

A LONGITUDINAL ANALYSIS OF SPANISH MORPHOSYNTACTIC  
PERFORMANCE BASED ON SPANISH-ENGLISH BILINGUAL  
EXPOSURE AND USAGE

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by  
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## ABSTRACT

This study examines the interaction between language experience and Spanish morphosyntactic development using longitudinal data of Spanish-English bilingual children with typical language development (TD) and developmental language disorder (DLD). Specifically, this study explores how language exposure and usage influence the production accuracy of articles, direct object clitics and subjunctives across 4 years. Analyses of growth trajectories show that the trajectories differ by both language ability groups and morphosyntactic structures. Among the three grammatical markers, the TD group demonstrates different patterns of growth while the DLD group demonstrates consistent ascending trajectories. The accuracy of articles is the highest in all three markers across 4 years for both TD and DLD groups. The accuracy of direct object clitics in the DLD group increases over time while it decreases slightly in the TD group. The accuracy of subjunctives increases in both TD and DLD groups, but the increase was higher in the DLD group than in the TD group. Results of the generalized linear model (GLM) of the accuracy of three grammatical markers indicate that the contributing factors differ by the marker: language exposure, language usage, language ability group and grade level have significant effects on accuracy of articles; language ability group is the only contributing factor to the production accuracy of direct object clitics; and language exposure, language ability group and grade level significantly influence the production accuracy of subjunctives. Results of the GLM of accuracy at the fourth assessment time also reveal that contributing factors to accuracy of fourth-year performance differ by grammatical markers: a significant effect of accuracy at first

observation time for articles and direct object clitics, a significant effect of baseline accuracy for articles and subjunctives, and a significant effect of language ability for subjunctives. These results confirm that articles, direct object clitics and subjunctives are reliable markers of language impairment for Spanish-English bilingual children. This study also describes the specific influence of language experience within the language ability group and grade level. The influence of language experience on production accuracy differs by language ability group and morphosyntactic structures.

## **DEDICATION**

This thesis is dedicated to my family and friends for their unconditional support.

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## **CHAPTER 1 INTRODUCTION**

### **Bilingual Language Development**

An estimated 3.7 million children speak the second language (L2) English at school and the first language (L1) Spanish at home (McFarland et al., 2017). Research (Arias & Friberg, 2017) has shown that English tends to be prioritized in bilingual language assessment as a result of the dominance of English in school education and speech language services. The language dominance shift from L1 to L2 and crosslinguistic influences from L2 impact the development of L1 or lead to the loss of L1 (e.g., Anderson, 1999). Children from bilingual backgrounds are sometimes overidentified or under-identified with language impairment or delay due to a lack of knowledge of bilingual language development and appropriate assessment tools (Bedore & Peña, 2008). There is a significant need for more studies on typical and atypical development of L1 for bilingual children (Bedore & Peña, 2008; Paradis, 2007).

Paradis et al. (2005/2006) reports that bilingual children with language deficits demonstrate the same rates and patterns of morphosyntactic development as monolingual children with language deficits, and bilingual experience plays a critical role for bilingual children with or without language deficits. A lot of studies have reported how language experience influences bilingual language development in general (e.g., Paradis & Genesee, 1996; Morgan et al., 2013). There has not been adequate research on the relationship between language experience and development-specific morphosyntactic structures. The present study seeks to investigate the influence of bilingual language experience on the development of specific grammatical structures across 4 years.

## **External Factor: Language Experience**

Usage-based theory hypothesizes that children's language reflects their input and language exposure (Bybee, 1999; Blom & Paradis, 2013). Communicative contexts and linguistic experience in different languages influence the bilingual language development as the specific language use leads to changes in the linguistic representations (Bybee, 1999). In other words, how bilingual children use specific words or forms in a context will influence how they cognitively represent and use their two linguistic systems.

Bilingual experience can be investigated from different perspectives including the amount of exposure, motivation, types of learning experience, environmental input/output and frequency of usage (Costa & Sebastián-Gallés, 2014). Rojas and Iglesias (2013) reports that growth trajectories of mean length of utterance in morphemes (MLUm) in Spanish and English are distinct and influenced by school, gender and initial status of acquisition. Bedore et al. (2012) also reports that several parameters need to be considered to investigate bilingual language learning including the age of first exposure, opportunities to use each language and context of learning. Bilingual exposure can be described from various quantitative and qualitative aspects, such as timing, intensity/frequency, proficiency and dominance. A study of reading development of Spanish-English bilingual children (Kovelman et al., 2008) shows that the age of first bilingual exposure significantly affects young bilingual children's development of reading. Bedore et al. (2012) shows that the amount of Spanish language exposure influences the Spanish semantic and morphosyntactic performances for Spanish-English bilingual children.

In addition to exposure, language usage in different social environments (school, home) and with various conversation partners (teacher, mother, father) plays a crucial role in bilingual language development (Blom & Paradis, 2013). It is widely recognized that the environment that bilingual children are exposed to and the reinforcement that they receive are essential to language acquisition (Ellis, 1985). The amount of language children hear and speak is crucial in bilingual language development (Bohman et al., 2010). Hammer et al. (2012) reports that Spanish-English bilingual children's vocabulary size and story recall abilities are correlated with both language exposure and input. A study of expressive language growth for Spanish-English bilingual children (Ribot et al., 2018) shows that language output contributes to expressive skills and substantial individual differences occur in language input and output. Bedore et al. (2016) reports that the age of first exposure to English and English input/output ratio have a linear relationship with the semantic and morphosyntactic growth for Spanish-English bilingual children.

To understand which aspect of language experience influences the development of specific morphosyntactic structures in L1 Spanish, this study utilizes both age of first exposure to L2 English and language usage of Spanish input-output ratio to investigate the relationship between language experience and bilingual morphosyntactic development.

## **Internal Factor: Morphosyntactic Structures**

In addition to language experience, morphosyntactic development may also be influenced by the linguistic characteristics of each certain morphosyntactic structure. Some grammatical markers may be more difficult than other markers for bilingual children due to their linguistic features. For example, plural and definite aspects of articles in Spanish are reported to be more difficult for Spanish-English bilingual children (Anderson, 2012). Baron et al. (2018) describes the hierarchy of difficulty of production of Spanish grammatical forms for Spanish-English bilingual children. Spanish morphosyntactic structures of imperfect, plural nouns, singular articles and conjunctions are found to be relatively easy for bilingual children; plural article and preterite are medium; and prepositions, direct object pronouns and subjunctive moods are hard. They also report that the relative difficulty is consistent for both Spanish-dominant and English-dominant bilingual children.

