toward tense as a clinical marker of specific language impairment in English-speaking children. *Journal of Speech and Hearing Research*, 39, 1239–1257.
- Rice, M. L., Wexler, K., & Hershberger, S. (1998). Tense over time: The longitudinal course of tense acquisition in children with specific language impairment. *Journal of Speech, Language and Hearing Research*, 41, 1412–1431.
- Rice, M. L., Wexler, K., Marquis, J., & Hershberger, S. (2000). Acquisition of irregular past tense by children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, 43, 1126–1145.
- Rispens, J., & DeBree, E. (2015). Regular and irregular past tense in Dutch-Hebrew children. *Bilingualism: Language and Cognition*, 18(2), 290–303.
- Rojas, R., & Iglesias, A. (2013). The language growth of Spanish-speaking English language learners. *Child Development*, 84(2), 630–646.
- Salameh, E., Håkansson, G., & Nettelbladt, U. (2004). Developmental perspectives on bilingual Swedish-Arabic children with and without language impairment: A longitudinal study. *International Journal of Language & Communication Disorders*, 39(1), 65–90.
- Schwartz, M., Kozminsky, E., & Leikin, M. (2009). Delayed acquisition of irregular morphology in Hebrew early sequential bilingualism. *International Journal of Bilingualism*, 13, 501–522.
- Schwartz, R. G. (2017). Specific language impairment, 2nd edition. In R. G. Schwartz (Ed.), *Handbook of child language disorders* (pp. 3–43). New York, NY: Psychology Press.
- Semel, E., Wiig, W. H., & Secord, W. (2006). *Clinical Evaluation of Language Fundamentals—Fourth Edition (CELF-4)*. San Antonio, TX: The Psychological Corporation.
- Tomasello, M. (2003). *Constructing a language: A usage-based theory of language acquisition*. Cambridge, MA: Harvard University Press.
- Tomblin, J. B., Records, N. L., Buckwalter, P., Zhang, X., Smith, E., & O'Brien, M. (1997). Prevalence of specific language impairment in kindergarten children. *Journal of Speech, Language, and Hearing Research*, 40, 1245–1260.
- U.S. Census Bureau. (2012). *Statistical abstract of the United States*. Retrieved from <https://www.census.gov/library/publications/2011/compendia/statab/131ed.html>
- van der Lely, H., & Ullman, M. (2001). Past tense morphology in specifically language impaired and normally developing children. *Language and Cognitive Processes*, 16, 177–217.
- Vitevitch, M. S., & Luce, P. A. (1999). Probabilistic phonotactics and neighborhood action in spoken word recognition. *Journal of Memory and Language*, 40, 374–408.
- Vitevitch, M. S., & Luce, P. A. (2004). A web-based interface to calculate phonotactic probability for words and nonwords in English. *Behavior Research Methods, Instruments, and Computers*, 36, 481–487.
- Weismer, S. E., Evans, J., & Hesketh, L. J. (1999). An examination of verbal working memory capacity in children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, 42(5), 1249–1260.
- Woodcock, R. W., & Muñoz-Sandoval, A. F. (2001). *Woodcock-Muñoz Language Survey English and Spanish versions*. Riverside, CA: Riverside Publishing.

Appendix

Language Sample Data: Means and Standard Deviations for the NDWs and Word and Morpheme Omissions in English and Spanish Based On Oral Narrative Retells in English and Spanish (Jacobson & Walden, 2013).

Variable	NDW: English	NDW: Spanish	Word/morpheme omissions: English	Word/morpheme omissions: Spanish
TD (<i>n</i> = 16)				
Lower grades	72.1 (21.4)	65.6 (17.0)	4.5 (4.2)	2.4 (2.1)
Higher grades	117.2 (14.4)	99.9 (10.6)	2.0 (2.8)	1.6 (1.2)
DLD (<i>n</i> = 17)				
Lower grades	74.4 (13.8)	81.3 (19)	8.8 (8.2)	4.6 (3.6)
Higher grades	105.9 (34.9)	79.4 (22)	6.6 (3.4)	4.9 (2.9)

Note. For NDWs, there was no main effect or interaction of language background (Spanish vs. English) or language disorder status ($p > .33$). For word and morpheme omissions, children with DLD produced more omissions overall ($p = .002$). NDWs = number of different words; TD = typical development; DLD = developmental language disorder.