Within various morphosyntactic structures, some grammatical markers in Spanish or English monolingual populations are reliable indicators of language impairment. In English, passive voice and wh-questions are reported to be reliable clinical markers of impairment (Leonard & Kueser, 2019). For monolingual Spanish speakers, articles are found to be a consistent and reliable indicator of impairment (Anderson & Souto, 2005). However, it is unclear if the same grammatical markers are reliable for language assessment for bilingual populations. Morphosyntactic patterns might vary depending on language exposure and usage. Castilla-Earls et al. (2016) shows that the production accuracy of direct object pronouns and articles in Spanish is influenced by English

proficiency and language ability status (TD or DLD) for Spanish-English bilingual children. In order to provide linguistically appropriate assessment, it is important to understand how specific morphosyntactic structures are acquired and what linguistic features are contributing factors in bilingual morphosyntactic development. This study aims to contribute to the discussion of bilingual morphosyntactic development and clinical markers in the bilingual population.

### **Present Study**

By analyzing the longitudinal data, the present study investigates the relationship between language experience and morphosyntactic development of Spanish in the groups of bilingual children with typical language development (TD) and with developmental language disorder (DLD). This study poses the following research questions:

1. What are the trajectories of Spanish morphosyntactic performance of Spanish-English bilingual children with TD or DLD across four years?
2. How Language Exposure and Language Usage influence Spanish production accuracy of three Spanish grammatical markers for Spanish-English bilingual children with TD or DLD?
3. What factors are contributing to the fourth-year performance of Spanish morphosyntactic structures for Spanish-English bilingual children with TD or DLD?

## CHAPTER 2 METHOD

### Participants

Participants' data were obtained from a longitudinal study of bilingual language performance of children (n=361) with and without DLD (Bedore et al., 2016). Participants were recruited from preschool, first-, and third-grade school classrooms in central Texas with large numbers of Hispanic students. Participants were followed between kindergarten and fifth grade for up to four years. Data collection ended when the participants reached fifth grade. This study utilized a sub-sample of 64 participants who completed the data collection at four time points (Time 1, Time 2, Time 3, Time 4). A total of 64 participants were included in this study: 52 children in the TD group (Female = 26, Male = 26) and 12 children in the DLD group (Female = 5, Male = 7). The majority of the participants spoke Mexican Spanish (60/64) and four participants spoke other Spanish dialects. Table 1 below summarizes the demographic information (F, M, Mex and O refer to Female, Male, Mexican Dialect and Other Dialects respectively).

Table 1

*Summary of Participants' Demographics at Time 1*

|                | Kindergarten     |    |                  |    | Second Grade     |    |                  |    |
|----------------|------------------|----|------------------|----|------------------|----|------------------|----|
|                | TD <i>n</i> = 29 |    | DLD <i>n</i> = 7 |    | TD <i>n</i> = 23 |    | DLD <i>n</i> = 5 |    |
| Age<br>(Month) | Mean             | SD | Mean             | SD | Mean             | SD | Mean             | SD |
| Sex            | F                | M  | F                | M  | F                | M  | F                | M  |
|                | 14               | 15 | 2                | 5  | 12               | 11 | 3                | 2  |
| Dialect        | Mex              | O  | Mex              | O  | Mex              | O  | Mex              | O  |
|                | 27               | 2  | 6                | 1  | 22               | 1  | 5                | 0  |

## **Procedure**

### ***Measurement***

Variables of Language Exposure (age of first exposure to English), Language Usage (Spanish input/output percentage), Grade (children's academic grade level) and Accuracy of each of the three morphosyntactic of articles, direct object clitics and subjunctives in TD and DLD groups were analyzed in this study.

Demographic information and language experience of participants were obtained via the Bilingual Input Output Survey of the Bilingual English Spanish Assessment (BESA; Peña et al., 2018). Through this survey, parents reported demographic information, age of first exposure to English, Spanish language input and output, as well as English language input and output. For Language Exposure, the later exposure to English indicated more Spanish exposure at an early age. Home language input and output estimates were based on parents' report on children's language use at home (hear Spanish/English and speak Spanish/English). School language input and output data were obtained from teachers' report of children's Spanish/English usage at school. The overall language usage of a week for Spanish and English was a total of school usage and home usage of Spanish and English. The children's input and output ratio of Spanish (input/output) was analyzed in this study. A higher input/output ratio indicated more opportunities of receiving Spanish language stimuli. According to Bedore et al. (2016), the input/output ratio is a reliable measurement of language usage and it can be utilized to compare language experience.

As shown in Table 2, there was variability among the study participant in regard to Language Exposure and Language Usage. The variability of Language Usage in the subgroup of children with DLD who entered the study at Kindergarten was low (Coefficient of Variation =  $SD/Mean = 5/74.5 = 7\%$ ) compared to other subgroups. Coefficient of Variation (CV) is an indicator of data variability. A lower CV value of less than 30% is considered to be acceptable and a low value equal to or less than 10% is considered to be a good indicator of precise estimate (Swartz & Krull, 2012).

Table 2

*Summary of Participants' Language Experience at Time 1*

|                       | Kindergarten |      |           |     | Second Grade |      |           |      |
|-----------------------|--------------|------|-----------|-----|--------------|------|-----------|------|
|                       | TD n = 29    |      | DLD n = 7 |     | TD n = 23    |      | DLD n = 5 |      |
|                       | Mean         | SD   | Mean      | SD  | Mean         | SD   | Mean      | SD   |
| Exposure <sup>a</sup> | 2.9          | 1.7  | 3.9       | 0.4 | 3.4          | 1.9  | 3.0       | 1.9  |
| Usage <sup>b</sup>    | 64.8         | 17.2 | 74.5      | 5.0 | 55.9         | 14.6 | 64.7      | 12.8 |

<sup>a</sup>Age of 1st English Exposure (year). <sup>b</sup>Spanish input/output percentage

Participants entered the study at kindergarten or second grade. Children who entered the study when they were in kindergarten were followed up to the fourth grade. Children who entered the study when they were in second grade were followed up to the fifth grade. A total of 36 participants entered the study in kindergarten (TD= 29, DLD = 7). A total of 28 (TD = 23, DLD = 5) participants started the study in second grade. Because of potential different expectations regarding the grammatical performance of

older versus younger children, grade levels were utilized to plot trajectories and analyze the development over time and average accuracy of children at the same grade level.

The BESA (Peña et al., 2018) or BESA-ME (Peña et al., 2010) was administered to assess participants' morphosyntactic performance. BESA was administered to participants ages 4;0 - 6;11 (Peña et al., 2018). BESA-ME (Peña et al., 2010) was administered to participants ages 7;0 or older. The morphosyntactic subtest consisted of a cloze task and a sentence repetition task. The cloze task contains 18 grammatical cloze items for English and 19 cloze items for Spanish. The sentence repetition task contained 6 sentences in each language. The accuracy of each morphosyntactic form in each task was calculated by dividing the number of items correct by the number of total targeted items. The total score from both cloze and sentence repetition tasks was a powerful and reliable tool to investigate morphosyntactic development (Bedore et al., 2018). Therefore, the total score based on both tasks was utilized in this study.

### *Statistical Analysis*

Data handling, visualization and GLM function in lme4 package (Bates et al., 2012) were conducted in R (R Core Team, 2020). Growth trajectories across 4 years in both TD and DLD groups were plotted for each grammatical marker using accuracy and grade. Both Generalized Linear Model (GLM) and Generalized Linear Mixed-effects model (GLMM) analyses were conducted and compared. GLMM is an extension to the GLM in which the linear predictor contains random effects in addition to the usual fixed effects. GLMM produces a separate intercept value for each participant, so that this

model, unlike the GLM, does not assume that the effects of language experience and time on accuracy is the same for each participant. GLM and GLMM were compared based on Akaike Information Criterion (AIC). AIC estimates the relative quality of each model, which can be applied for different generalized linear models (Dunteman & Ho, 2006). The AIC results indicated that GLM fits better than GLMM due to relatively lower AIC values for all three grammatical markers in GLM, as shown in Table 3.

Table 3

*AIC Comparison Between GLM and GLMM of Production Accuracy for Three Grammatical Markers*

| Grammatical Markers | AIC     |       |
|---------------------|---------|-------|
|                     | GLM     | GLMM  |
| Article             | -327.76 | 98.7  |
| Clitic              | 101.47  | 325.3 |
| Subjunctive         | -53.069 | 217.4 |

Based on the comparison result, GLM was chosen to assess the fixed effects of Language Ability, Language Usage, Language Exposure and Grade on accuracy for each grammatical structure. GLM was also utilized to investigate whether and how T4 Accuracy (fourth-year performance) is influenced by Language Ability, T1 Accuracy (first-year performance), T1 Grade (grade level at first observation time), Language Exposure and Language Usage.

## CHAPTER 3 RESULTS

### Growth Trajectories

For each grammatical form, the trajectory of development across 4 years was plotted by accuracy and grade, as shown in Figure 1-3.

In Figure 1, the TD group demonstrated a flat trajectory while the DLD group showed a steeper trajectory. The average accuracy at the first and fourth assessments for the TD group were 0.86 (SD=0.14) and 0.93 (SD=0.03). The average accuracy at the first and fourth assessments for the DLD group were 0.50 (SD=0.20) and 0.82 (SD=0.10). The accuracy at the first observation time in the TD group was significantly higher than it in the DLD group. In the DLD group, the accuracy increased over time. The average accuracy at the fourth assessment almost achieved the same level as the TD group but it was still slightly lower ( $0.82 < 0.93$ ). The variability in both TD and DLD group was low ( $CV < 30\%$ ).

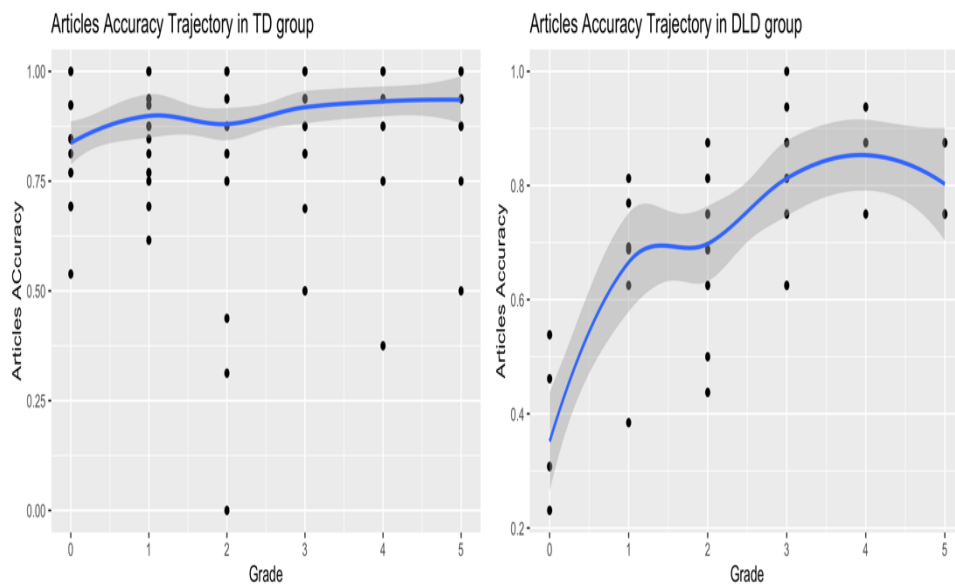


Figure 1. Trajectories of Articles in the TD and DLD Groups

The trajectories of direct object clitics demonstrated a tendency similar to articles. In Figure 2, the TD group demonstrated a flat trajectory while the DLD group showed a steep ascending trend. In the TD group, the average accuracy of articles decreased slightly from 0.73 (SD=0.34) to 0.67 (SD=0.29) over 4 years. It was noted that a decrease occurred in second grade. In contrast, in the DLD group, the average accuracy increased from 0.21 (SD=0.32) to 0.44 (SD=0.32). There were two stages of increase including kindergarten to second grade and third grade to fifth grade. A decrease occurred during second grade to third grade. While the DLD group demonstrated substantial growth, the average accuracy in the DLD group was consistently lower than that in the TD group across four time points. The variability in both TD and DLD groups was high (CV > 30%).

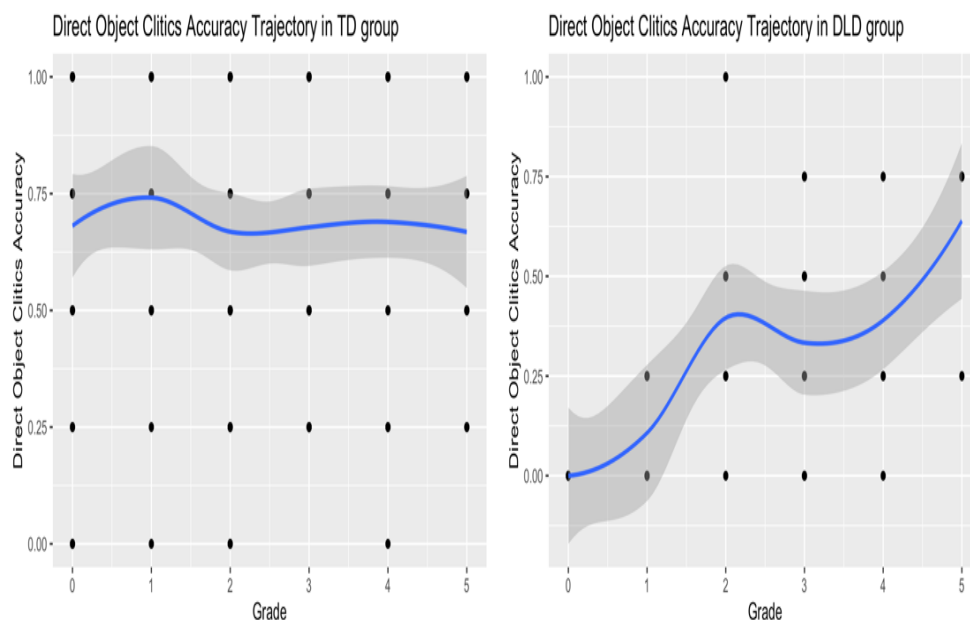


Figure 2. Trajectories of Direct Object Clitics in the TD and DLD Groups

As shown in Figure 3, both language ability groups demonstrated a growing trend of production accuracy for subjunctives, but the trajectory in the DLD group was relatively steeper. In the TD group, the average accuracy of subjunctives developed from 0.63 (SD=0.26) to 0.84 (SD=0.15). In the DLD group, the average accuracy grew from 0.27 (SD=0.26) to 0.61 (SD=0.27). High variability of accuracy was observed in both TD and DLD groups (CV > 30%).

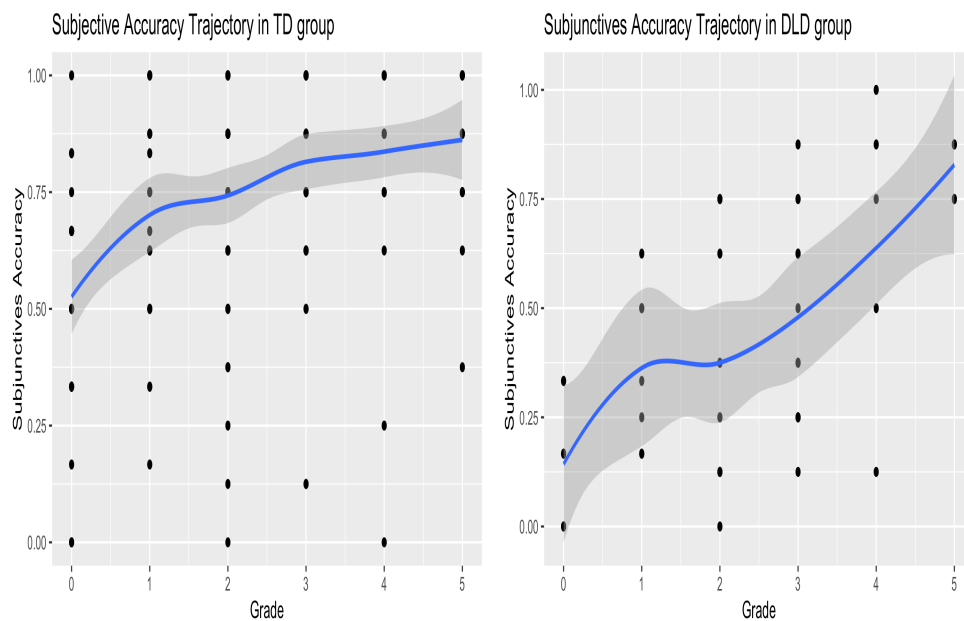


Figure 3. Trajectories of Subjunctives in the TD and DLD Groups

In the TD group, the trajectories of three grammatical structures differed, as shown in Figure 4. The trajectory of articles demonstrated a flat trend with limited growth. The growth of articles accuracy was limited by the high initial accuracy. Similar to the articles, direct object clitics had a high initial accuracy. However, the accuracy decreased slightly over four years. The trajectory of subjunctives demonstrated the most growth with the relatively lowest initial value.

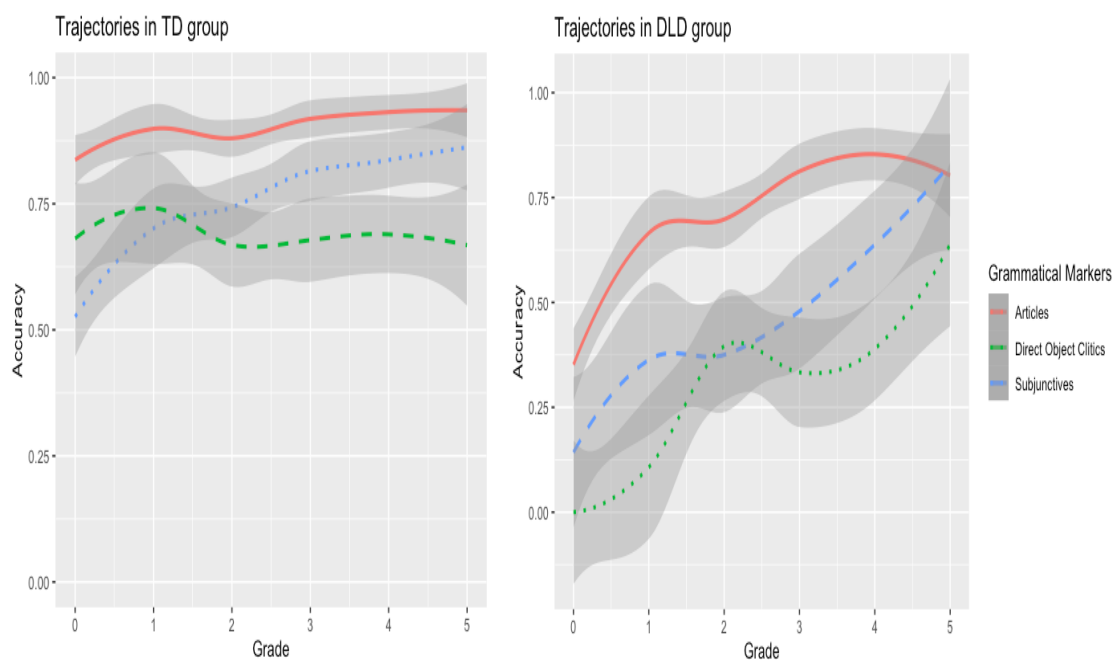


Figure 4. Trajectories of Three Grammatical Markers in the TD and DLD Groups

The DLD group demonstrated a consistent ascending trend in all three grammatical structures, as shown in Figure 4. Substantial growths were observed in all three grammatical forms. The primary difference among the three trajectories was the initial accuracy. The initial accuracy of articles was higher than it of subjunctives which was higher than it of the direct object clitics. Even though the DLD group demonstrated consistent growths in all three markers, the overall accuracy for each marker in the DLD group was lower than the TD group. The summary of the trajectories of three grammatical markers in both language ability groups is provided in Table 4. Accuracy less than 0.4 was considered as low; accuracy ranges from 0.4 to 0.6 was considered as medium; and accuracy higher than 0.6 was considered as high. And both TD and DLD groups had low ( $CV < 30\%$ ) variability for accuracy of articles, indicating that the articles had high within-group consistency in both language ability groups.

Table 4

*Summary of Growth Trajectories of Three Morphosyntactic Structures in TD and DLD*

*Groups across 4 time Points*

|             | Articles    |             | Direct Object Clitics |             | Subjunctives |             |
|-------------|-------------|-------------|-----------------------|-------------|--------------|-------------|
|             | TD          | DLD         | TD                    | DLD         | TD           | DLD         |
| Type        | Flat        | Ascending   | Flat                  | Ascending   | Ascending    | Ascending   |
| T1 Accuracy | 0.86        | 0.5         | 0.73                  | 0.21        | 0.63         | 0.27        |
| T4 Accuracy | 0.93        | 0.82        | 0.67                  | 0.44        | 0.84         | 0.61        |
| Growth Rate | 0.08        | 0.64        | -0.08                 | 1.10        | 0.33         | 1.26        |
| Variability | CV <<br>30% | CV <<br>30% | CV ><br>30%           | CV ><br>30% | CV ><br>30%  | CV ><br>30% |

*Note.* Coefficient of Variation (CV) is an indicator of data variability. A CV value of less than 30% indicates a relatively lower variability.

**GLM Analyses**

*Articles*

As fixed effects, Language Exposure, Language Usage, Language Ability and Grade were entered into the model of articles accuracy (Articles Accuracy ~ Language Ability + Language Usage + Language Exposure + Grade)

The results of GLM analysis showed that Language Exposure (coefficient = 0.015,  $t= 3.02$ ,  $p < 0.01$ ), Language Usage (coefficient = 0.001,  $t= 2.94$ ,  $p < 0.01$ ), Language Ability (coefficient = 0.218,  $t= 10.77$ ,  $p < 0.001$ ) and Grade (coefficient =

0.0398,  $t = 6.47$ ,  $p < 0.001$ ) were significantly contributing to the accuracy of articles and these factors had positive correlation with the accuracy of articles in this model, as summarized in Table 5.

The intercept of 0.471 indicated that the baseline of accuracy was close to 50% without the influences from Language Exposure, Language Usage, Language Ability and Grade. The intercept, which is the baseline of accuracy of articles, was significantly contributing to the accuracy of articles (coefficient = 0.471,  $t = 11.95$ ,  $p < 0.001$ ). Both Language Exposure and Usage were positively correlated with accuracy. With later exposure to English and more input in Spanish, accuracy of articles increased. Language Ability was a categorical factor in this model. The difference between TD and DLD increased 21.8% in accuracy (coefficient = 0.218). Grade was also positively contributing to the model of articles accuracy. Increase of each level of grade contributed to approximately 4% accuracy increase (coefficient = 0.0398).

Table 5

*Summary of GLM of Articles Accuracy*

| Variables        | Estimate | Std. Error | t     | p          |
|------------------|----------|------------|-------|------------|
| Intercept        | 0.471    | 0.04       | 11.95 | < 0.001*** |
| Exposure         | 0.015    | 0.005      | 3.02  | 0.003**    |
| Usage            | 0.001    | 0.0005     | 2.94  | 0.004**    |
| Language Ability | 0.218    | 0.02       | 10.77 | < 0.001*** |
| Grade            | 0.0398   | 0.006      | 6.47  | < 0.001*** |

\* < 0.05, \*\* < 0.01, \*\*\* < 0.001

Based on the GLM model of articles accuracy, the simulated plotting is shown in Figure 5. The effects of Language Usage and Exposure on accuracy for each grade level were plotted in each panel (e.g., Panel 1 for Grade 1, Panel 2 for Grade 2).

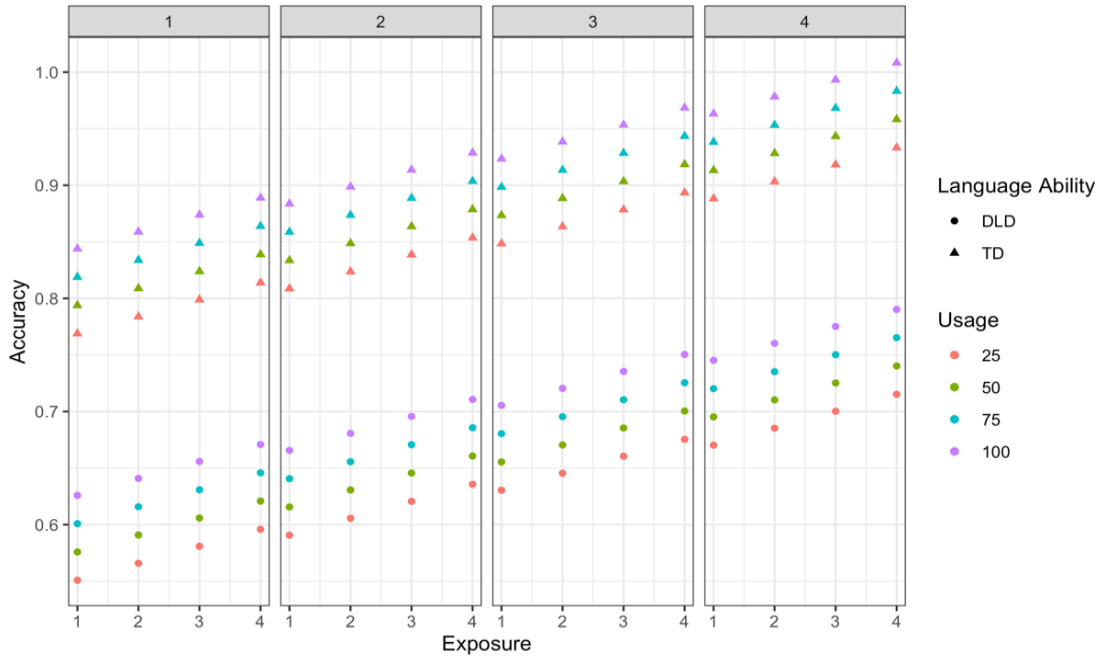


Figure 5. Simulated Predictions for Articles Accuracy

In each panel, there are two bands of accuracy development. The band of the TD group is on top of the band of DLD group, suggesting that the TD group has an overall higher accuracy over time than the DLD group. As the grade level increases (Panel 1 to 4), the range of accuracy also increases. Within the range for each grade level, higher input/output ratio and later exposure to English are positively correlated with accuracy of articles. These findings suggest that language ability and grade level determine the accuracy range while language experience including exposure and usage specifies the level of accuracy within a certain range.

### *Direct Object Clitics*

As fixed effects, Language Exposure, Language Usage, Language Ability and Grade were entered into the model of accuracy of direct object clitics. The result showed that Language Ability (coefficient = 0.398,  $t=8.36$ ,  $p < 0.001$ ) was the only significant contributing factor in this model, as shown in Table 6.

Table 6

*Summary of GLM of Direct Object Clitics Accuracy*

| Variables        | Estimate | Std. Error | t    | p          |
|------------------|----------|------------|------|------------|
| Intercept        | 0.14     | 0.09       | 1.51 | 0.13       |
| Exposure         | 0.02     | 0.012      | 1.76 | 0.08       |
| Usage            | 0.0008   | 0.0005     | 0.68 | 0.50       |
| Language ability | 0.398    | 0.001      | 8.36 | < 0.001*** |
| Grade            | 0.019    | 0.015      | 1.29 | 0.20       |

\* < 0.05, \*\* < 0.01, \*\*\* < 0.001

According to this model, the accuracy of direct object clitics was determined by the baseline (intercept, coefficient = 0.14,  $t = 1.51$ ,  $p = 0.13$ ) and Language Ability. Based on the model equation (Direct Object Clitics Accuracy =  $0.14 + 0.398 \times \text{Language Ability}$  (TD=1, DLD=0)), the accuracy of direct object clitics is expected to be 54% for the TD group and 14% for the DLD group. Temporal change and differences in language experience do not have a significant effect on the accuracy of direct object clitics.

## *Subjunctives*

As fixed effects, Language Exposure, Language Usage, Language Ability and Grade were entered into the model of accuracy of subjunctive moods. The result showed that Language Exposure (coefficient = 0.024,  $t= 1.76$ ,  $p < 0.01$ ), Language Ability (coefficient = 0.319,  $t= 9.12$ ,  $p < 0.001$ ) and Grade (0.077,  $t= 7.2$ ,  $p < 0.001$ ) were significantly contributing to the model, as shown in Table 7.

Table 7

*Summary of GLM of Subjunctives Accuracy*

| Variables        | Estimate | Std. Error | t    | p          |
|------------------|----------|------------|------|------------|
| Intercept        | 0.132    | 0.07       | 1.94 | 0.054      |
| Exposure         | 0.024    | 0.012      | 1.76 | 0.007**    |
| Usage            | 0.0008   | 0.0008     | 0.98 | 0.33       |
| Language ability | 0.319    | 0.04       | 9.12 | < 0.001*** |
| Grade            | 0.077    | 0.011      | 7.20 | < 0.001*** |

\* < 0.05, \*\* < 0.01, \*\*\* < 0.001

Based on the model equation (Subjunctives Accuracy = 0.13 +0.024\*Language Exposure + 0.319\*Language Ability + 0.077\*Grade), the simulated trajectory was plotted, as shown in Figure 6. Similar to the simulated plotting of accuracy of articles, the Language Ability and Grade level determine the accuracy range. The language exposure specifies the level of accuracy within the certain range for a specific language ability group and a specific grade level.

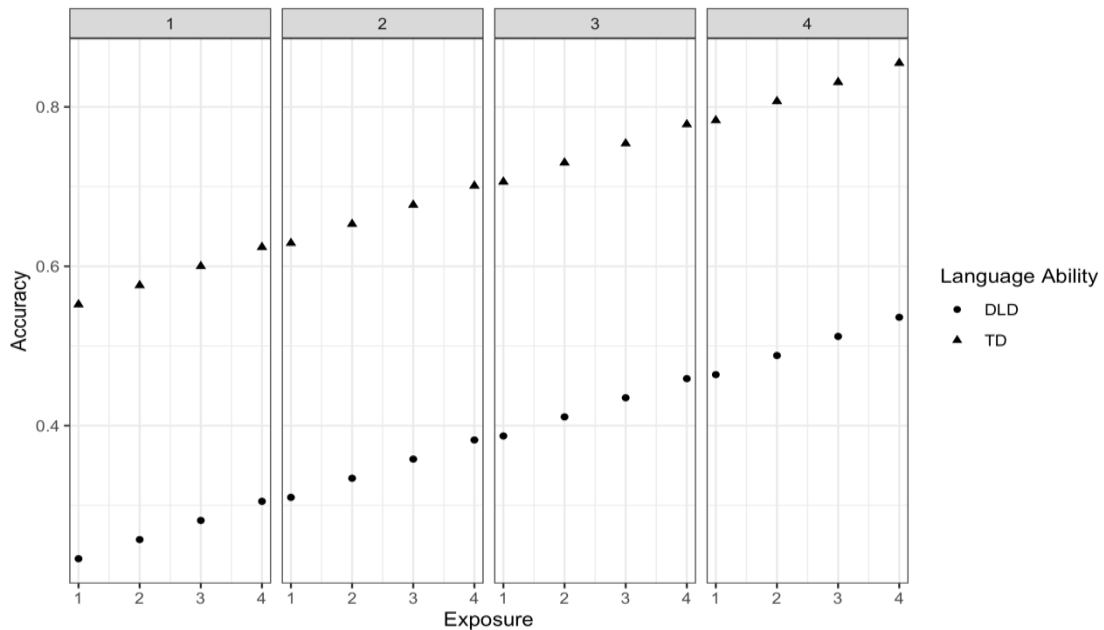


Figure 6. Simulated Predictions for Subjunctives Accuracy

To summarize, Language Ability was a significant factor for all three markers. Language Exposure and Grade were significantly contributing to the accuracy of both articles and subjunctive moods. Different from the other two markers, the model of accuracy of articles involved both Language Exposure and Language Usage as significant factors. Direct object clitics differed from the other two forms as Language Ability was the only significant factor.

#### *GLM of Accuracy at Time 4*

GLM analysis was also performed to investigate the contributing factors involved in the performance at the fourth assessment (T4 Accuracy ~ Language ability + T1 Accuracy + T1 Grade + Language Exposure + Language Usage).

The GLM results showed that Intercept (coefficient = 0.539,  $t = 10.12$ ,  $p < 0.001$ ) and Articles Accuracy at Time 1 (coefficient = 0.317,  $p < 0.001$ ) were significant contributors in the model of articles, as shown in Table 8. The model equation (T4 Article Accuracy =  $0.539 + 0.317 * T1$  Accuracy) showed that the baseline (0.539) determined the relatively high accuracy level at the fourth assessment. And the initial accuracy was positively correlated to the fourth-year performance.

Table 8

*Summary of GLM of Articles Accuracy at Time 4*

| Variables        | Estimate | Std. Error | t     | p          |
|------------------|----------|------------|-------|------------|
| Intercept        | 0.539    | 0.053      | 10.12 | < 0.001*** |
| Exposure         | 0.006    | 0.007      | 0.93  | 0.356      |
| Usage            | 0.0016   | 0.0008     | 1.973 | 0.0533     |
| Language ability | 0.011    | 0.036      | 0.297 | 0.77       |
| T1 Grade         | -0.0089  | 0.011      | -0.81 | 0.42       |
| T1 Accuracy      | 0.317    | 0.067      | 4.726 | <0.001***  |

\* < 0.05, \*\* < 0.01, \*\*\* < 0.001

For direct object clitics, the GLM results showed that T1 Accuracy was the only significant contributor to the model (coefficient = 0.477,  $t = 4.726$ ,  $p < 0.001$ ), as shown in Table 9. The initial accuracy was positively correlated to later performance. Based on the model equation (T4 Direct Object Clitics Accuracy =  $0.354 + 0.477 * T1$  Accuracy), the baseline was relatively low (0.354) and the coefficient of T1 Accuracy was also relatively low. Therefore, the accuracy at the fourth assessment point did not achieve a high level (<83%).

Table 9

*Summary of GLM of Direct Object Clitics Accuracy at Time 4*

| Variables        | Estimate | Std. Error | t      | p         |
|------------------|----------|------------|--------|-----------|
| Intercept        | 0.354    | 0.186      | 1.908  | 0.0613    |
| Exposure         | -0.0059  | 0.024      | -0.244 | 0.81      |
| Usage            | 0.0002   | 0.0027     | 0.085  | 0.93      |
| Language ability | -0.01    | 0.103      | -0.104 | 0.92      |
| T1 Grade         | -0.014   | 0.037      | -0.376 | 0.71      |
| T1 Accuracy      | 0.477    | 0.067      | 4.726  | <0.001*** |

\* < 0.05, \*\* < 0.01, \*\*\* < 0.001

For subjunctive moods, the GLM results showed that Intercept (coefficient = 0.391,  $t=3.246$ ,  $p < 0.01$ ), Language Ability (coefficient = 0.214,  $t=3.296$ ,  $p < 0.01$ ) and T1 Grade (coefficient = 0.054,  $t=2.114$ ,  $p < 0.05$ ) were contributing to the model, as shown in Table 10. Based on the model equations (T4 Subjunctives Accuracy = 0.391 + 0.214\*Language Ability + 0.071\*T1 Grade), the baseline and language ability were more influential than the grade level.

Table 10

*Summary of GLM of Subjunctives Accuracy at Time 4*

| Variables        | Estimate | Std. Error | t      | p         |
|------------------|----------|------------|--------|-----------|
| Intercept        | 0.391    | 0.121      | 3.246  | 0.00195** |
| Exposure         | 0.014    | 0.016      | 0.924  | 0.36      |
| Usage            | 0.0016   | 0.002      | 0.879  | 0.38      |
| Language ability | 0.214    | 0.065      | 3.296  | 0.00168** |
| T1 Accuracy      | -0.014   | 0.037      | -0.376 | 0.45      |
| T1 Grade         | 0.054    | 0.025      | 2.114  | 0.039*    |

\* < 0.05, \*\* < 0.01, \*\*\* < 0.001

To summarize, initial accuracy was a significant contributor to the models of articles and direct object clitics, and baseline accuracy was a significant factor in the

models of articles and subjunctives. Subjunctives were different from the other two grammatical forms as the initial grade level and language ability were significantly influencing the accuracy at the fourth assessment point. These results showed that the development of production accuracy differs by morphosyntactic structures.

## CHAPTER 4 CONCLUSION

This study shows that the trajectories of production accuracy differ by language ability group and grammatical structure. TD and DLD groups differ in overall accuracy level across 4 years as well as growth patterns. For all three grammatical markers, the TD group has higher accuracy than the DLD group as the accuracy of all three markers is consistently in the high range for 4 years (high: accuracy > 0.6). For the TD group, the initial accuracy is relatively higher than the DLD group for all three markers (TD: initial accuracy > 0.6; DLD: initial accuracy = 0.4~0.6 or < 0.4). Even with steady growth over time, the DLD group still has a lower accuracy level compared to the TD group, due to the initial difference. This finding suggests that the initial accuracy determines the level of accuracy of later performance. In the TD group, three grammatical markers demonstrate different trajectory patterns. The production accuracy increases slightly for articles, decreases slightly for direct object clitics, and increases with the highest growth rate for subjunctives. In the DLD group, all three grammatical markers demonstrate ascending trajectories. However, initial accuracy and growth rate differ by morphosyntactic structures.

Within each language ability group, the trajectories differ by morphosyntactic structures within the language group. In the TD group, accuracy of articles demonstrates the highest overall accuracy over time with the limited increase due to high initial accuracy. The overall accuracy levels are similar for direct object clitics and subjunctive moods. However, the accuracy of subjunctives shows relatively greater growth among the three markers. The accuracy of direct object clitics maintains at the same level over

time with a slight decrease. In the DLD group, trajectories of three grammatical markers differ by initial accuracy and growth rate. The hierarchy of initial accuracy in the DLD group is articles > subjunctives > direct object clitics. And the hierarchy of growth rate in the DLD group is subjunctives > direct object clitics > articles.

In terms of the relationship between language experience and accuracy for each morphosyntactic structure, this study finds that accuracy of each morphosyntactic structure is influenced by different factors. The accuracy of articles is influenced by four factors including the age of first English exposure, Spanish input/output ratio, language ability and grade level. Similar but not exactly the same, the accuracy of subjunctives is influenced by language exposure, language ability group and grade level. Different from the other two markers, language ability is the only contributing variable to the accuracy of direct object clitics.

In regard to the contributing factors to the fourth-year performance, this study shows that the baseline accuracy and initial accuracy are significantly contributing to the fourth-year performance of articles; initial accuracy is the only significant factor for direct object clitics; and three factors of baseline accuracy, initial grade level and language ability are influencing the fourth-year performance of subjunctives. For all three markers, the baseline accuracy determines the overall level of the accuracy at the fourth assessment. Initial accuracy and initial grade level are positive related the later performance. Subjunctives differ from the other two grammatical markers as the initial grade level and language ability significantly influence the fourth-year performance.

## CHAPTER 5 DISCUSSION

In agreement with the results from Bedore and Lenard (2001), Anderson and Souto (2005) and Morgan et al. (2013), results from this study show that children with DLD had lower production accuracy than TD children across all three grammatical structures. This result confirms that articles, direct object clitics and subjunctives are reliable markers of language impairment for Spanish-English bilingual children. The different growth trajectories among the three markers suggest that the baseline production accuracy and growth rate differ by morphosyntactic structures. From a linguistic perspective, the morphosyntactic development observed here is grammatically selective. Articles mark number and gender in Spanish. The form of articles depends on the semantic knowledge of nouns and marking. Direct object clitics are bound morphemes that need to be attached to verbs to mark the object which is indirectly affected by the action of a verb. The form of direct object clitics depends on the relationship between the verb and noun which involves both syntactic and semantic processing. The Spanish subjunctive mood is used to express emotions including doubt, desires, wishes and possibilities. The form of the subjunctive depends on the tense of the main clause verb as well as the temporal relationship between that main clause verb and the subjunctive verb. The person/number agreement may also influence the subjunctive mood marking for certain tenses. The use of subjunctive mood requires complex semantic and syntactic processing that involves emotional concepts, temporal relationships and tense identification. The growth trajectories observed in this study suggest that morphosyntactic structures requiring complex semantic and syntactic processing (direct

object clitics, subjunctives) may have a lower baseline and growth rate of production accuracy than the structure requiring only semantic processing (articles). Another hypothesis is that verb-related forms (direct object clitics, subjunctives) have higher error rates than noun forms (articles). Detailed error analysis will further our understanding of the linguistic effects of bilingual morphosyntactic development.

Consistent with previous research on language experience (Bedore et al., 2016; Bohman et al., 2010), the results of this study also indicate that language experience is related to morphosyntactic development. However, this study reports the specific influence of language experience within the language ability group and grade level. Language experience is important in morphosyntactic development, but the influence of language experience is second to language ability and grade level. Another interesting finding is that the influence of language experience on production accuracy differs by morphosyntactic structures. Both age of first exposure to English and Spanish input/output percentage contribute to the model of accuracy of articles. Only the age of first exposure to English is a significant predictor of the accuracy of subjunctives. Neither exposure nor usage has an effect on the accuracy of direct object clitics. This result suggests that a hierarchy of sensitivity to the influence of language experiences may exist. While language exposure and usage have an effect on overall expressive language skills reported in previous research (e.g., Bohman et al., 2010), certain morphosyntactic structures may be less influenced by language experience.

Based on the results of this study, articles may be the most reliable clinical marker to detect language impairment considering the distinguished trajectory patterns in TD and DLD groups as well as low variability of the accuracy data in both groups. With more

data, a predictive growth model of accuracy of articles can be developed, and this model can be utilized to predict the expected accuracy level based on language experience and age. Subjunctive moods can be another clinical marker to monitor morphosyntactic development for both children with TD and DLD. Given the current age and the age of first exposure to English, the expected accuracy can be estimated for a child with TD or DLD. Future studies of predictive models are needed to confirm the predicting power of language experience.

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